Episodic Foresight in Typically-Developing Children and Children with Autism Spectrum Disorder

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ABSTRACT

The capacity to mentally project the self into the future or, what has recently been termed "episodic foresight" is an emerging topic of study in developmental psychology. The aim of this dissertation was to review available research on this topic and explore its development in two groups of children: typically-developing preschoolers and children with autism spectrum disorder (ASD). This dissertation had two main goals. The first goal was to explore whether tasks thought to measure episodic foresight in children are related and whether, as has been hypothesized, they were related to theory of mind (ToM) and executive function (EF). Study 1 showed that after controlling for age and language ability, episodic foresight tasks were not intercorrelated, nor were they individually related to ToM or EF tasks. Importantly, however, an episodic foresight composite score was related to several EF tasks. Specifically, the results suggested a significant relation between episodic foresight and inhibitory control. The second goal of this dissertation was to explore the development of episodic foresight in children with ASD. Specifically, I tested whether children with ASD would perform more poorly on a series of episodic foresight tasks than a mental-age matched group of typically-developing children. Study 2 revealed significant group differences on several episodic foresight tasks, suggesting that children with ASD showed impairments in thinking about themselves in the future. These results are a timely contribution to the research on episodic foresight and will hopefully aid in the further development of tasks that adequately measure this important cognitive ability in children.

Episodic Foresight in Typically-Developing Children and Children with Autism Spectrum Disorder

Humans spend a great deal of time thinking about, planning for, and anticipating the future. Yet, it is only recently that researchers have begun to focus on these capacities in adults, young children, and children with autism spectrum disorder (ASD) (e.g., Atance & O'Neill, 2001; Buckner & Carroll, 2007; Busby & Suddendorf, 2005; Busby Grant & Suddendorf, 2009; Gilbert & Wilson, 2007; Jackson & Atance, 2008). This is surprising given that the capacity to think ahead allows us to act in the present to secure future benefits and, in turn, avoid future negative consequences (Suddendorf & Moore, 2011). The development of this capacity in both typically-developing children and children with ASD is the focus of this dissertation.

Refining the Concept of Future Thinking

Thinking about the future is a multifaceted skill. Researchers have recently focused on identifying and measuring the various aspects of this capacity. This is similar to the approach that has been taken in the study of memory and, as such, it is helpful to review how the terminology used to describe various aspects of future thinking emerged from research on memory. Memory researchers have developed a lexicon of terms to describe the various aspects of memory, including long-term and short-term memory, working memory, and, most notably, episodic and semantic memory. Semantic memory allows individuals to retrieve facts about the world, while episodic memory, a later-developing skill, allows individuals to remember personally experienced events (Tulving, 1984). Episodic memory is one aspect of *mental time travel*, and is described as a cognitive skill that allows individuals to project backwards in time to mentally re-experience an event (Suddendorf & Corballis, 1997). Atance and O'Neill (2001) identified a corresponding skill, another aspect of mental time travel, that they termed “episodic future thinking”. They defined episodic future thinking as the ability to project the self into the future to mentally pre-experience events.

Episodic future thinking can be distinguished from the broader concept of “future thinking” because it refers specifically to the ability to project the *self* forward in time to pre-experience an event (Atance & O’Neill, 2001). Thus, important aspects of this type of future thinking include the focus on the self, and the act of mentally simulating one’s thoughts and feelings (Hudson, Mayhew, & Prabhakar, 2011). It also entails more than simply imagining oneself in the future. Rather, it involves developing a plan that takes into account one’s specific situation (Atance & O’Neill, 2001*)*. Episodic future thinking may underlie the capacity to act as a function of future needs that do not correspond to our current needs (Suddendorf & Corballis, 1997). Episodic future thinking was one of the first terms used to describe this specific skill; however, the lexicon has continued to change as the field has grown.

One of the current challenges of future thinking research is the multitude of different terms used to describe the specific capacity of mentally projecting the self into the future. These include “mental time travel into the future” (Suddendorf & Corballis, 1997), “episodic future thinking” (Atance & O’Neill, 2001), “episodic simulation of future events” (Schacter, Addis, & Buckner, 2007), “prospection” (Buckner & Carroll, 2007; Gilbert, 2006), “simulation” (Schacter & Addis, 2007; Schacter, Addis, & Buckner, 2008), and “projection” (Okuda et al., 2003). Recently, in a special issue of *Cognitive Development* devoted to research on the development of future thinking, Suddendorf and Moore (2011) proposed the term “episodic foresight” to describe the ability to “imagine future scenarios and use such imagination to guide current action” (p. 296). It is specifically this aspect of future thinking that is the focus of this dissertation. Although previous research has often used one of the above terms (or the more general term "future thinking") to describe this capacity, for clarity's sake, I will most often use the term "episodic foresight" (EpF; although this term was not always used by the researchers themselves).

In the first section of this dissertation I explore how future thinking research, and more specifically EpF research, has evolved by reviewing existing research with adults, children, and special populations. I begin with the EpF research that has been conducted with adults, highlighting the variety of methods used to assess this skill. Next, I outline research on this same topic in children and outline the tasks I selected for Hanson, Atance, and Paluck (Study 1) and Hanson and Atance (Study 2). I also explore the relation between EpF, theory of mind (ToM), and executive function (EF). Finally, I make the case for the importance of exploring EpF, ToM, and EF in children with ASD (the focus of Study 2). I then present Study 1 and Study 2 to demonstrate how I tested my hypotheses. Finally, I conclude with my General Discussion, which explores how the studies I conducted address the hypotheses I raise in the General Introduction, and suggests directions for future research.

Future Thinking Research with Adults

Research about future thinking in adults has focused on several main themes, including: how future thinking is related to memory, the adaptive function of thinking about the future, examining how losing the ability to think about one's personal future affects overall functioning, and the neural basis of future thinking, in particular EpF.

Future thinking and Memory. Psychology has channeled substantial energy into theories about, and empirical studies on, memory. Early experimental psychologists, including Wilhelm Wundt and Hermann Ebbinghaus, focused extensively on memory and the human capacity for retrospection (Scheerer, 1980). Most ideas about future thinking, however, emerged only recently in the history of psychological research. Many of these studies were inspired by memory research, and thus focused on the link between memories for the past and thoughts about the future. For example, Ingvar (1985) examined the role of the frontal/prefrontal cortex in creating “memories of the future” (p.127), which he described as plans for future behavior. He suggested that our capacity for future thought and behavioral planning was based on our repertoire of past experiences, thus linking the functions of memory and future thinking. This idea has been carried forward into more current research, particularly in Suddendorf’s research about “mental time travel”. Suddendorf and Corballis (1997) defined mental time travel as the mental reconstruction of personal events from the past (episodic memory) and the mental construction of possible events in the future (episodic foresight) and suggested that the two capacities were linked. More recently, researchers have begun to realize the importance of studying future thinking as a critical cognitive capacity in its own right.

Adaptive Function of Future Thinking. Researchers have also highlighted the adaptive function of thinking about the future. Without the ability to think about the future, humans would not be able to rehearse possible future events, thereby making us less prepared for potential occurrences, both practically and emotionally. Taylor and Schneider (1989) argued that mental simulation of future events helps us to plan how we will cope with difficult situations, and also helps us to organize our emotional experience of these events. Relatedly, Zimbardo and his colleagues have extensively researched time perspective, which is an individual’s view on his/her psychological past and future (Lewin, 1951). Specifically, Zimbardo and Boyd (1999) describe five dimensions of an individual’s time perspective, one of which is the “Future” factor. Individuals who score high on this factor show behavior that is dominated by striving for future goals and rewards. This factor is positively correlated with conscientiousness, and the consideration of consequences. College students who scored high on the "future" factor spent more hours studying each week than those who scored low on the same factor. Conversely, scoring low on the "future" factor was correlated with novelty seeking and sensation seeking. Zimbardo and Boyd suggested that future-oriented self-control has an important impact on social and academic success.

In clinical psychology, researchers have examined the role of future orientation in the lives of individuals experiencing depression. For example, MacLeod and Salaminiou (2001) found that these individuals generated fewer anticipated positive experiences than controls. Additionally, reduced positive future thinking was related to hopelessness in individuals at risk for suicide (MacLeod et al., 1998). Clearly, thinking about the future plays an important adaptive role in humans' lives. Indeed, as I outline in the following section, the loss of this ability as a result of traumatic brain injury can be devastating.

Loss of Future Thinking. Several studies have examined the loss of future thinking ability following traumatic brain injury and surgery, particularly to regions of the frontal cortex. Ingvar (1985) argued that damage to the frontal/prefrontal cortex results in a "loss of the future" (p.127). He described patients who demonstrated indifference, inactivity, lack of ambition, and an inability to foresee future consequences of their own behavior. A number of other studies described cases of individuals who have lost (at least partially) the ability to think about the future following a brain injury or surgery despite the retention of other abilities, including semantic memory and some EF abilities (Bechara, Damasio, Damasio, & Anderson, 1994; Fellows & Farah, 2005; Klein, Loftus, & Kihlstrom, 2002; Kwan et al., 2011; Levine et al., 1998; Tulving, 1985). Interestingly, some of these patients were specifically impaired in the ability to imagine and make decisions about future events concerning the self, but retained the ability to make general plans for the future based on scripts for familiar events or plans for the "impersonal" future. That is, they specifically lost the ability we now call EpF. This research suggests that EpF may be a separable cognitive capacity unique from more general future thinking ability.

What effect might the loss of EpF have on an individual's ability to function in the world? Tulving (1985) described his patient, K.C.'s, deficit as follows: "…he cannot remember any particular episodes from his life, nor can he imagine anything that he is likely to do on a subsequent occasion. He seems to be living in a 'permanent present'" (p.4). Tulving argued that this deficit would lead to difficulties with learning and planning for the future. Buckner and Carroll (2007) reviewed cases of individuals with frontal lobe lesions who struggled with an inability to plan and adapt when confronted with novel or challenging situations, despite intact general intelligence and an ability to follow well-established routines. It seems that these individuals had specifically lost the ability to imagine themselves in the future and use these imaginings to plan action, or what we call EpF. I suspect that without EpF ability, they would struggle with work and social relationships, and would likely have difficulty learning from experiences and avoiding subsequent negative consequences. This research highlights the importance of the ability to mentally project the self into the future and sheds some light on which neural systems might be implicated in EpF.

Neural Basis of Future Thinking. Numerous researchers have examined the neural basis of EpF in adults (Addis, Wong, & Schacter, 2007; Bar, 2007; 2009; Buckner & Carroll, 2007; Okuda et al., 2003; Schacter & Addis, 2009). For example, using fMRI, Addis et al. (2007) found that EpF engaged the left and right hippocampus, the posterior visuospatial regions, right frontopolar cortex, and left ventrolateral prefrontal cortex. Additionally, the medial temporal lobe, including the hippocampus and parahippocampal cortex, long linked to memory function, was also involved in EpF (Schacter & Addis, 2009). Okuda et al. (2003)

also found that areas in both the frontal and medial temporal lobes were activated during a task in which adults were asked to recall future and past events. Finally, several researchers have investigated what they propose to be a core brain network, the "default" network, composed of medial prefrontal, medial-temporal, and medial and lateral parietal regions. They argued that the default network is implicated in several processes, including EpF, episodic memory, navigation, and theory of mind (Buckner & Carroll, 2007; Spreng, Mar, & Kim, 2009; Spreng & Grady, 2009). This research suggests that EpF is not housed in one specific part of the brain, but instead is composed of a neural network of interrelated brain regions.

The research discussed thus far suggests that future thinking is important for cognitive, emotional, and social functioning. This research has been quite broad in its scope, focusing on the general capacity for future thought. However, in the past 10 years or so, a number of studies have focused specifically on EpF ability in healthy adults. These studies typically use one of two methods: thought-sampling and word-cueing (Szpunar, 2010). In thought-sampling studies, participants are asked to monitor the frequency and content of their thoughts about the future during the course of their daily lives (e.g., Berntsen & Jacobsen, 2008; D'Argembeau, Renaud, & Van der Linden, 2011). In word-cuing studies, participants are presented with word cues, such as "birthday", and asked to generate as many details as possible about personal future scenarios (e.g., D'Argembeau & Mathy, 2011; D'Argembeau & Van der Linden, 2004). In some studies participants are also asked to rate various phenomenological aspects of these mental representations, including sensorial, contextual, and emotional details (D'Argembeau & Van der Linden, 2004). In general, this research revealed that adults think about the future often throughout the day, are able to generate more detail about proximal versus more distant future events, and tend to have an optimistic view of their futures (Szpunar, 2010).

Developmental research has also begun to focus on future thinking ability, with research in recent years focusing specifically on the development of EpF. However, methods used with children are necessarily different than those used with adults. Thought-sampling and word-cueing experiments are too verbally-reliant and too challenging for young children (Hudson et al., 2011), who are only beginning to describe their experiences with words. Thus, the study of EpF in early development represents a methodological challenge that researchers are just beginning to tackle, using a variety of verbal and nonverbal paradigms that are outlined below.

Developmental Research about Future Thinking and EpF

Research about children's future thinking has gained momentum in recent years, with several new and innovative methods and findings emerging. However, there are also a few early studies on this topic that also warrant review (e.g., Ames, 1946; Harner, 1975). These studies have mainly examined children's talk about the future. Thus, in the section that follows, I review the literature on children's future talk, including both older and more recent studies on this topic, followed by the research about various future-oriented processes, including temporal cognition, and planning abilities. Finally, I review the recent research about EpF, thus setting the stage for Studies 1 and 2 of this dissertation.

Children's Talk about the Future. In an early article, Ames (1946) investigated children's ability to talk about the future by observing and interviewing children aged 18 to 48 months of age. Ames found that, at 24 months of age, English-speaking children began using future-oriented terms, including "gonna" and "in a minute". Between the ages of 36 and 48 months, children began using a number of additional future-oriented terms, including “later”, “pretty soon”, “next year”, and “when she’s bigger”. In addition to a series of questions about time and understanding of temporal concepts, Ames asked children between the ages of 24 and 48 months “What are you going to do tomorrow?” She found that by 3 years of age, 50% of children were able to respond to this question correctly. Later, Harner (1975) examined English-speaking children’s understanding of the linguistic terms “yesterday” and “tomorrow” by asking them to distinguish between toys played with the day before (“yesterday’s toys”), toys played with on the day of testing (“today’s toys”), and toys designated for the following day (“tomorrow’s toys”). She found a significant improvement between the ages of 2 and 4, with 4-year-olds demonstrating a consistent understanding of the terms “yesterday” and “tomorrow”.

More recently, researchers have focused on children’s ability to talk about situations involving the self in the future, thus tapping skills more closely related to EpF. For example, Atance and O’Neill (2005) used a “trip task” paradigm in which 3-year-olds were given a choice between various items that might be helpful to bring on a trip. Examples included such items as juice, raisins, sunglasses, and a teddy bear. Children were told to pretend that they would be going on a trip with their parents, and that they would have to help prepare for this trip by choosing 3 of the 8 available items to bring with them. Finally, they were asked, “Hey, how come you’re bringing (name of item) on your trip?” by a puppet character. Children’s explanations were coded according to whether they reflected a future orientation (e.g., use of the terms will, going to, can, could, when) and contained uncertainty terms (e.g., might, if, in case, maybe). Across both experiments, between 37% and 50% of children’s explanations were coded as future-oriented or future-oriented and uncertainty. Atance and O’Neill (2005) argued that these findings indicated that, by 3 years of age, children’s language is beginning to reflect an ability to anticipate future situations involving the self.

Busby and Suddendorf (2005) developed another paradigm that they argue measures EpF. Their paradigm expanded on Ames' (1946) strategy of asking children, "What are you going to do tomorrow?" Thus, 3-, 4-, and 5-year-old children were asked to report something that they did yesterday and something that they would do tomorrow. In addition, they were asked to report events that did not happen yesterday and predict events that would not occur tomorrow. In two experiments, they found that 4- and 5-year-old children were able to correctly report events that would and would not occur tomorrow (as verified by their parents), while 3-year-olds could report events, but most of these events were not rated as correct by their parents. Busby and Suddendorf argued that by 4 years of age, children are capable of "mental time travel" because they can report personal events that will occur in the future. Accordingly, this is the first task I included in Studies 1 and 2 as a measure of EpF.

Children's Temporal Reasoning. The ability to think about the future - and events involving the self more particularly - necessarily requires some understanding of the principles of time. Without an understanding that the past, present, and future exist as temporal locations, it would be impossible to imagine a specific future event occurring at a specific time. In 1999, McCormack and Hoerl outlined the relation between temporal reasoning and episodic memory. They argued that episodic memories, at least in adults, are temporally dated; that is, we remember these events occurring at particular, unique times. These events are not necessarily precisely temporally dated (that is, we sometimes have difficulty ascertaining the particular date or time), but they do exist in our memories as unique past episodes, occurring at a particular place and time. Just as temporal reasoning has been argued to be a critical aspect of episodic memory, it may also be an important aspect of EpF (McColgan & McCormack, 2008). Having an established temporal framework allows humans to place future events at particular points in time (Suddendorf & Corballis, 2007).

Although temporal reasoning is an ability that is well established in adulthood, developmental research suggests that it continues to mature throughout early childhood (Friedman, 1990, 2000, 2005).

Friedman (1990, 2000, 2005) has written extensively about children's understanding of conventional time categories and their knowledge of the distance of future events. Using various timeline paradigms, he found that 5-year-olds could distinguish events that would occur in the coming weeks from those that would occur in the coming months. But, it was not until 8 to 10 years of age that children were able to accurately judge distances of future events by using mental representations of the times of events in the annual cycle (i.e., calendar time). Recent research by Hudson and Mayhew (2011) showed that knowledge of recurring time patterns and conventional time measurement systems is important for locating autobiographical events on a future timeline. Children showed significant improvement in this ability between the ages of 5 and 7. Although it is clear that having an understanding of timelines, time categories, and the distance of future events is important for fully-developed, adult-like EpF, it is possible that the earliest manifestations of EpF can occur with only an elementary understanding of the time dimension, and can be assessed using tasks more suitable for younger children.

Busby Grant and Suddendorf (2009) designed a simplified version of Friedman's timeline paradigm for use with 3-, 4-, and 5-year-olds. Temporal reference points on their timeline were described as "things that are going to happen in a little time" (approximately 24 hours), "things that are going to happen in a long time" (approximately 12 months), and "things that are going to happen in a really, really long time" (several years). Busby Grant and Suddendorf found that 3-year-olds were unable to differentiate between the times of future events, 4-year-olds successfully differentiated daily events from more remote future events, and 5-year-olds successfully differentiated between all three temporal categories (e.g., placing “get married” at the “really, really long time” point, and “play at the park” at the “little time” point). This was the second task we used in Studies 1 and 2 because it is appropriate for 3- to 5-year-olds, and it appears to measure an important aspect of EpF – temporal reasoning.

In addition to Busby Grant and Suddendorf’s (2009) task, Studies 1 and 2 included a temporal reasoning task designed by McColgan and McCormack (2008). This task targets the ability to grasp the significance of chronological organization; that is, an understanding that the temporal order in which events occur can affect the outcome of a sequence of events. McColgan and McCormack’s task uses a “zoo” set-up, in which children plan where to place a character’s camera while taking into account several temporal order contingencies. More specifically, there are five locations in the zoo that the character can visit. In the first trial, there are lockers in front of the first, second, fourth, and fifth locations in which to leave the camera. Children are told that the character wants to take a picture of the animal in the third cage. In the second trial, there are places in front of all locations except the second (the location where the character wants to take a picture) in which to leave the camera. Children learn that the character can only travel through the zoo once, and that she cannot travel in reverse. To pass the task, children are required to place the camera in one of the locations preceding the chosen animal’s cage. McColgan and McCormack found that it was not until 5 years of age that children solved this task, thus demonstrating temporal reasoning; an ability they argue may be closely related to EpF.

Planning. Planning is a complex, dynamic operation that entails evaluating one’s current situation, looking ahead and identifying alternatives, making choices, and finally implementing and revising the plan as necessary (Hill, 2004). Haith (1997) argued for an important connection between planning and future thinking. Specifically, he noted that to choose among alternative courses of action, an individual must be able to imagine what could happen in the future. The Tower of Hanoi task is commonly used to assess planning ability in children. A series of disks are placed on pegs in a particular configuration, and children are asked to reconfigure them into a goal state in the fewest moves possible while adhering to prescribed rules (Welsh, Satterlee-Cartmell, & Stine, 1999).

It is logical to argue for a connection between traditional planning tasks and EpF because of the common aspect of "looking ahead". However, Atance and Jackson (2009) found that the former (specifically, the Tower of Hanoi and another planning task, the Truck Route Planning task, Carlson, Moses, & Claxton, 2004) were not correlated with several EpF tasks (Picture Book Trip and Tomorrow) after controlling for the effects of age and language. Consistent with this finding, McCormack and Atance (2011) reviewed research on the development of planning and argued for a difference between traditional planning tasks and EpF tasks. Specifically, whereas EpF tasks require self-projection and the representation of more distant goals, most traditional planning tasks do not. Rather, in the latter, the goal is most often rooted in the present (e.g., the goal state of the disks in the Tower of Hanoi) and thus need not entail children imagining a future state (i.e., self-projection). Accordingly, the planning task that we used in Studies 1 and 2 is Hudson, Shapiro, and Sosa's (1995) Grocery/Beach task, a verbal planning task that is arguably reflective of EpF because the events that children are asked about entail distant future goals. Specifically, Hudson and colleagues asked 3-, 4-, and 5-year-old children to provide plans for familiar events, including going grocery shopping and going to the beach. They found that older preschoolers' verbal plans for familiar events included more information and specific planning activities than those of younger preschoolers. Interestingly, children were also asked to provide “scripts” of these same events and results indicated that although the adequacy of children’s plans increased significantly with age, the adequacy of their scripts did not (that is, 3-year-olds were already quite proficient at providing scripts for familiar events). Because plans are more future-oriented than scripts, Atance (2008) argued that the capacity to provide a plan for going to the beach, for example, draws more heavily on the episodic system than does providing a script for this same event. As such, asking children to provide a plan for a specific event may be a good method to assess their capacity for EpF. The ability to integrate and flexibly apply plans for travelling to familiar locations may be an aspect of EpF and accordingly was tested in Studies 1 and 2.

In summary, tasks designed to measure children’s talk about the future (e.g., Busby & Suddendorf, 2005), their temporal reasoning (e.g., Busby Grant & Suddendorf, 2009; McColgan & McCormack, 2008), and their ability to plan for the future (e.g., Hudson et al., 1995) could be conceptualized as requiring a projection of the self into the future and thus were used to measure this ability in Studies 1 and 2. The fifth and final task that we included in Studies 1 and 2 will be discussed next.

Episodic Foresight. As future thinking research has continued to evolve, researchers have become more interested in isolating and measuring EpF specifically. Atance and Meltzoff (2005) developed the Picture Book Trip task to assess children’s ability to anticipate physiological states of the self, a skill they conceptualized as involving EpF. In this task, children are shown pictures of various locations, and are asked to choose an item to bring with them to these locations. They are then asked to explain their item choice. Atance and Meltzoff argued that both the item choice and the item explanation variables reflect children’s capacity to project themselves forward in time to pre-experience an event, or EpF. Because it is one of the primary studies of EpF, I included this task in Studies 1 and 2.

Applications of EpF Research

Research on children's EpF has evolved rapidly in the past few years. Early research targeted the broader construct of "future thinking" and mostly examined children's talk about the future. However, as the field evolved, researchers recognized the importance of children's temporal reasoning and planning ability. Finally, the focus shifted to EpF and children' ability to mentally project themselves into the future. Although performance on tasks in each of these domains improves between the ages of 3 and 5, this fact alone does not shed light on whether these tasks are related, or whether they all require EpF (Hudson et al., 2011). Each of these tasks has different language demands, may require other cognitive skills to succeed (e.g., inhibitory control, working memory), and perhaps even different degrees or types of future thinking. To date, no one study has administered the group of tasks that I have outlined in the previous sections concurrently to children to assess whether these diverse methods of measuring future thinking are indeed related in development, and whether they are measuring one unique construct, EpF. Doing so is important not only with respect to understanding children's development, but also for understanding development across the lifespan.

In adulthood, adopting a future-oriented perspective has been linked to important physical and psychological health outcomes, and has several important social implications. For example, Boyd and Zimbardo (2005) measured adults' time perspective and found that having a future orientation (rather than a present or past orientation) was consistently related to achieving a higher social class, higher academic achievement, displaying less risk-taking behaviour, and less substance abuse. Additionally, some clinical disorders including schizophrenia (D'Argembeau, Raffard, & Van der Linden, 2008), ASD (Jackson & Atance, 2008; Lind & Bowler, 2010), and depression (MacLeod & Salaminiou, 2001) have been characterized as involving deficits in future thinking. Because future orientation and future-directed behaviors appear to be critical aspects of adaptive functioning in both children and adults, it is important that researchers have a means of measuring these skills during early development using a reliable and valid battery (as has been done with other key aspects of children's cognitive development, including ToM and EF). Determining the extent to which existing tasks designed to measure children's EpF are related is an important first step in this process.

In summary, the tasks described in the first section of the General Introduction were all designed to measure children's ability to project themselves into the future, but have yet to be administered to the same group of children to determine whether they are related. The first goal of this dissertation was to determine whether the five tasks described earlier (i.e., Atance & Meltzoff, 2005; Busby & Suddendorf, 2005; Busby Grant & Suddendorf, 2009; Hudson et al., 1995; McColgan & McCormack, 2008) were correlated in a sample of 3-, 4-, and 5-year-old typically-developing children.

The second goal of this dissertation was to determine the extent to which children's performance on the EpF tasks is related to other cognitive abilities that also show marked development during the preschool years. This goal stemmed from theoretical proposals that EpF is not an isolated ability but is likely dependent on ToM and EF (Atance & Jackson, 2009; Atance & Meltzoff, 2005; Atance & O'Neill, 2001; Buckner & Carroll, 2007; Moore, Barresi, & Thompson, 1998; Russell, Cheke, Clayton, & Meltzoff, 2011; Spreng, Mar, & Kim, 2009; Suddendorf & Corballis, 1997, 2007). I now describe the development of these cognitive abilities, outlining relevant research and theoretical proposals about how they might be related to EpF.

Theory of Mind

Mental states, including intention, desire, knowledge, belief, and emotion are not directly observable, yet they affect behavior and impact social relationships. To function effectively in the social world, individuals must be aware of their own mental states and those of others around them. In 1978, Premack and Woodruff coined the term “theory of mind” (p.515) to describe humans’ ability to understand and attribute mental states to self and others. Researchers have argued that one way to measure theory of mind is to assess whether children can predict the actions of a person who holds a false belief; that is, a belief that differs from the actual, observable state of the world. By making this prediction accurately, it is argued that children are inferring the mental state of the other person (Bloom & German, 2000). To assess the developmental origins of this skill, Wimmer and Perner (1983) designed the Change-in-Location false belief task. This task was modified by Baron-Cohen and his colleagues and is now the well-known “Sally-Anne” task (Baron-Cohen, Leslie, & Frith, 1985). In this task, children are introduced to a protagonist, “Sally”, who places an object (e.g., a rubber ball) in one location (e.g., a box). Sally leaves the scene and another character, “Anne”, appears and moves the object to a new location (e.g., a cupboard). Sally returns to look for the ball and the child is asked the false belief question: “Where will Sally look for the ball, in the box or in the cupboard?” If children respond that Sally will look in the box (thus acting on her false belief), this is taken as evidence of ToM competence. At age 3, children tend to fail standard false belief tasks, responding that the protagonist will look for the object in the new location (indicating the true situation) rather than the original location (corresponding to the protagonist’s false belief). By age 5, children tend to pass this task, thus demonstrating their understanding that individuals can have false beliefs (Wellman, Cross, & Watson, 2001).

Assessing theory of mind. Although the false belief task has often been considered the "litmus" test of ToM competence, ToM is comprised of more than just an understanding of false belief. A great deal of research has investigated the development and manifestations of ToM in young children (e.g., Carlson & Moses, 2001; Wellman et al., 2001). Wellman and Liu (2004) demonstrated that ToM development follows a predictable progression, whereby children first demonstrate an understanding of desires, followed by belief, knowledge, and false belief. As such, they developed a series of tasks tapping each of these respective abilities. Four of these tasks, Diverse Desires, Diverse Beliefs, Knowledge Access, and Contents False Belief were used in Studies 1 and 2. In Diverse Desires and Diverse Beliefs, children must recognize that others can hold desires or beliefs that are different than their own. In Knowledge Access, children must recognize that someone may not know things that they know. Finally, the Contents False Belief task assesses the more advanced skill of recognizing that an individual may hold and act on a belief that does not reflect reality. A fifth task, the classic Change-in-Location (Carlson & Moses, 2001, derived from Wimmer & Perner, 1983), was used to further assess children's understanding of false belief.

Relation Between Theory of Mind and Episodic Foresight. Children demonstrate an important aspect of ToM when they understand that their perspective may not always match other individuals' perspectives. For example, in the Change-in-Location false belief task, children must recognize that the character will not know where the ball is located, even though children, themselves, know where it is. A number of researchers have argued that the ability to mentally project oneself into the future (EpF) is related to ToM (Atance & O'Neill, 2005; Buckner & Carroll, 2007; Moore, Barresi, & Thompson, 1998; Suddendorf & Corballis, 1997). When projecting oneself into the future, an individual must adopt the perspective of a *future* self, rather than the perspective of *another person*. That is, recognizing that you might feel differently in the future than you do right now may draw on ToM ability.

For example, to effectively pack for a trip, as children are asked to do in the Picture Book Trip task, they must disregard their current state and imagine a future, alternative state. Indeed, if I were packing for a trip to a sunny destination during a cold Canadian winter, I might forget to pack shorts if I could not imagine feeling differently than I feel in the present. Therefore, similar to ToM, EpF involves a shift in perspective from the immediate, current perspective to an alternative perspective (Buckner & Carroll, 2007). Additionally, EpF and ToM both emerge during the preschool years, suggesting a developmental relation. Finally, neurophysiological evidence indicates an overlap in the frontal lobe brain structures (including prefrontal and frontopolar regions along the midline, posterior parietal regions, and the medial temporal lobe) underlying these two forms of perspective taking, supporting the notion that they may be intimately related (Buckner & Carroll; Spreng & Grady, 2009; Spreng, Mar, & Kim, 2008; Szpunar, 2010).

Executive Function

Atance and Jackson (2009) and Suddendorf and Corballis (2007) have also argued that EF skills are related to EpF. EF skills are generally described as a set of abilities that allow an individual to solve a problem or accomplish a goal (Welsh & Pennington, 1988). Specifically, EF skills are higher order, self-regulatory, cognitive processes that allow the monitoring and control of thought and action (Carlson, 2005). EF has historically been synonymous with frontal lobe function, and is frequently investigated behaviourally in children where it is considered to play an important role in normative cognitive and social development (Carlson). Unlike ToM, there is no single "litmus" test of EF; thus, EF ability is measured using a series of tasks assessing its various components.

Assessing EF. EF comprises a number of elements, including inhibition, working memory, planning, cognitive flexibility/set-shifting, and generativity (Carlson, 2005). Inhibition, or inhibitory control (IC), allows individuals to suppress inappropriate but prepotent thought processes or actions that interfere with the accomplishment of a goal (Carlson, Moses, & Breton, 2002). A task used to assess IC in preschool children is the Day/Night task (Gerstadt, Hong, & Diamond, 1994). Children are instructed to say "day" when shown a card with a picture of a moon and stars on it, and "night" when shown a card with a sun on it, thus testing their ability to inhibit a prepotent response. Five-year-old children outperform 3-year-old children on this task (Carlson, 2005; Gerstadt et al., 1994). This task also requires children to remember two rules (moon and stars = "day", and sun = "night") while inhibiting their prepotent responses, and therefore also tests children's working memory capacity. The working memory component of this task tends, however, to add a certain amount of noise to the results. Children, particularly young children, sometimes revert to saying "morning", or "bedtime", instead of "day" and "night", thereby complicating the analysis of the results. Simpson and Riggs (2005) developed a modified version of this task in which children are required to say "black" when shown a white card, and "white" when shown a black card. They argue that this version of the task requires less working memory and is therefore a purer measure of IC. This task was used in Studies 1 and 2.

According to Baddeley (1986), working memory is a system designed to temporarily maintain and process information. In Studies 1 and 2, working memory was assessed using two tasks, Count/Label (Gordon & Olson, 1998) and Backwards Digit Span (Davis & Pratt, 1995). In the Count/Label task, children are shown three objects and are then asked to first label them, then count them, then count and label them each in turn (e.g. “One is a dog, two is a shoe, three is a car”). In Backward Digit span, children are asked to repeat back sequences of numbers read aloud by the experimenter, but in reverse order (e.g., E says “1, 3”, C says “3, 1”).

Planning is a complex, dynamic operation because it involves the constant monitoring, re-evaluation, and updating of a sequence of planned actions (Hill, 2004). To successfully implement a plan, one must first assess the current situation, look ahead and identify alternatives, make choices, and finally implement and revise the plan as necessary (Hill, 2004). The Tower tasks - the Tower of London and the Tower of Hanoi - are commonly used to assess planning ability in children. Both tasks require that a starting configuration of disks, or balls, placed on pegs be reconfigured into a goal state in the fewest moves possible while adhering to prescribed rules of allowable moves (Welsh, Satterlee-Cartmell, & Stine, 1999). Successful performance requires that a sequence of moves be planned, executed, monitored, and revised in advance of action (Welsh et al., 1999). Additionally, some goal states require that counter-intuitive moves, or moves in the “wrong direction” be made. This requirement may tax the inhibitory control system. Although similar, and moderately correlated, the Tower of London and the Tower of Hanoi vary in their inhibitory and working memory demands. Welsh and colleagues (1999) found that inhibitory control variables contributed less to Tower of Hanoi performance than to Tower of London performance, possibly due to slightly different rules involved in each of the tasks. The Tower of Hanoi, which was used in Studies 1 and 2, has been modified for use with children, and performance improves with age (Welsh, 1991; Carlson, Moses, & Claxton, 2004).

EF skills are crucial for problem solving because they allow for the planning of specific moves or actions, inhibition of prepotent, but incorrect, moves or actions, and generation of new ideas or action plans. The Truck Loading task, used by Carlson and colleagues (2004), modified from Fagot and Gauvain (1997), taps into these problem solving and planning skills. In this task, children are asked to deliver party invitations to pretend houses on a pretend street in a specified manner while following certain order rules. Specifically, the invitations must be loaded into a toy truck in reverse order so that the invitation for the first house is on the top of the pile. This task is similar to the Tower of Hanoi task because children are required to ignore local suboptimal solutions and instead plan the series of actions that will allow them to solve the problem (Carlson et al., 2004). Children's performance on this task showed marked improvement between ages 3 and 5 (Carlson et al., 2004). This task was used in Studies 1 and 2.

Cognitive flexibility is the ability to shift to a different thought or behaviour as required in a situation (Hill, 2004). Weaknesses in cognitive flexibility are reflected by perseverative responding. The Standard Dimensional Change Card Sort task (DCCS; Frye, Zelazo, & Palfai, 1995) is often used to assess cognitive flexibility in preschool children. In this task, children are first asked to sort cards along one dimension (e.g., colour), then the rule switches and children must now sort the same cards along another dimension (e.g., shape). Young children and individuals with prefrontal cortical damage tend to perseverate and continue sorting the cards by the first dimension, demonstrating a lack of cognitive flexibility (Zelazo, 2006). Most 3-year-olds perseverate during the post-switch phase while most 5-year-olds switch immediately when asked to do so (Zelazo, 2006). This task was used in Studies 1 and 2 to measure cognitive flexibility.

The last component of executive function that was investigated in Studies 1 and 2 is generativity, or the ability to generate novel ideas and behaviors (Turner, 1999). Without the capacity to generate new ideas or behaviours, the executive control of behavior would not be possible (Turner, 1999). To assess children's ability to generate multiple responses, a simple word fluency task was used in Studies 1 and 2. Children were asked to name as many animals, then as many foods as they could think of in 60 seconds (Turner, 1999).

Together, these EF tasks provide a measure of children's overall executive function ability for the dimensions of inhibition, working memory, planning, cognitive flexibility/set-shifting, and generativity, and were thus used in Studies 1 and 2.

Relation Between EF and Episodic Foresight. EF may also be closely related to EpF ability. Common neuroanatomy exists between EpF and EF; namely, frontal and medial temporal regions (Addis, Wong, & Schacter, 2007; Okuda et al., 2003; Stuss & Alexander, 2000; Zelazo & Müller, 2010) and, as outlined above, these two abilities both emerge during the preschool years, suggesting that they may be closely related. From a theoretical standpoint, when thinking about the future, and shifting our perspective accordingly, we must always keep track of the shifts we make, which conceivably draws on EF (Buckner & Carroll, 2007). Thinking about the future also involves suppressing perception of the current world while simulations of possible alternative situations are constructed, followed by a return to the present. This coordination of internal perspectives likely involves EF ability (Buckner & Carroll). Inhibitory control in particular has been identified as a potentially important factor in future thinking. To imagine a future state, one must inhibit the present state and prepotent response (Suddendorf & Corballis, 2007). Planning is another EF component closely linked to EpF. In fact, some studies of future thinking have included planning tasks as part of the future thinking battery (e.g., Atance & Jackson, 2009).

However, in the current study, the type of planning measured by tasks such as Truck Loading and Tower of Hanoi is conceptualized as an EF skill due to the heavy executive components of the tasks. In the Tower of Hanoi, for example, children must remember a series of rules (working memory) and inhibit (incorrect) actions that would initially bring them closer to the goal in favour of the correct actions that initially distance them from the goal. These requirements arguably differ from those in the Grocery/Beach task (which I have argued taps into EpF), in which children may need to mentally project themselves into the future to devise a plan that involves the self. Another component of EF that may be related to EpF is generativity. To talk about what they are going to do tomorrow, or think of examples of actions to be taken on a trip to the beach, children must be capable of generating multiple responses, a skill that is measured by the animal naming task.

Finally, EpF and EF may be related in development because as EF skills develop, they allow children to better manage the demands of EpF tasks. In addition to keeping track of the perspective shifts made in EpF tasks, children must also track and remember task rules, inhibit impulsive responses, and process a significant amount of information.

Despite a great deal of theorizing about relations between EF and EpF, and ToM and EpF (Atance & Jackson, 2009; Atance & Meltzoff, 2005; Atance & O'Neill, 2001; Buckner & Carroll, 2007; Moore, Barresi, & Thompson, 1998; Russell, Cheke, Clayton, & Meltzoff, 2011; Spreng, Mar, & Kim, 2009; Suddendorf & Corballis, 1997, 2007), there is limited empirical evidence to this effect. Moore and colleagues (1998) investigated the development of future-oriented prosocial behaviour in relation to developing ToM and EF skills. They found that children's ability to delay rewards to share with a partner was correlated with their developing ToM and inhibitory control abilities. They proposed that to engage in this future-oriented delay of gratification, children had to imagine the noncurrent mental states of both themselves and their partner (thus drawing on ToM) while also inhibiting the strong immediate desire for the reward (thus drawing on inhibitory control). This is why the second goal of Study 1 was to determine the extent to which EF and ToM are related to EpF, with the ultimate goal of allowing us to better understand the development of EpF.

Episodic Foresight and Autism Spectrum Disorder

To better understand normative cognitive development, it is often helpful to study atypical development. By examining the types of cognitive deficits in a disorder such as ASD, researchers can help delineate the critical components and developmental trajectory of various cognitive skills. Accordingly, in Study 2, we examined EpF in a group of children with ASD. ASD is a neurodevelopmental condition characterized by qualitative impairments in social interaction and communication, and restricted repetitive and stereotyped patterns of behavior, interests, and activities (American Psychiatric Association [APA], 2000). Several cognitive theories have been proposed to account for some of the deficits in ASD. The ToM deficit account, originally proposed by Baron-Cohen and colleagues (1985), provides a parsimonious account for the social and communicative deficits central to the disorder. Specifically, if children with ASD cannot understand their own and other people's minds, it follows that their social and communication skills would be affected. However, this theory does not account for the repetitive behaviors and restricted interests also present in ASD. The EF account was proposed by Damasio and Maurer (1978) and posits that deficits in cognitive flexibility, generativity, and inhibition explain why children with ASD display repetitive and restricted behaviors. Without strong EF skills, children with ASD struggle when asked to regulate their thoughts and behaviour, and instead engage in restricted and repetitive patterns of behaviour.

Although the ToM deficits theory and the EF deficit theory provide a reasonable explanation for the symptoms of ASD, researchers have often debated the primacy of deficits (e.g., Pellicano, 2007). Moreover, it is becoming increasingly clear that ASD is far too complex a disorder for one cognitive deficit to explain all of the diverse symptoms (Ozonoff, Pennington, & Rogers, 1991). Suddendorf and Corballis (1997) proposed that children with ASD also have a deficit in their ability to think about themselves in the future. Indeed, children with ASD also demonstrate behaviours that might suggest a deficit in EpF. Children with ASD often demonstrate excessive dependence on repetitive behaviours and lack the behavioural flexibility seen in typical development (APA, 2000). It is possible that such inflexibility stems from underlying difficulties with EpF (Suddendorf & Corballis, 1997). Interestingly, some individuals with traumatic brain injuries are also described as having an inability to think about the future and show behavioural similarities to individuals with ASD. Specifically, these individuals demonstrate impaired self-regulation, and their behaviour tends to be driven either by generic, learned rules about how one should behave or by irrelevant environmental goals, rather than by specific goals and intentions relating to their identity and future selves. As a result, they often demonstrate inappropriate habits or routines (Levine et al., 1998). Given the evidence just discussed, it is reasonable to hypothesize that the often stereotyped and inflexible behaviour seen in individuals with ASD may reflect an inability to mentally project into the future.

Jackson and Atance (2008) conducted a pilot study with children with ASD to test this hypothesis. Results indicated that these children performed more poorly on two future thinking tasks that required the projection of the self into the future (e.g., deciding what part of an “ant costume” to put on first, with the order restricted by the shape of the costume) than on two future thinking tasks that required predictions of physical transformations (e.g., selecting which size of ball to roll down a tunnel that changes in diameter from large to small). In fact, children with ASD had more success with the physical transformation tasks than verbal mental age matched typically-developing children. This suggests that children with ASD may be capable of engaging in certain forms of future thinking, but that their ability to do so depends on the specific requirements of the task. The degree of ToM and EF requirements of the EpF tasks may be an important factor. Whether this is the case, and whether children with ASD show deficits on published tasks specifically designed to assess EpF has not yet been examined.

In Study 2, we administer the same five EpF tasks to children with ASD to examine whether they have a deficit in the ability to think about themselves in the future. Their performance is compared to a group of typically-developing preschoolers, matched on verbal mental age. These tasks are administered along with the same EF and ToM tasks as in Study 1 to examine whether EpF is related to EF and ToM in ASD.

Hypotheses

The purpose of this thesis was to examine several specific hypotheses related to the development of the ability to think about the future in two groups of children: typically-developing children between the ages of 3 and 5 and children with ASD. The hypotheses outlined below were addressed in two studies, Hanson, Atance, and Paluck (Study 1), and Hanson and Atance (Study 2).

Typically-Developing Children

1) I hypothesized that older children would significantly outperform younger children on the EpF, ToM, and EF tasks; 2) I hypothesized that tasks within each category (i.e., EpF, ToM, and EF) would be statistically significantly correlated with each other; 3) I hypothesized that, due to their close neurological ties and overlapping functional

requirements, EpF, ToM, and EF tasks would be at least moderately correlated, even after controlling for age and language ability; 4) Finally, I predicted that a significant amount of the variance in EpF ability would be predicted by ToM and EF ability.

Children with Autism Spectrum Disorder

1) I hypothesized that the five EpF tasks would be significantly correlated with each other; 2) I predicted that the EpF, ToM, and EF tasks would be at least moderately correlated; 3) I hypothesized that children with ASD would perform significantly worse on EpF tasks than a group of typically-developing children, matched on mental age.

Is Episodic Foresight Related to Theory of Mind and Executive Function in Preschoolers?

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Abstract

The capacity to mentally project the self into the future or, what has recently been termed "episodic foresight," (EpF) is becoming a popular topic of study in developmental psychology. We explored the extent to which tasks thought to measure this capacity in children are related and also whether, as has been hypothesized, they relate to theory of mind (ToM) and executive function (EF). We administered a battery of EpF, ToM and EF tasks to 90 3-, 4-, and 5-year-olds. After controlling for age and language ability, the EpF tasks were not intercorrelated, nor were they individually related to EF or ToM. However, an EpF composite score was related to an inhibitory control composite score, even after controlling for age and language. We discuss whether existing tasks adequately measure EpF, and suggest future directions for how best to measure this developmental construct.

Keywords: future thinking; theory of mind; executive function; episodic foresight; preschoolers

Is Episodic Foresight Related to Theory of Mind and Executive Function in Preschoolers?

Thinking about the future is an integral aspect of human cognition that underlies our abilities to anticipate possibilities, plan ahead, and control aspects of our environment and our relationships with others (Suddendorf & Corballis, 2007). Adults think about the future and engage in future-oriented behaviors on a daily basis, and these capacities are argued to distinguish humans from other species (e.g., Suddendorf & Corballis, 2007; Tulving, 2005; but see also Clayton, Bussey, & Dickinson, 2003; Raby, Alexis, Dickinson, & Clayton, 2007). Whether young children also think and behave in a future-oriented manner is less clear, but has recently become a topic of study among developmental psychologists (e.g., Suddendorf & Moore, 2011). Of particular interest is children's capacity to mentally project the self into the future or, what has been termed "mental time travel" (Suddendorf & Corballis, 1997, 2007), "episodic future thinking/thought" (Atance & O'Neill, 2001; Szpunar, 2010), "prospection" (Gilbert & Wilson, 2007), "episodic simulation of future events" (Schacter, Addis, & Buckner, 2007) and, most recently, "episodic foresight" (EpF) (Suddendorf & Moore, 2011). EpF is broadly defined as the capacity to "…imagine future scenarios and use such imagination to guide current action" (Suddendorf & Moore, 2011, p. 296).

1. Measuring EpF in Young Children

Although the study of EpF is still in its infancy, when we began our data collection there existed a handful of methods to measure it (we will discuss several new methods that have appeared in the interim in the Discussion). The bulk of the findings using these methods suggest that this ability develops substantially between ages 3 and 5. Here we discuss the various approaches that have been developed to assess children's ability to mentally project into the future.

A relatively straightforward approach is simply to ask children to provide verbal accounts or plans for the future. For example, Hudson, Shapiro, and Sosa (1995) asked 3-, 4-, and 5-year-old children to provide plans for familiar events, including going grocery shopping and going to the beach. They found that older preschoolers' verbal plans for familiar events included more information and specific planning activities than those of younger preschoolers. Interestingly, children were also asked to provide "scripts" of these same events and results indicated that although the adequacy of children's plans increased significantly with age, the adequacy of their scripts did not (that is, 3-year-olds were already quite proficient at providing scripts for familiar events). Because plans are more future-oriented than scripts, Atance (2008) argued that the capacity to provide a plan for going to the beach, for example, draws more heavily on the episodic system than does providing a script for this same event. As such, asking children to provide a plan for a specific event may be a good method to assess their capacity for EpF. Suddendorf and colleagues (e.g., Busby & Suddendorf, 2005; Suddendorf, 2010) have also assessed children's verbal plans, or "future talk," by asking 3-, 4-, and 5-year-olds to report events that they would/would not do "tomorrow." Results showed that by 4 years of age, children's reports were relatively coherent and accurate.

Another approach has been to examine whether children plan/act in anticipation of future needs. Atance and Meltzoff (2005) developed a "Picture Book" task designed to assess whether children can anticipate physiological states of the self, such as hunger and thirst, which might occur in the context of relatively novel situations, such as walking up a mountain or along a desert path. Children were presented with stories and pictorial scenes of "trip" destinations, asked to imagine themselves in these scenarios, and then to choose one item from a set of three to bring with them. One of the three items was one that could be used to address a future state of the self. Developmental differences among 3-, 4-, and 5-year-olds were observed for correct item choices and the ability to explain these choices using future-oriented justifications (e.g., "I might get thirsty").

Another type of task that potentially requires EpF (McColgan & McCormack, 2008; Suddendorf & Corballis, 2007) tests children's ability to conceptualize temporal event sequences both for the immediate and longer-term future. For example, McColgan and McCormack (2008) investigated children's ability to reason and plan for an immediate future event according to temporal order information. They found that 3- and 4-year-olds were unable to consistently apply a temporal order rule (position a camera in a model zoo so that it could be used to take a picture of a particular animal that appeared later in the sequence), while 5-year-olds succeeded. Similarly, when Busby Grant and Suddendorf (2009) asked 3-, 4-, and 5-year-olds to place pictures of various longer-term future events (e.g., playing at the park, getting married) along a timeline, only 5-year-olds were able to differentiate daily events involving the self from more remote future events involving the self.

Although EpF may be related to other future-oriented capacities such as planning, prospective memory, and delay of gratification, it is not synonymous with them. For example, a number of researchers have argued that traditional planning tasks such as the Tower of Hanoi (in which children are asked to replicate a pattern with a series of disks while following a number of rules) require skills (e.g., strategy choice, execution, and monitoring) that may not fully overlap with those required for EpF (e.g., Atance & Meltzoff, 2005). Similar arguments can be made with respect to delay of gratification and prospective memory. For example, Atance and Meltzoff (2005) and Hudson, Mayhew, and Prabhakar (2011) note that the strong inhibitory control demands in delay of gratification tasks may obscure children's (especially younger preschoolers') developing capacity for EpF. Finally, Hudson et al. argue that prospective memory tasks, where children are asked to remember to perform an action at a certain point in the future, may draw more strongly on working memory and attentional processes than they do on EpF. Most importantly, it has been proposed that these tasks measure children's ability to meet immediate, rather than future, goals (e.g., McCormack & Atance, 2011), and do not capture the critical aspect of projecting the *self* into the future situation (e.g., Atance & Meltzoff; Hudson, et al., 2011). In contrast, tasks designed to assess EpF require an individual to imagine a future self that may have different mental states (thoughts, feelings, beliefs) from the current self (McCormack & Atance, 2011). In addition to such theoretical arguments about the distinctiveness of EpF from these other cognitive skills is the empirical finding that two tasks (Atance & Meltzoff, 2005; Busby & Suddendorf, 2005) designed to measure children's EpF were related to one another but not to children's planning, delay of gratification, or prospective memory abilities (Atance & Jackson, 2009). Thus, for both theoretical and empirical reasons, we chose not to include traditional planning, delay of gratification, or prospective memory tasks in our EpF battery.

2. Conceptualizing Episodic Foresight

The research to date suggests that children's ability to mentally project into the future is developing significantly during the preschool years. However, an important issue to consider is the extent to which the various tasks are reflective of EpF specifically. EpF has been defined as the capacity to imagine future scenarios and use such imagination to guide current action (Suddendorf & Moore, 2011). Each of the tasks described above, including the planning component of Hudson et al.'s (1995) "Grocery/Beach" task, Atance and Meltzoff's (2005) "Picture Book" task, Busby and Suddendorf's (2005) "Tomorrow" task, McColgan and McCormack's (2008) "Zoo" task, and Busby Grant and Suddendorf's (2009)

“Sequencing” task, require that children envision a future scenario or course of action and use this to guide their responses and behavior. Consequently, one would predict that performance on these various tasks would be significantly correlated. Indeed, Atance and Jackson found that Busby and Suddendorf’s (2005) Tomorrow task and Atance and Meltzoff’s (2005) Picture Book task were significantly correlated in a sample of 72 3-, 4-, and 5-year-olds even after controlling for age and receptive vocabulary.

Yet, an equally conceivable view is that because the EpF tasks may vary significantly in their broader cognitive demands, they will not be closely related in early development. Some tasks are largely verbal (e.g., Busby & Suddendorf, 2005); others may require inhibitory control skills to allow children to overcome competing responses (e.g., Atance & Meltzoff, 2005) while others require children to think about either their own future perspective (Busby Grant & Suddendorf, 2009) or that of another person (McColgan & McCormack, 2008). Though they are all argued to test an aspect of children’s ability to mentally project into the future, the tasks vary significantly in terms of verbal demands, structure, and likely their reliance on other related cognitive skills, including theory of mind (ToM) and executive function (EF).

Although a common conceptual core ability (“episodic foresight”) has been proposed, and the five tasks we have described (i.e., Atance & Meltzoff, 2005; Busby & Suddendorf, 2005; Busby Grant & Suddendorf, 2009; Hudson et al., 1995; McColgan & McCormack, 2008) seem to capture this ability, the relation among these various tasks has yet to be directly tested in young children. Doing so is important not only with respect to children’s development, but also for development across the lifespan. In adulthood, adopting a future-oriented perspective has been linked to important physical and psychological health outcomes, and has several important social implications. For example, Boyd and Zimbardo

(2005) have measured adults' time perspective and have found that having a future orientation (rather than a present or past orientation) is consistently related to achieving a higher social class, higher academic achievement, displaying less risk taking, and less substance abuse. Additionally, some clinical disorders have been characterized as involving deficits in thinking about the future, including schizophrenia (D'Argembeau, Raffard, & Van der Linden, 2008) and autism (Jackson & Atance, 2008; Lind & Bowler, 2010). Individuals experiencing depression have more difficulty discussing possible future positive events than do control individuals (MacLeod & Salaminiou, 2001). Because the way in which/whether individuals think about themselves in the future appears to be a critical aspect of adaptive functioning in both children and adults, it is important that researchers have a means of measuring it during early development using a reliable and valid battery (as has been done with other key aspects of children's cognitive development, including ToM and EF). Determining the extent to which existing tasks designed to measure the capacity to imagine oneself in the future are related is an important first step in this process and is the first goal of our study.

The second goal of our study was to determine the extent to which children's performance on the EpF tasks is related to other cognitive abilities that also show marked development during the preschool years. This goal stemmed from recent theoretical proposals that EpF is not an isolated ability but is likely dependent on ToM and EF (e.g., Atance & Jackson, 2009; Buckner & Carroll, 2007; Moore, Barresi, & Thompson, 1998; Russell, Cheke, Clayton, & Meltzoff, 2011; Spreng, Mar, & Kim, 2009; Suddendorf & Corballis, 1997, 2007).

3. Theory of Mind and Episodic Foresight

ToM is described as the ability to understand and attribute mental states to self and others (Premack & Woodruff, 1978). A large body of work has examined ToM development using a variety of tasks that require children to reason about false beliefs or, the recognition that others can hold beliefs that are different from their own, or different from reality (e.g., Baron-Cohen, Leslie, & Frith, 1985; Wimmer & Perner, 1983). At age 3, children tend to fail these tasks whereas, by age 5, they tend to pass (Wellman, Cross & Watson, 2001). Although the false belief task has often been considered the “litmus” test of ToM competence, ToM is comprised of more than just an understanding of false belief and, indeed, a number of studies have examined the development and manifestations of ToM in young children using tasks other than those measuring false belief (e.g., Carlson & Moses, 2001; Träuble, Marinović, & Pauen, 2010). Most notably, Wellman and Liu (2004) demonstrated that children’s ToM development follows a predictable progression, whereby children first demonstrate an understanding of desires, followed by belief, knowledge, and false belief.

A number of researchers have argued that the ability to mentally project oneself into the future (EpF) is related to ToM (e.g., Atance & Jackson, 2009; Buckner & Carroll, 2007; Moore et al., 1998; Suddendorf & Corballis, 1997). When projecting oneself into the future, an individual must adopt the perspective of a *future self*, rather than that of *another person*. That is, recognizing that you might feel differently in the future than you do right now may draw on ToM ability. For example, to effectively pack for a trip, as children are asked to do in the Picture Book task, they must disregard their current state and imagine a future, alternative state. Therefore, similar to ToM, EpF involves a shift from an immediate/current perspective to an alternative one (Buckner & Carroll, 2007). ToM has also been found to be closely related to episodic memory (Perner, Kloo, & Gornik, 2007), a capacity that, in turn, shares important cognitive and neural mechanisms with EpF (Addis, Wong, & Schacter, 2007; Busby & Suddendorf, 2005; Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Okuda et al., 2003; Schacter et al., 2007).

EpF and ToM both develop substantially during the preschool years, suggesting a possible developmental relation. However, to date the only empirical evidence to suggest that there may be a link between future thinking, more generally, and ToM in children was reported by Moore et al. (1998) who found that children's future-oriented prosocial (sharing) behaviour is significantly related to ToM, as assessed by Appearance-Reality and Diverse Desires tasks. In addition, a meta-analysis of neuro-imaging studies in adults indicated significant functional overlap of several brain areas (or, the "common core brain network") when people were engaged in tasks of autobiographical memory, prospection, navigation, and ToM (Spreng et al., 2009).

The current study systematically tested the relation between EpF and ToM by examining how children's performance on the five EpF tasks was related to their performance on a variety of ToM tasks. We expected that EpF tasks designed to explicitly measure the projection of the self into the future, such as the Picture Book and Tomorrow tasks, may be more closely related to ToM than those tasks that measure temporal reasoning and planning for a familiar event (i.e., the Sequencing, Zoo, and Grocery/Beach tasks).

4. Executive Function and Episodic Foresight

EF comprises a set of cognitive abilities, including inhibition, working memory, planning, cognitive flexibility, and generativity, that allow an individual to solve a problem or accomplish a goal (Carlson, 2005; Welsh & Pennington, 1988). EF has historically been synonymous with frontal lobe function, and is frequently investigated behaviorally in children where it is considered to play an important role in normative cognitive and social development (Carlson, 2005). A number of researchers (Atance & Jackson, 2009; Buckner & Carroll, 2007; Suddendorf & Corballis, 2007) have argued that EF may also be related to EpF. At a broad level, when thinking about the future, and shifting our perspective accordingly, we must always keep track of the shifts we make (Buckner & Carroll, 2007). EpF also involves suppressing perception of the current world while simulations of possible alternative situations are constructed, followed by a return to the present. This coordination of internal perspectives likely involves EF (Buckner & Carroll, 2007). Finally, common neuroanatomy exists between EpF and EF; namely, frontal and prefrontal cortex regions (Addis et al., 2007; Okuda et al., 2003; Stuss & Alexander, 2000).

EF comprises a complex set of abilities, each of which may be differentially related to EpF. Inhibitory control allows individuals to suppress inappropriate but prepotent thought processes or actions that interfere with goal attainment (Carlson, Moses, & Breton, 2002). A number of EpF tasks have a correct answer embedded among other prepotent responses (e.g., Atance and Meltzoff's Picture Book task and McColgan and McCormack's Zoo task), and thus might be related to inhibitory control tasks. Working memory, cognitive flexibility, and generativity may also be related to EpF. Suddendorf and Corballis (2007) argue that working memory is necessary for EpF because it provides a space where information can be temporally combined and manipulated. Cognitive flexibility – or, the ability to shift to a different thought/behaviour as required in a situation (Hill, 2004) – may also be critical for EpF because it allows a shift in perspective from current events to the anticipation of future events. Generativity, or the ability to generate novel ideas and behaviors spontaneously (Turner, 1999), may be strongly related to the EpF tasks in which children are required to generate verbal responses to questions (Picture Book, Grocery/Beach, and Tomorrow).

Planning may also be particularly related to EpF. Planning is a complex, dynamic operation because it involves the constant monitoring, re-evaluation, and updating of a sequence of planned actions (Hill, 2004). In the current study, the planning tasks we used (Truck Loading and Tower of Hanoi) were conceptualized as EF tasks due to their focus on more immediate goals. In contrast, the EpF tasks were conceptualized to involve a focus on more distant goals, and were thought to require a projection of the self into the future (McCormack & Atance, 2011). Nonetheless, it was expected that the EpF tasks, some of which may rely heavily on planning ability (particularly the Zoo and Grocery/Beach tasks), would be closely related to this aspect of EF.

As with ToM, however, the empirical data linking EpF and EF in young children is sparse. Interestingly, in addition to showing that future-oriented pro-social behavior was related to ToM, Moore et al. (1998) reported that it was related to inhibitory control. Additionally, a great deal of evidence exists to support a strong relation between ToM and EF skills in young children (Carlson & Moses, 2001; Hala, Hug, & Henderson, 2003; Müller, Zelazo, & Imrisek, 2005), adding support to the idea that if either ToM or EF is related to EpF, it is likely that all three skills will be related.

5. Summary

EpF is a highly adaptive aspect of human cognition that has recently become an important focus of study in various areas of psychology - including neuro- (e.g., Addis et al., 2007; Buckner & Carroll, 2007; Okuda et al., 2003), cognitive (e.g., D'Argembeau & Mathy, 2011; Spreng & Levine, 2006), social (e.g., Gilbert, 2006; Thompson, Barresi, & Moore, 1997; Van Boven & Loewenstein, 2003), and developmental (e.g., Atance & O'Neill, 2005; Suddendorf & Moore, 2011). It has also become a lively topic of debate in the field of comparative cognition (e.g., Clayton et al., 2003; Raby et al., 2007). Although developmentalists have used a variety of tasks to assess children's EpF, the extent to which these tasks are related is not known.

Given the potential implications for both typical and atypical development, identifying a battery of tasks is of benefit to experimental as well as clinical psychologists. From a theoretical perspective, it is also important to determine whether various EpF tasks are related, suggesting that they are tapping a distinct cognitive skill. Tackling this issue was the first goal of this study. In addition, a substantial amount of theorizing converges on the idea that EpF shares important links with both ToM and EF (e.g., Buckner & Carroll, 2007; Spreng et al., 2009; Suddendorf & Corballis, 2007), but these links have not yet been assessed systematically in young children. Doing so was the second goal of this study.

6. Method

6. 1. Participants

Participants were 90 typically-developing preschoolers (*M* = 4 years, 5 months; range = 3,0-5,11): 30 3-year-olds (*M* = 3,5; 15 male), 30 4-year-olds (*M* = 4,5; 15 male), and 30 5-year-olds (*M* = 5,6; 15 male), all of whom were fluent in English. Several additional children were recruited, but were not included in the study due to fussiness (*n* = 6), and failure to return for session 2 (*n* = 3). Children were recruited by telephoning parents who responded to print and online advertisements. The sample was predominantly Caucasian (*n* = 69), while other ethnic groups were represented to a lesser degree (*n* = 12 Asian, *n* = 3 Black, *n* = 2 Hispanic, *n* = 1 Middle Eastern, *n* = 3 other). Participants were also from primarily middle-class or upper middle-class income brackets (*n* = 81) and had highly-educated parents (*n* = 81, college diploma or other post-secondary degree).

6.2. Procedure

Children were tested individually in two sessions, each lasting approximately 1 hour, and scheduled no more than one month apart (*M* = 10 days, range = 0-26 days, with the exception of one child who returned after 44 days). The sessions were video recorded, and parents observed the session on a television screen in an adjacent room. The first author completed the first session with all participants, while the second session was completed by either the first or third author. A research assistant, who was blind to the study's hypotheses, completed reliability coding on 40% of the sessions. Measures of reliability accompany each task description in the Appendix, and all disagreements were resolved through discussion.

6.3. Measures

6.3.1. Cognitive functioning. During the first session, all children completed the Wechsler Preschool and Primary Scale of Intelligence, Third Edition (WPPSI-III; Wechsler, 2002). Although children completed the full battery, in this study, we use only the General Language Composite (GLC) score, made up of the Receptive Vocabulary and Expressive Vocabulary subtests, as a proxy for children's linguistic development.

6.3.2. EpF, ToM, and EF tasks. The EpF, ToM, and EF tasks were administered in the second session. Because total randomization across all tasks would have required an unwieldy number of participants, the tasks were counterbalanced using a block randomization procedure. This procedure ensured that no one type of task was any more likely than any other type of task to be selected for any particular position in the random sequence. The result was 15 unique protocols that were administered twice in each block of participants. That is, one 3-year-old girl and one 3-year boy completed protocol one, as did one 4-year-old girl and one 4-year-old boy, and so on. Table 1 provides a brief description of the five EpF tasks, five ToM tasks, and seven EF tasks. Complete task descriptions can be found in the Appendix. Total administration time ranged from 45 to 60 minutes.

7. Results

7.1. Preliminary Analyses

Scores on the Black/White and Sequencing tasks had $z_{skewness}$ values larger than 4 and so were transformed by reflecting and taking the square root to correct for moderate negatively skewed distributions (Tabachnick & Fidell, 2007). The resulting variables were then re-reflected to preserve the direction of the distribution. The transformed variables are used in subsequent analyses.

Two univariate outliers were identified, whereby two different children provided 25 and 23 correct responses to the Word Fluency and Grocery/Beach tasks, respectively. These outliers were transformed by making them one unit larger than the next highest scores of 17 and 15 responses, respectively. Due to the exploratory nature of this study, we used an alpha level of .05 for all analyses.

7.2. Descriptive and Developmental Analyses

One-way analyses of variance (ANOVAs) indicated that children's performance on the tasks did not vary significantly as a function of sex and so we collapsed across this variable for all subsequent analyses. Age effects on the various tasks, as well as the GLC on the WPPSI-III, were tested using one-way ANOVAs followed up with Tukey's HSD tests. When variances were not equal, Dunnett's C procedure was used as a follow-up test (see Table 2).

Children's performance on all tasks differed significantly across age groups, with the exception of Diverse Desires and Zoo. Standardized scores on the General Language Composite (GLC, from the WPPSI-III) were not significantly different across age groups either but this is expected because it confirms that the three age groups were drawn from approximately equal ability samples.

7.3. Relation between Tasks

The following analyses examined the extent to which all of the different task scores were related to one another and to age in months and raw scores on the tasks that make up the GLC (Receptive Vocabulary and Expressive Vocabulary) on the WPPSI-III. First, we examined the Pearson product-moment correlations within the ToM, EF, and EpF tasks.

Four of the five ToM tasks (Diverse Desires, Knowledge Access, Contents False Belief, and Change in Location) were significantly intercorrelated both before and after controlling for age and language (see Table 3). We calculated the Cronbach's alpha level on a scale made up of all five ToM tasks, and the resulting alpha was adequate, $\alpha = .72$, leading us to retain all five ToM variables in the creation of a ToM composite score (an average of all five ToM scores).

Several of the EF tasks were intercorrelated before controlling for age and language (see Table 4). After controlling for age and language, Truck Loading and Tower of Hanoi were significantly correlated ($p < .01$), while the correlations between Black/White, Backward Digit Span, and Count/Label approached significance (at least $p < .10$). The Dimensional Change Card Sort (DCCS) task remained correlated with only one other task, and showed limited variability (at ceiling for 4-year-olds and 5-year-olds) and the Word Fluency task was not correlated with any other task once the effects of age and language were controlled. As a result, we created an EF composite score by averaging the scores (after first standardizing individual scores into *z*-scores so they fell on the same scale) from the five intercorrelated EF tasks: Black/White, Backward Digit Span, Count/Label, Truck Loading and Tower of Hanoi. The Cronbach's alpha for this composite score was adequate, $\alpha = .78$.

The ToM and EF composite scores were examined for age differences using one-way ANOVAs. The ANOVAs were statistically significant for both the ToM, F (2, 86) = 18.25, p < .001, η^2= 0.30 and EF composite scores, F (2, 80) = 39.00, p < .001 , η^2= 0.49. Tukey's HSD follow-up tests were conducted to evaluate pairwise differences among the means and these indicated that for the ToM composite score, 3-year-olds' performance was significantly lower than 4- and 5-year-olds' (p < .001), while the performance of 4- and 5-year-olds did not differ (p = .99). On the EF composite, 3-, 4-, and 5-year-olds' performance differed significantly across all pairwise comparisons (p < .01).

Finally, we considered the relations between the EpF tasks. As can be seen in Table 5, several of the tasks were correlated before controlling for the effects of age and language, but these correlations were non-significant after controlling for these factors. For exploratory purposes, we created an EpF composite score by averaging the scores on all five EpF tasks (after first standardizing each individual score into a z-score so they fell on the same scale). This approach was exploratory, but can be justified by the argument that lower inter-item correlations can be expected when measuring psychological constructs that are multifaceted and complex (Guilford, 1954; Kline, 2000). Indeed, it is possible that the EpF tasks are not intercorrelated because they are measuring different aspects of this ability. However, when combined they may be correlated with other components (such as EF and ToM) because the sum is a combination of independent attributes. As expected based on the inter-item correlations, the Cronbach's alpha calculated for this score was modest, α = .44.

A one-way ANOVA conducted on the EpF composite score showed age differences, F (2, 86) = 26.18, p < .001, η^2= 0.38. Tukey's HSD follow- up tests were conducted to evaluate pairwise differences among the means, and indicated that 3-year-olds' performance was significantly lower than 4- and 5-year-olds' performance (p = .001), while the difference between the 4- and 5-year-old groups approached significance (p = .05).

7.4. Relations Between Categories of Tasks

Zero-order and partial Pearson product-moment correlations, controlling for age and language, were calculated between the ToM and EF composite scores and between each of these two composites and children's scores on the individual EpF tasks and the EpF composite. The ToM and EF composite scores were significantly related before (r = .57, p < .001) and after controlling for age and language (r = .34, p < .01).

We then examined the relation between the ToM and EF composite scores and each of the five individual EpF tasks. None of the correlations remained significant after controlling for age and language (see Table 6), except for the Grocery/Beach task, which remained correlated with the EF composite score (r =. 22, p < .05). However, the EpF composite score was significantly related to both the ToM (r = .46, p < .001) and EF (r = .68, p < .001) composites, and remained correlated with EF after controlling for age and language (r = .31, p < .01), but not with ToM (r = .16, p = .16).

Historically, EF has also been broken down into two separate elements, namely, inhibitory control and planning (Carlson, Moses, & Claxton, 2004). To further explore the relation between these elements of EF and EpF we created an Inhibitory Control (IC) composite score by averaging the performance on the inhibitory control and working memory tasks (Black/White, Backward Digit Span, and Count/Label) and a Planning composite score by averaging the performance on the two planning (TOH and Truck Loading) tasks. The IC composite score remained correlated with the ToM composite score after controlling for age and language (r = .44, p < .001), while the Planning composite score did not (r = .06, p = .61). Additionally, the EpF composite score remained correlated with the

IC composite score after controlling for age and language ($r = .37$, $p = .001$), but not with the Planning composite score ($r = .09$, $p = .43$).

8. Discussion

The first goal of this study was to examine whether a series of tasks thought to measure children's ability to mentally project the self into the future (i.e., Atance & Meltzoff, 2005; Busby & Suddendorf, 2005; Busby Grant & Suddendorf, 2009; Hudson et al., 1995; McColgan & McCormack, 2008) or, what has recently been termed "episodic foresight," were related in a sample of 3-, 4-, and 5-year-olds. Although our results indicated significant age-related changes in performance on all but one task (Zoo), and several significant zero-order correlations between tasks, when we controlled for the effects of age and language, none of the tasks remained inter-correlated[1]. As such, our findings are most consistent with the idea that the "episodic foresight" tasks developed thus far are measuring a number of different aspects or sub-components of this ability, rather than one unitary construct. Although some of these components may develop around the same age, our data suggest that they are not closely related in early development.

Our findings in this respect are not altogether surprising given that each task was developed with somewhat different theoretical goals in mind. For example, the Grocery/Beach task was developed to examine children's ability to formulate verbal plans; an ability that Hudson et al. (1995) argued initially relies on children's semantic or script-based knowledge about familiar events but, as Atance (2008) has argued, may also rely on the ability to think about the future self. In contrast, the Picture Book task, which asks children about more "novel" scenarios for which they may have limited, or no, experience, was specifically designed to reduce the likelihood that children could rely solely on script-based knowledge to succeed. Meanwhile, the Sequencing and Zoo tasks were both developed with an emphasis on children's understanding of temporal reasoning, an ability that has been argued to be crucial for, but perhaps not synonymous with, EpF (McColgan & McCormack, 2008).

There are additional ways in which these tasks differ including the extent to which they draw on a sense of self extending into the future, and children's imaginative capacities to anticipate situations they have experienced before versus situations that are relatively novel. With respect to the former, it is conceivable that some tasks, including Tomorrow and Picture Book, are measuring children's ability to pre-experience events, thereby drawing on their sense of a future self, while the Zoo task requires that children think about someone else's future perspective (however, this task can also be completed by imagining yourself in the character's position, walking around the zoo). With respect to the latter (i.e., familiar versus novel events), in the Grocery/Beach task, for example, the events discussed are relatively familiar to children, and therefore generating a correct response may draw less on their EpF and more on their semantic memory stores. The Sequencing task also requires children to reason about events that are relatively familiar, while the Zoo and Picture Book tasks focus on novel, hypothetical events and therefore may place stronger demands on children's ability (or imaginative capacity) to construct an event that they have not previously experienced. Thus, whereas imagining a future scenario is required in all of these contexts, the extent to which the "to-be-imagined" scenario is familiar versus novel may be an important distinguishing factor. Nonetheless, both may be critical to EpF given that thinking about the future may at times especially benefit from the knowledge we have about the past (e.g., "I'm going to a dinner party and so I must take a gift for the host"), whereas at other times the future event under contemplation is more unique and thus may not draw on our knowledge base to the same extent.

It would seem possible, in future research, to manipulate such task demands to determine how they affect children's performance. For example, it may be (as Hudson et al., 1995, have argued) that children first begin to think about the future when they can draw on their semantic knowledge base. Only later in development might children succeed on a task that requires them to imagine and construct a more "novel" future episode. Hudson et al. (2011) also argue for an approach that takes into account young children's "partial success" on tasks of EpF. In other words, even young children may have some of the sub-components of this ability but not the full-blown concept. However, to better understand children's partial knowledge it will be important for researchers to agree on what these components may be.

Two recent proposals are important in this respect. More specifically, Hudson et al. (2011) argued that EpF tasks should meet the following criteria: (1) require children to think about a *specific* episode, and not the future in general; (2) require children to think about *themselves* in this specific episode and imagine what they would be thinking/feeling; and (3) require children to think about a specific moment in time. Although these criteria are open for debate, a useful direction for future research is to determine whether each emerges at the same or different points in development. For example, it is possible that the ability to think about a specific episode (e.g., "going to the park with Grandma") emerges prior to the capacity to think about this event as happening at a specific moment in time.

Hudson et al.'s (2011) criteria are also interesting to consider in the context of our study because the tasks that we used vary along these dimensions. For example, whereas "Tomorrow" and "Sequencing" require children to think about a specific moment in time, "Trip" and "Grocery/Beach" target a more hypothetical future. The task that may come closest to meeting Hudson et al.'s criteria is "Tomorrow" but, even here, it is possible that the verbal demands of the task (e.g., understanding the term "tomorrow") obscure the youngest children's capacity for EpF (Hudson et al.) or, alternately, that children may succeed on this task by talking about what "typically" happens (e.g., semantic knowledge about the future) from day-to-day (e.g., going to nursery school, having a sandwich for lunch, etc.) without necessarily thinking about themselves in the episode in question.

Another criterion that has been argued to be important for EpF is thinking about/acting on a future state that differs from one's current state (e.g., Suddendorf, Nielsen, & von Gehlen, 2011; Tulving, 2005; but see Raby & Clayton, 2009, for cogent arguments about why this particular criterion may not characterize all instances of EpF). Recent research with both humans (e.g., Russell et al., 2010; Suddendorf et al., 2011) and non-human animals (e.g,. Mulcahy & Call, 2006; Osvath & Osvath, 2008) has been particularly inspired by a scenario described by Tulving (2005), now referred to as the "spoon test." In Tulving's scenario, a little girl dreams about attending a party where guests are being served a delicious chocolate pudding. Unfortunately, the young girl has not brought her own spoon and so she cannot have any. The next night, she falls asleep while holding a spoon in her hand to avoid making the same mistake again. Tulving predicted that non-human animals and children younger than 4 would not succeed (i.e., would fail to bring the spoon) on a task structured to mirror his proposed scenario. The main reason for such a failure is argued to be an inability to anticipate a future need state that differs from one's current state.

Suddendorf et al. (2011) adapted Tulving's scenario with 3- and 4-year-olds in the following way: Children were shown a locked box with a triangular keyhole that could be opened by a red triangle key to obtain a sticker. They were then given the opportunity to use the key on two consecutive trials. A future need for a key was then created by having the experimenter pretend to break the existing one. At this point, children were guided to another room but were told that they would later return to the first room to play with the box. After a brief delay, children were asked to select one of four keys to take back to the first room. The majority of 4-year-olds (65%) selected the correct key, while significantly fewer 3-year-olds (29%) did so. While it is tempting to conclude that the 4-year-olds were thus able to anticipate a future state that differs from a current one, even the authors recognize that children may have maintained the desire to obtain stickers throughout the experimental session. Nonetheless, this task appears to fit the criteria outlined by Hudson et al. That is, children are required to think about themselves in a specific future episode at a specific point in time. Further refining existing tasks to fit Hudson et al.'s (2011) criteria, while also varying the extent to which children's current and future needs may differ/conflict may help to highlight important developmental changes in children's capacity for EpF.

8.1. ToM, EF, and EpF

The second goal of our study was to examine the relation between children's ability to imagine future scenarios and their ToM and EF. As with the EpF tasks, we largely replicated the age-related changes in ToM and EF reported in numerous other studies (e.g., Carlson & Moses, 2001; Wellman et al., 2001). The ToM tasks were inter-correlated with one another, as were a number of the EF tasks. The ToM and EF composite scores also remained correlated after controlling for age and language, which is consistent with previous research that suggests that these two cognitive skills are closely related (Carlson & Moses, 2001; Hala et al., 2003; Müller, et al., 2005). Further analyses revealed that the inhibitory control composite score remained correlated with the ToM composite score, while the planning composite score did not, again replicating previous work in the field (Carlson et al., 2004). This replication of previous research is important because it helps to rule out the possibility that our failure to find inter-correlations between the EpF tasks was due to the testing of a small or unrepresentative sample, or that our particular testing context led children to respond in a peculiar way.

Our key question, however, was whether the EpF tasks would be correlated with children's ToM and/or EF. Here, our results were mixed. We first examined the correlations between the ToM and EF composites and each EpF task separately. The results of these analyses indicated that neither the ToM nor the EF composite scores were significantly correlated with any of the individual EpF tasks after controlling for age and language, except the Grocery/Beach task, which remained correlated with the EF composite. Next, we conducted a series of exploratory analyses that entailed creating an EpF composite score (by averaging the performance on all five tasks) and then correlating it with the ToM and EF composites. The results of these exploratory analyses indicated that the EpF and the EF composites were significantly correlated after controlling for the effects of age and language, whereas the EpF and ToM composites were not. Our analyses further revealed that a composite score made up only of the EF tasks that measure inhibitory control and working memory (Black/White, Count/Label, and Backward Digit Span) was related to the EpF composite score, while a composite score made up of the EF tasks that measure planning (Tower of Hanoi, Truck Loading task) was not. This supports the idea, espoused by McCormack and Atance (2011), that traditional planning tasks are not one and the same as EpF tasks. In summary, our data offer some preliminary evidence that EpF is related to working memory and inhibitory control, as has been suggested by a number of researchers (Atance & Jackson, 2009; Buckner & Carroll, 2007; Suddendorf & Corballis, 2007), though this finding will need to be replicated and extended upon in future studies.

In contrast, our results do not support a link between EpF and ToM; a finding that contrasts with theories that predict overlap between people's ability to think about the future (or the perspective of a “future self”) and to think about others (or, ToM) (e.g., Atance & Jackson, 2009; Atance & Meltzoff, 2005; Buckner & Carroll, 2007; Moore et al., 1998; Spreng et al., 2009; Suddendorf & Corballis, 1997, 2007). At the heart of this argument is the idea that an overlap stems from the shared requirement to mentally project (or “self-project”, e.g., Buckner & Carroll) out of one’s current perspective to envision an alternate perspective, either one’s own future self or another person’s. And, indeed, a classic false belief task, for example, requires children to acknowledge that their current perspective (e.g., that there is a pig in the Band-Aid box) is different (and, in fact conflicting) from the perspective of another person (e.g., that there are Band-Aids in the Band-Aid box). At issue then, is the extent to which the EpF tasks that we administered in this study require children to explicitly contrast their current perspective with a future one.

It is possible, as we argued, that the EpF tasks that we administered may not have required the same kind of “perspective shift” as the ToM tasks. Even in the Picture Book and Tomorrow tasks, which arguably require some sense of self extended over time, children do not need to explicitly contrast present and future selves. That is, their present state is not necessarily salient enough to interfere with their ability to override a choice for the future. It may be possible, however, to develop other EpF tasks, perhaps based on the “spoon” test scenario, in which present and future states explicitly conflict. For example, in a task developed by Atance & Meltzoff (2006), children were asked to either choose pretzels (the child’s stated preference) or water for the future. Immediately after eating pretzels, when children were presumably in a “thirsty” state, they chose water for “tomorrow”, indicating that they could not override their current, salient state, when choosing for the future. One could imagine other similar tasks designed to manipulate children’s present state while requiring them to make a choice for the future. For example, the Picture Book task could be modified by asking children to make the same choices for the future walk in the hot desert in a thirsty, neutral, or non-thirsty state. Our hypothesis is that tasks that require overcoming a conflict between current and future states will be correlated with ToM tasks that measure false belief, for example.

In summary, the key to understanding the relation between EpF, ToM, and EF may be to isolate which particular component(s) of EpF are related to (or even dependent on) ToM and EF by manipulating EpF task design and components. For example, one could conceive of instances in everyday life when it may be important for individuals to appreciate that their future state will differ from their current state and thus plan accordingly. However, at other times, with a continued state/desire in mind, an individual may need to plot out a course of action to satisfy it. Whereas the former may require a higher degree of ToM or EF, for example, the latter may not. We would argue that both instances require EpF nonetheless.

8.2. Limitations

When designing this study, we strove to select a group of tasks representative of the current thinking in the field. Subsequent to the development of this dissertation, several relevant EpF tasks were published, and one unavoidable limitation of the present dissertation is that these tasks were not included in the battery. Although our sample size was adequate and consistent with past studies in this field, the children in our study were not entirely representative of the general population. Due to the demographic make-up of the city where we conducted the study, the sample was skewed towards a high-income, highly educated, and largely Caucasian sample of children. As such, our results are not likely generalizable to all cultural, ethnic, and socio-economic groups, and thus future research should strive to recruit a more varied sample of children. Finally, the results of the analyses employing composite scores must be interpreted with some caution due to the low Cronbach alpha results, particularly with regards to the EpF composite score.

8.3. Conclusions

In sum, despite theoretical arguments supporting a relation between EpF, ToM, and EF, very little research has addressed this issue. To our knowledge, the study we report here is the first to do so in young children. Although we did not detect significant correlations between tasks that were conceptualized as measuring “episodic foresight,” we nonetheless argue that each captures important components of this ability. We (and, more recently, others) speculated about what some of these components may be, but future research will need to more clearly delineate them and how/when each develops during the preschool years. We did not detect a significant relation between EpF (as measured in this study) and ToM but do provide evidence that EpF may be related to several key components of EF: inhibitory control and working memory. As noted, this finding will need to be replicated but it is consistent with theoretical arguments about the importance of these particular abilities to the development of EpF (e.g., Suddendorf & Corballis, 2007).

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Footnotes

[1]Unlike in Atance and Jackson (2009), the Picture Book and Tomorrow tasks did not remain correlated after controlling for age and language. This discrepancy may be due to the fact that Atance and Jackson's language measure only accounted for receptive language, whereas in the current study we factored out both receptive and expressive language.

[2] Busby Grant and Suddendorf (2009) used three categories; however, in pilot testing, children in our study had difficulty differentiating between the closest and middle categories, therefore we chose to simplify the task.

[3] In Hudson et al. (1995), the model script was about a trip to the zoo, but this was problematic for the current study because another one of the tasks employed was a "zoo" themed task. Therefore, the script was modified to focus on "going on a picnic". The general structure of the model script was maintained, in that it emphasized preparatory activities.

Table 1

Task Descriptions

Task	Description
Episodic Foresight Tasks	
Sequencing (Busby Grant & Suddendorf, 2009)	Child judges the temporal distance of short- and long-term future life events.
Picture Book (Atance & Meltzoff, 2005)	Child selects items for imaginary trips to four novel locations (e.g., the desert).
Grocery/Beach (Hudson et al., 1995)	Child reports verbal plans for going to the grocery store and the beach.
Tomorrow (Busby & Suddendorf, 2005)	Child explains what they will and will not be doing tomorrow.
Zoo (McColgan & McCormack, 2008)	Child plans where to place a toy camera in zoo set-up, making inferences using temporal order information.
ToM Tasks	
Diverse Desires (Wellman & Liu, 2004)	Child chooses a "snack" for someone whose preference is stated to be opposite of that of the child's.
Diverse Beliefs (Wellman & Liu, 2004)	Child indicates where a character will search for her cat, after finding out that the character's belief is the opposite of the child's own belief.
Knowledge Access (Wellman & Liu, 2004)	Child sees inside a cupboard, which contains a stuffed dog, then is asked whether a character, who has not seen inside the cupboard, knows what is inside.
Contents False Belief (Wellman & Liu, 2004)	The true contents of a Band-Aid box (a pig) are revealed to the child, who is then asked what a naïve character will think is in the box.
Change in Location (Carlson & Moses, 2001)	A classic "Sally-Anne" task, where the child must assess a character's false belief.
EF Tasks	
Black/White (Simpson & Riggs, 2005)	Child is instructed to say "white" when presented with a black card, and "black" when presented with a white card.
Dimensional Change Card Sort (DCCS) (Zelazo, 2006)	Child learns to sort cards by color, and then is told to sort by a new dimension, shape.
Tower of Hanoi (Carlson et al., 2004)	Child must copy the experimenter's pattern in a classic tower task, while following several rules, including the rule that larger disks cannot be placed on top of smaller disks.
Truck Loading (Carlson et al., 2004)	Child must deliver "letters" to house on a pretend street, while respecting the rule that the letters must be loaded into a toy truck so that the first house's letter is placed in the truck last (so as to be on the top of the pile).
Fluency (Turner, 1999)	Child must generate as many animal names, then as many different foods, as possible in 30 seconds.
Backward Digit Span (Carlson, 2005)	Child is asked to repeat a series of numerical digits, in reverse order, beginning with sequences of 2 digits.
Count/Label (Carlson, 2005)	Child is instructed to first label (e.g. dog, car, tree), then count (e.g. 1, 2, 3), and finally count and label objects at the same time (e.g. 1 is a dog…)

Table 2
Mean Scores on all Tasks as a Function of Age

Task	3-year-olds	4-year-olds	5-year-olds	Age effects
Language				
WPPSI-III GLC (standardized scores)	111.7 (10.4)	106.8 (13.4)	105.2 (11.2)	F (2, 87) = 2.46
EF tasks				
Black/White (range = 0-21)	11.7 $(7.1)_1$	16.1 $(4.6)_2$	16.8 $(4.8)_2$	F (2, 84) = 7.08**
Trans				F (2, 84) = 6.12**
DCCS (range = 0-6)	3.8 $(2.6)_1$	5.8 $(1.1)_2$	5.2 $(2.1)_{1,2}$	F (2, 87) = 7.62**
TOH (range = 0-6)	1.4 $(1.1)_1$	2.3 $(1.8)_{1, 2}$	3.0 $(2.1)_2$	F (2, 86) = 6.45**
Truck Loading (range = 0-4)	1.2 $(0.7)_1$	2.6 $(1.3)_2$	3.6 $(1.1)_3$	F (2, 87) = 38.35**
Fluency (range = 0-18)	4.8 $(3.0)_a$	6.3 $(2.8)_a$	10.4 $(4.2)_b$	F (2, 87) = 22.25**
Backward Digit (range = 0-5)	0.3 $(0.8)_1$	1.5 $(1.3)_2$	2.6 $(1.2)_3$	F (2, 84) = 30.74**
Count/Label (range =0-2)	0.4 $(0.8)_a$	1.5 $(0.8)_b$	1.7 $(0.7)_b$	F (2, 87) = 23.20**
ToM Tasks				
DD (range = 0-1)	0.8 (0.4)	0.8 (0.4)	0.8 (0.4)	F (2, 87) = 0.28
DB (range = 0-1)	0.6 $(0.5)_1$	0.9 $(0.4)_2$	0.6 $(0.5)_{1,2}$	F (2, 87) = 3.91*
KA (range = 0-1)	0.3 $(0.5)_1$	0.9 $(0.3)_2$	0.9 $(0.3)_2$	F (2, 86) = 24.79**
CF (range = 0-1)	0.1 $(0.3)_1$	0.7 $(0.5)_2$	0.7 $(0.5)_2$	F (2, 87) = 16.06**
CL (range = 0-1)	0.2 $(0.4)_1$	0.7 $(0.5)_2$	0.8 $(0.4)_2$	F (2, 87) = 15.46**
Episodic Foresight Tasks				
Sequencing (range = 0-6)	3.9 $(1.5)_a$	4.8 $(1.2)_b$	5.1 $(0.9)_b$	F (2, 87) = 7.58**
Trans				F (2, 87) = 7.97**
Picture book (range = 0-8)	2.9 $(2.1)_a$	4.8 $(2.3)_b$	6.0 $(1.7)_b$	F (2, 86) = 16.24**
Grocery/Beach (range = 0-16)	4.8 $(2.9)_a$	6.4 $(3.9)_a$	8.6 $(3.5)_b$	F (2, 87) = 8.86**
Tomorrow (range = 0-4)	1.5 $(1.1)_a$	2.0 $(1.4)_{a,b}$	2.4 $(1.4)_b$	F (2, 87) = 3.32*
Zoo (range = 0-2)	0.7 (0.7)	1.0 (0.7)	0.9 (0.7)	F (2, 87) = 1.33

Note. Standard Deviations are in parentheses. The *n*s for the individual tasks differ due to missing data. Means in the same row that do not share alphabetical subscripts differ at $p < .05$ using Tukey's HSD test. Means in the same row that do not share the same numerical subscript differ at $p < .05$ using Dunnett's C procedure. DCCS = Dimensional Change Card Sort, TOH = Tower of Hanoi, DD = Diverse Desires, DB = Diverse Beliefs, KA = Knowledge Access, CF = Contents False Belief, CL = Change in Location. * $p < .05$, ** $p < .01$

Table 3

Correlations between Theory of Mind Tasks

Task	2	3	4	5	6	7
1. Age	.68**	.07	.04	.53**	.46**	.50**
2. GLC	-	.22*	.06	.42**	.47**	.53**
3. DD		-	.16 (.16)	.35** (.36**)	.38** (.35**)	.27** (.22*)
4. DB			-	.08 (.06)	.10 (.09)	.15 (.14)
5. KA				-	.56** (.42**)	.60** (.45**)
6. CF					-	.69** (.57**)
7. CL						-

Note. Partial correlations controlling for age and language are shown in parentheses. * $p < .05$, ** $p < .01$. GLC = General Language Composite, DD = Diverse Desires, DB = Diverse Beliefs, KA = Knowledge Access, CF = Contents False Belief, CL = Change in Location

Table 4

Correlations between Executive Function Tasks

Task	2	3	4	5	6	7	8	9
1. Age	.67**	.31**	.22*	.37**	.71**	.59**	.68**	.58**
2. GLC	-	.22*	.09	.38**	.59**	.57**	.63**	.50**
3. Black/White		-	.19+(.13)	.24* (.14)	.23* (.01)	.22* (.05)	.35** (.20+)	.38** (.25*)
4. DCCS			-	.15 (.09)	.19 (.07)	.14 (.03)	.29** (.23*)	.19+ (.10)
5. TOH				-	.49** (.32**)	.34** (.12)	.55** (.40**)	.32** (.11)
6. Truck					-	.46** (.01)	.57** (.10)	.54** (.19)
7. Fluency						-	.52** (.13)	.29** (-.14)
8. BKWD							-	.55** (.21+)
9. Count/Label								-

Note. Partial correlations controlling for age and language are shown in parentheses. * $p < .05$, ** $p < .01$, + $p < .10$. GLC = General Language Composite, DCCS = Dimensional Change Card Sort, TOH = Tower of Hanoi, BKWD = Backward Digit Span

Table 5

Correlations between Episodic Foresight Tasks

Task	2	3	4	5	6	7
1. Age	.66**	.41**	.55**	.33**	.40**	.07
2. GLC	-	.23*	.68**	.25*	.38**	.24*
3. Sequencing		-	.19+ (-.01)	.03 (-.12)	.09 (-.08)	.04 (.02)
4. Picture Book			-	.20* (.01)	.32** (.05)	.10 (-.07)
5. Tomorrow				-	.17 (.04)	.20 (.18)
6. Grocery/Beach					-	.01 (-.06)
7. Zoo						-

Note. Partial correlations controlling for age and language are shown in parentheses. * $p < .05$, ** $p < .01$, + $p < .10$. GLC = General Language Composite.

Table 6

Correlations between Composite Scores and Episodic Foresight Tasks

Composite Score	Sequencing	Picture Book	Tomorrow	Grocery	Zoo
ToM	.30** (.17)	.44** (.15)	.17 (-.02)	.21+ (.01)	.15 (.05)
EF	.33** (.12)	.57** (.17)	.33** (.07)	.43** (.22*)	.19+ (.09)

Note. Partial correlations controlling for age and language appear in parentheses. * $p < .05$, ** $p < .01$, + $p < .10$.

Appendix

Episodic Foresight Tasks

Sequencing (modified from Busby Grant & Suddendorf, 2009). Children were shown a timeline, which consisted of a colored board with two Velcro pieces placed at either end of the timeline. Children were told that they were going to play a game involving “how long until things happen in the future.” At one end of the timeline was a small black and white figure depicting a child-size person, and at the other end was a larger black and white figure, depicting an adult[2]. The experimenter explained the timeline to the child (e.g., “this is a picture of a person as big as you, a 3/4/5-year-old, just like you are right now. We will put things here that are going to happen in a little time, like how big you are right now”). The experimenter also explained to children that they were to place items next to the appropriately-sized person. There were six target events, three for each of the two differently-sized people. For the child-sized person, these included “going home” (house), “having dinner” (plate with food), and “playing at the park” (playground)/“playing in the snow” (snowman; for use during winter testing). For the adult-sized person, these included “get married” (bride and groom), “go to work” (person with briefcase), and “cook dinner” (people cooking). The child was then asked to name each event and place it on the board. If children placed it midway between the two points, they were told that they could only choose one. Each card was removed before presenting the next card. The events were presented in random order, with the requirement that no more than two items from the same category be presented in a row. The number of correct placements was recorded (Total score: range = 0-6). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Picture Book (Atance & Meltzoff, 2005). Children were shown four large color photographs, one at a time, of four "trip" destinations: a waterfall, a desert with a long road, a mountain, and a river with large flat rocks. Children were told to pretend they were going to visit the location in the picture. They were then shown three pictures of items they could choose to bring with them. Children were asked: "Which one of these do you need to bring with you to (e.g., walk close to the waterfall)?". After selecting one item to bring with them, children were asked "How come you need to bring X?". The items for each photograph were Band-Aids, fish, pillow (river); water, present, plant (desert); raincoat, rocks, money (waterfall); and lunch, bowl, grass (mountain). Children received a score of 1 for each correct item chosen (i.e., Band-Aids, water, raincoat, and lunch). The correct items were those that could address a future state (e.g., water to satisfy potential thirst). Children also received a score of 1 for each correct explanation (e.g., "because I might get thirsty"). Their explanations were coded as correct only if they contained both a future referent (e.g., gonna, might, will) and a state referent (e.g., hungry, thirsty, hurt). For each trial, scores ranged from 0 to 2 (Total score: range = 0-8). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Grocery/Beach (Hudson et al., 1995). This task assessed children's ability to discuss preparatory (planning) activities for two familiar events. After hearing a model plan for going on a picnic[3] that emphasized preparatory activities, children were asked to tell the experimenter plans for the familiar activities of going to the beach and going grocery shopping. Children's responses were coded for the number of actions generated. A response was considered an action if it contained a verb (e.g., "you swim", "you buckle your seatbelt"), or if it included an optional or conditional action (e.g., "you could buy strawberries", "you might go swimming"). Repetitions of previously mentioned actions and nonsensical unrelated information (e.g., “I like dinosaurs”) were not coded as actions. Reliability coding resulted in an interclass correlation coefficient = .98, $p < .001$, indicating significant agreement.

Tomorrow (Busby & Suddendorf, 2005). This task assessed children’s ability to report things that they “will” and “will not” do tomorrow. Children were introduced to “Scruffles,” a stuffed dog, who asked them “Can you tell me something you are going to do tomorrow?”, and “Can you tell me something you are not going to do tomorrow?”. Each question was asked twice. Children received a score of 1 for each specific event that they provided (range = 0-4). Parents, who were watching from another room, rated each response as an accurate or inaccurate account of the children’s activities. The total number of plausible events was recorded (range = 0-4). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Zoo (Modified from McColgan & McCormack, 2008). Two trials of McColgan and McCormack’s task were administered. In each trial, an apparatus depicting either a zoo or an aquarium (counterbalanced) was displayed, with five “cages” or “tanks”, and four lockers. In the first trial, there were lockers in front of the first, second, fourth, and fifth cages and, in the second trial, there were lockers in front of all cages except the second. Children were introduced to a cloth doll (“Molly” in the 1st trial, “Jake” in the 2nd), and were told that “Molly/Jake is going to the zoo/aquarium.” Children were given a brief description of a “zoo” and told that “Molly has a camera with her that she wants to bring to the zoo.” The experimenter then explained that Molly must follow the path through the zoo, and that she can only go through the zoo once. Children were asked to point to the start and end of the path (the direction of the path, left to right and right to left, was counterbalanced across participants), and were asked to name all the animals in order. Finally, children were told

"Molly wants to take a picture of the (animal) when she goes to the zoo." The animal selected was always the third animal in the first trial, and the second animal in the second trial. The actual animals in any given position varied because the placement of the animals was random. Children were asked to point to the animal selected to verify that they remembered/understood which it was, and the experimenter pointed out that there was no locker beside that animal's cage. Children were then told: "You could leave the camera in one of the other lockers and then Molly could get it when she goes to the zoo. Here is a sticker. Put this sticker on the locker that Molly should leave her camera in so she can take a picture of the (animal) when she goes to the zoo." Finally, children were asked two memory control questions to ensure that they recalled the direction Molly would travel around the path, and which animal she intended to photograph. To receive a score of 1 for each trial, children were required to place the camera in one of the lockers preceding the chosen animal's cage/tank and answer both memory questions correctly (range 0-2). Reliability coding resulted in an interclass correlation coefficient = .95, $p < .001$.

ToM Tasks

Diverse Desires (Wellman & Liu, 2004). Children were shown a toy figure of an adult, a picture of a carrot, and a picture of a cookie. The experimenter said "Here's Mr. Jones. It's snack time, so, Mr. Jones wants a snack to eat. Here are two different snacks: a carrot and a cookie." They were then asked the own desire question: "Which snack would you like best?" Whichever snack they chose, they were told that Mr. Jones preferred the opposite snack. They were then asked the target question: "So, now it's time to eat. Mr. Jones can only choose one snack, just one. Which snack will Mr. Jones choose? A carrot or a cookie?" The order in which the snacks was named was counterbalanced across participants. To receive a score of 1, children had to respond to the target question with the opposite snack from the own-desire question (Total Score: range = 0-1). Reliability coding resulted in a Cohen's kappa = .87, $p < .001$, indicating significant agreement.

Diverse Beliefs (Wellman & Liu, 2004). Children were shown a toy figure of a girl and a picture of a house with a garage and a section of bushes. They were told "Here's Linda. Linda wants to find her cat. Her cat might be hiding in the bushes, or it might be hiding in the garage." They were then asked the own-belief question: "Where do you think the cat is? In the bushes or in the garage?" Whichever location they chose, they were told that Linda thought her cat was in the other location. The target question was then asked: "So where will Linda look for her cat? In the bushes or in the garage?" The order in which the options were presented was counterbalanced across participants. To receive a score of 1, children had to answer the target question with the opposite response given to the own-belief question (Total Score: range = 0-1). Reliability coding resulted in Cohen's kappa = .94, $p < .001$.

Knowledge Access (Wellman & Liu, 2004). Children were shown a miniature wooden cupboard, and told "Here's a cupboard. What do you think is inside the cupboard?" Children could respond with any item, or by indicating that they did not know what was inside the cupboard. Next, the cupboard was opened and the child was shown the content of the cupboard: a small plush dog. The experimenter then closed the cupboard, with the dog concealed inside, and asked the check question: "Okay, what is inside the cupboard?" Children were then introduced to a toy figure of a girl, Polly, and told "Polly has never seen inside this cupboard. Now here comes Polly." They were then asked the target question, "So, does Polly know what is in the cupboard?", followed by a memory question, "Did Polly see inside the cupboard?". To receive a score of 1, the child had to answer "no" to both the target and memory questions (Total Score: range = 0-1). Reliability coding resulted in Cohen's kappa = .82, $p < .001$.

Contents False Belief (Wellman & Liu, 2004). Children were shown a clearly identifiable Band-Aid box, and asked "What do you think is inside the Band-Aid box?". Next, the Band-Aid box was opened to reveal a toy pig, and the experimenter commented "Let's see… it's really a pig inside!". The Band-Aid box was then closed and children were asked the check question: "Okay, what is in the Band-Aid box?" Children were then shown a toy figure of a boy (Peter) and were told, "Peter has never seen inside this Band-Aid box. Now here comes Peter. So, what does Peter think is inside the Band-Aid box?" If children hesitated or did not respond, they were given a forced-choice question, "Band-Aids or a pig?". Finally, they were asked the memory question: "Did Peter see inside this box?". To receive a score of 1, children had to respond correctly to both the target ("Band-Aids") and memory ("no") questions (Total Score: range = 0-1). Reliability coding resulted in a Cohen's kappa =1.0.

Change in Location False Belief (Carlson & Moses, 2001). Children were introduced to a red box and a blue box and to two character puppets: Ernie and Bert. Bert entered the scene and played with a bouncy ball. He then put the ball in one of the boxes (right or left, blue or red, counterbalanced across participants) and left to "go play outside". Ernie entered, retrieved the ball, and played with it. He then put the ball in the opposite box and left to go "outside". Bert returned and children were asked the false belief question: "Where does Bert think the ball is?" and the reality control question "Where is the ball really?". To receive a score of 1, children had to answer both the false belief and reality control questions correctly (Total score: range = 0-1). Reliability coding resulted in a Cohen's kappa =1.0.

EF Tasks

Black/White (Inhibitory Control; Simpson & Riggs, 2005). The experimenter showed the child a black card and said "This card is black right? When you see this card, I don't want you to say 'black'. No, I want you to say 'white'." The same procedure was repeated with the white card. Children were then given two practice trials in which any errors were corrected. If necessary, up to six practice trials were given until the child could correctly label both a black ("white") and a white ("black") card. The 21 test cards were then administered, at a rate of approximately one card every second, with no additional rule reminders provided. The cards were presented in a fixed, pseudorandom order, with the restriction that no more than two cards of one color be presented in a row. Accuracy (number correct out of 21) was recorded (Total score: range = 0-21). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Standard Dimensional Change Card Sort (DCCS) (Cognitive Flexibility/Set-Shifting; Zelazo, 2006, derived from Frye, Zelazo, & Palfai, 1995). Following the standard version of the DCCS, the two sorting boxes were placed in front of the children, and they were told that they were going to play a card game. The experimenter explained "This is the color game. In the color game, all the yellow ones go here (points to the tray with the yellow star affixed to the front), and all the red ones go there (points to the box with the red truck affixed to the front)". The experimenter then demonstrated by sorting a yellow truck card into the yellow star box. Children were asked to sort a red card, and were either praised or corrected for their performance. Children were then asked to sort the six test cards, a mixture of yellow trucks and red stars, in pseudo-random order, with the exception that no more than two of one type were presented in a row. Children were instructed to place them face down into the boxes. Regardless of whether they sorted correctly or not, the experimenter proceeded to the next trial without correction. Each card was labelled according to the relevant attribute as it was handed to the child, e.g., "Here is a red one. Where does this one go?". The sorted cards remained in the boxes throughout the task. The experimenter then introduced the post-switch phase, explaining "Now, we are going to play a new game. We're not going to play the color game anymore, now we are going to play the shape game." Children were then asked to sort six test cards according to the new criterion (i.e., shape), without any feedback. Again, each card was labeled with the relevant attribute as it was handed to the child (e.g., "Here is a truck. Where does this one go?"). Children's total score was the total number of correct post-switch card placements they made (Total score: range = 0-6). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Tower of Hanoi (Planning; Carlson et al., 2004). Children were presented with a small wooden structure with three pegs. Two wooden circles, referred to as "monkeys," were placed on the pegs, with the smaller one on top. The experimenter also explained the three rules: (1) the monkeys have to stay in the trees, and cannot go into the water (onto the table), (2) only one monkey can jump at a time, and (3) the larger monkey can never go on top of the smaller monkey. A rule check confirmed that children understood all the rules before the task began. The experimenter then produced an identical wooden structure, and explained that the children's monkeys were "copycat" monkeys and always wanted to look just like the experimenter's monkeys. Children were asked to copy the experimenter's pattern using the least possible number of moves. There were six levels of this task, of which the last three involved the addition of a third, smaller disk. The level of difficulty increased with each level of the task, ranging from two wooden disks and two moves to three disks and four moves required to duplicate the pattern. Children were allowed a maximum of two trials of each level and were required to pass one of the trials in order for the task to continue. Relevant rule reminders were provided when a child failed the first trial of a particular level (e.g., "Remember, only one monkey can jump at a time"). Children received a score of 0 to 6 based on the highest level they achieved (Total score: range = 0-6). Reliability coding resulted in an interclass correlation coefficient = .99, $p < .001$.

Truck Loading (Planning; Carlson et al., 2004). In this task, children played the role of a mail carrier, with the task of delivering five color-coded "party invitations" to five matching miniature houses on a miniature street. Children were asked to deliver the "party invitations" to the houses while following the four rules: (1) the street is a one-way street, so the delivery truck can only drive in one direction, (2) the invitations need to be delivered as quickly as possible, so the truck can only drive around the street once, (3) the color of the invitation has to match the color of the house, and (4) the invitations have to be taken off the top of the pile in the back of the truck. Following the warm up, there were four possible levels of the task, ranging from two to five houses. Children were given a maximum of two trials of each level, with relevant rule reminders given for the first failed trial of a particular level (e.g., "Remember, you can only take a letter off the top of the truck"). Self-corrections were allowed only during the loading stage; if they occurred after the child began "driving" the truck, then the trial was scored as a failure. Children received a score of 1 for each level if they correctly loaded the letters into the truck in reverse order. Scores ranged from 0 to 4, corresponding to the highest level achieved (Total score: range = 0-4). Reliability coding resulted in an interclass correlation coefficient = .96, $p < .001$.

Word Fluency (Generativity; Turner, 1999). To make this task sufficiently engaging for children, we used a stuffed dog, "Scruffles," to ask children the generativity questions. The experimenter explained that Scruffles was very curious and wanted to know all the animal names they knew. The experimenter then asked children to tell Scruffles as many animal names as they could think of, as fast as they could. After 30 seconds, the experimenter proceeded to the next trial, in which children were asked to name as many foods as they could in 30 seconds. The score reflected the number of novel animal names and foods generated within the time limits. Repetitions of previously mentioned animals or foods or vague categories, such as "snacks," were not included in the score, nor were any foods or animal names mentioned outside of the 30 seconds. (Total score = total number of items generated in both categories: range = 0-18). Reliability coding resulted in an interclass correlation coefficient = .99, $p < .001$.

Backward Digit Span (Working Memory; Carlson, 2005, derived from Davis & Pratt, 1995). Children were introduced to a doll named Jenny and were told that Jenny says everything the experimenter says, but says it backwards. The experimenter then demonstrated, saying "5-8", and making Jenny say "8-5". Children were given two practice trials with feedback, followed by two test trials each with an increasing number of digits, beginning with two digits. The task ended when children erred on both trials of a given level. Children were awarded a score of 1 for each successful trial (Total score – range = 0-5). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Count/Label (Working Memory; Carlson, 2005). In this task, the experimenter showed children three small, 2D wooden objects (e.g., a boat, an apple, and a bird) and children watched while the experimenter labeled them ("boat, apple, bird"). The experimenter then counted the objects out loud ("one, two, three"). Finally, she counted and labeled them each in turn (e.g., "one is a boat, two is an apple, and three is a bird"). Children were then asked to complete all three steps in two test trials using different objects. Children's ability to correctly count and label was awarded a score of 1 for each trial (Total score – range = 0-2). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Episodic Foresight in Autism Spectrum Disorder

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Abstract

Episodic foresight (EpF) or, the ability to imagine the future and use such imagination to guide our actions, is an important aspect of cognition that has not yet been explored in autism. This is despite its proposed links with theory of mind (ToM) and executive function (EF), two areas found to be impaired in autism. Twenty-five children with autism spectrum disorder (ASD) (M = 5 years, 10 months; 22 male) and 25 mental-age-matched typically developing children (M = 4 years, 10 months; 22 male) completed a series of EpF, ToM, and EF tasks. Significant group differences were detected on several EpF tasks suggesting that children with ASD show impairments in thinking about their future selves.

Keywords: Autism, episodic foresight, future thinking, theory of mind, executive function.

Episodic Foresight in Autism Spectrum Disorder

Thinking about the future allows us to anticipate possibilities, plan ahead, and control aspects of our environments and our relationships with others (Suddendorf & Corballis, 2007). Future-directed processes, such as anticipation and prospection, and future-directed behaviors, such as planning and delay of gratification, allow us to act in the present in anticipation of a need or state that will only be experienced in the future. Suddendorf and Moore (2011) recently proposed the term "episodic foresight" (EpF) to describe the ability to "imagine future scenarios and use such imagination to guide current action" (p. 296), and researchers have emphasized that a critical aspect of EpF is the mental projection of the self into the future (Atance & O'Neill, 2001; Hudson, Mayhew, & Prabhakar, 2011; Suddendorf & Corballis, 2007). There is evidence that EpF improves dramatically between ages 3 and 5 in typically-developing children (TDC) (Atance & Meltzoff, 2005; Busby Grant & Suddendorf, 2009; Busby & Suddendorf, 2005; Hudson, Shapiro, & Sosa, 1995; McColgan & McCormack, 2008).

In addition, researchers have argued that EpF may be related to other cognitive abilities that develop during the preschool years, most notably theory of mind (ToM) and executive function (EF) (Atance & Jackson, 2009; Atance & Meltzoff, 2005; Atance & O'Neill, 2001; Buckner & Carroll, 2007; Moore, Barresi, & Thompson, 1998; Russell, Cheke, Clayton, & Meltzoff, 2011; Spreng, Mar, & Kim, 2009; Suddendorf & Corballis, 1997; 2007). For example, Buckner and Carroll (2007) argue that both EpF and ToM require that individuals consider a perspective that differs from their own – a more global ability that they term "self-projection." Thinking about the future also requires perspective shifts between the present and the future (Buckner & Carroll). Both the capacities to keep track of these shifts in perspective and to imagine a future state that may conflict with a present state conceivably draw on EF ability (Suddendorf & Corballis, 2007).

The linkages between EpF, ToM and EF are especially important to consider with respect to children with autism spectrum disorder (ASD) given that ToM and EF are areas in which these children have well-documented deficits (Baron-Cohen, Leslie, & Frith, 1985; Hill, 2004; Hughes, Russell, & Robbins, 1994; Pellicano, 2007; Peterson, Wellman, & Liu, 2005). In addition, a critical aspect of EpF is the mental projection of the self into the future, and knowledge and understanding of the self has been found to be deficient in ASD (Lind & Bowler, 2008; Mitchell & O'Keefe, 2008). Together, these deficits in ToM, EF, and self-knowledge have led some researchers to suggest that children with ASD may have difficulty mentally projecting the self into the future, or engaging in EpF (Atance & Jackson, 2009; Suddendorf & Corballis, 1997).

Children with ASD also demonstrate behaviours that might suggest a deficit in EpF. For example, these children often demonstrate excessive dependence on repetitive and stereotyped behaviours and lack the behavioural flexibility seen in typical development (American Psychiatric Association, (APA), 2000). It is possible that such inflexibility stems from underlying difficulties with EpF (Suddendorf & Corballis, 1997). Interestingly, some patients with traumatic injuries to parts of the brain also affected by autism are described as having an inability to think about the future and show behavioural similarities to children with ASD. Specifically, these patients demonstrate impaired self-regulation, and their behaviour tends to be driven either by generic, learned rules about how one should behave or by irrelevant environmental goals, rather than by specific goals and intentions relating to their identity and future selves. As a result, they often demonstrate inappropriate habits or routines (Klein & Loftus, 2002; Levine et al., 1998; Tulving, 1985). As such, it is possible that the stereotyped and inflexible behavior and difficulties with planning in children with ASD may reflect an inability to mentally project into the future (Suddendorf & Corballis, 1997).

In sum, there are several reasons to hypothesize that children with ASD are impaired in their capacity for EpF. However, this hypothesis has not been explored until recently. Notably, Jackson and Atance (2008) found that children with ASD performed more poorly on two tasks that required them to make a prediction about the future self (e.g., deciding what part of an “ant costume” to put on first, with the order restricted by the shape of the costume) than on two tasks that required predictions about physical transformations (e.g., selecting which size of ball to roll down a tunnel that changes in diameter from large to small). In fact, children with ASD performed better on the physical transformation tasks than verbal mental age matched TDC. This suggests that children with ASD may be capable of engaging in certain forms of future thinking, but that their ability to do so depends on the specific demands of the task; most notably, the extent to which mentally projecting the *self* into the future is required, or EpF.

In the current study we expand on Jackson and Atance (2008) by administering to children with ASD and TDC a series of tasks that can all be conceived as measuring EpF. Because children with ASD have well-documented deficits in ToM, EF, and self-knowledge – all skills that may be required for EpF - we hypothesize that they will also have difficulty with tasks that measure EpF and will perform worse on these tasks than a group of TDC. We also administer a battery of ToM and EF tasks to assess whether deficits in these abilities might accompany deficits in EpF in children with ASD.

Method

Participants

Test Group - Children with ASD

Participants were 25 children between the ages of 3 years, 2 months and 8 years, 3 months (*M* = 5 years, 10 months; 22 male) with a diagnosis of ASD. Several additional children were recruited, but could not be included in the study due to severity of autism/language delay (n = 7), or failure to return for session 2 due to illness (n = 3). Children were recruited by telephoning parents who responded to print and online advertisements. The sample was predominantly Caucasian (*n* = 24), from middle-class families (*n* = 25) and had highly-educated parents (*n* = 21; college diploma or other post-secondary).

Diagnostic Confirmation. To confirm that the test and control groups were developmentally distinct, ASD diagnoses were verified in several ways. First, parents were asked to confirm their child's diagnosis on a history questionnaire. Parents were then asked to provide a copy of their child's diagnostic report, if it was readily available (n = 21). Each report was reviewed to confirm that the diagnosis was consistent with the criteria outlined in the Diagnostic and Statistical Manual of Mental Disorders (4^{th} ed: DSM-IV-TR, APA, 2000). In addition, the first author completed the Childhood Autism Rating Scale – Second Edition (CARS-II; Schopler, Van Bourgondien, Wellman, & Love, 2010), a 15-item behavior rating scale that is suitable for use with children older than 2, and helps to distinguish children with ASD from children with other disorders and from TDC. These ratings were also supplemented with a parent questionnaire, a component of the CARS-II. Report review indicated that 13 children had a diagnosis of Autism, Autistic disorder, or ASD, 1 Asperger's Disorder, and 7 PDD-NOS. The reports of the 4 additional children could not be reviewed directly, but their parents reported a diagnosis of ASD, and their CARS-II scores fell above the clinical cut-off for ASD. One child had an additional diagnosis of Attention Deficit/Hyperactivity Disorder.

Control Group - Typically-Developing Children

Twenty-five TDC were drawn from a larger sample of preschool children (*M* = 4 years, 10 months; 22 male) who participated in a study (Hanson, Atance, & Paluck, 2013) that examined the relation between EpF, ToM and EF. Children with language or other developmental delays, or health problems that would impair their ability to participate in the study were excluded. The sample was similar to the autism group in terms of demographic variables.

Children with ASD and TDC were matched pairwise on sex and mental age (as determined by age equivalence scores on the General Language Composite [GLC] of the Wechsler Preschool and Primary Scale of Intelligence – Third Edition [WPPSI-III], Wechsler, 2002).

Procedure

Children were tested individually in two videotaped sessions, each lasting approximately 1 hour, and scheduled no more than one month apart. Children were given ample time to adjust to their environment and the experimenter (a clinical psychology graduate student with extensive experience working with children with ASD). Parents observed the sessions on a television screen in an adjacent room. Either a small gift for children or $25 cash was provided after each session.

Measures

Cognitive Functioning. During the first session children completed the WPPSI-III (Wechsler, 2002). In this study, we refer primarily to the GLC score, made up of the

Receptive Vocabulary (RV) and Picture Naming (PN; expressive vocabulary) subtests, as a proxy for children's linguistic development.

EpF, ToM, and EF tasks. During the second session, children completed a total of five EpF tasks, five ToM tasks, and seven EF tasks (see Table 1 and Appendix). All tasks were administered in a block-randomized order.

Results

Preliminary Data Analysis

Due to the exploratory nature of this study and to minimize the chance of Type II error, we retained an alpha level of $p < .05$. Paired-samples *t*-tests were conducted to confirm that the TDC and ASD groups were closely matched on age equivalence on the GLC, $t(23) = .589$, $p = .562$. Significant group differences on chronological age $t(24) = -4.181$, $p < .001$, and Full Scale IQ (normed on chronological age) were found $t(16) = 4.88$, $p < .001$ (see Table 2), which is not surprising given the nature of intellectual deficits in many cases of ASD. However, groups were well matched on age equivalence of the FSIQ, $t(21) = - 0.15$, $p = .88$.

Group Differences on EpF, ToM, and EF Tasks

TDC performed significantly better than children with ASD on two ToM tasks, Knowledge Access, $t(23) = 2.304$, $p = .031$, and Change in Location, $t(24) = 2.551$, $p = .018$, and the EF task Black/White, $t(23) = 2.657$, $p = .014$. Although group differences on other tasks were not significant, they were in the expected direction (TDC > ASD; apart from the Diverse Beliefs and Truck tasks), and the failure to detect significant differences was likely because of insufficient power due to the small sample size and small effect sizes (see Table 3). TDC also performed significantly better than children with ASD on the following EpF tasks: Picture Book Trip, $t(24) = 3.098$, $p = .005$, and Grocery/Beach task, $t(22) = 2.171$, $p =$

.041. A marginally significant group difference also emerged on the Sequencing task, $t(23) = 2.004$, $p = .057$ (see Table 3).

Pattern of EpF Impairments in children with ASD

To further analyze the nature of the EpF deficits in children with ASD, we created an EpF composite score, made up of an average of all five EpF tasks (after first averaging each task so that they all fell on the same scale). The same procedure was used to create EF and ToM composite scores. We then compared the characteristics of children with ASD who had relatively intact EpF ability (i.e., fell above the median on the EpF composite score) with those who fell below the median. Due to the small sample size, non-parametric tests (Mann-Whitney *U*) were used to compare the groups. The two groups differed significantly in terms of language, as measured by their scores on the GLC and its subtests, and chronological age. They did not however show significant differences in terms of Full Scale IQ or autistic symptoms (as measured by their CARS-II scores). Finally, the groups differed significantly on both ToM and EF composite scores, with lower EpF scores corresponding with lower ToM and EF scores (see Table 4).

Discussion

Researchers have hypothesized that children with ASD have deficits in their ability to imagine themselves in the future or what has been termed “episodic foresight” (Jackson & Atance, 2008; Suddendorf & Corballis, 1997). However, with the exception of one study by Jackson and Atance (2008) that found that children with ASD performed worse than TDC on future thinking tasks related to the self, this hypothesis has not been systematically tested. In this study, using a battery of EpF tasks, we found that children with ASD performed worse than TDC on the Picture Book Trip, Grocery/Beach, and Sequencing tasks, but not on the Zoo and Tomorrow tasks. Given these findings, an important issue to address is why children with ASD showed deficits on only some of the EpF tasks. It is possible that the focus on the self is the aspect of EpF that causes children with ASD the most difficulty; a finding that is consistent with Jackson and Atance (2008). And, indeed, the Picture Book Trip, Grocery Beach, and Sequencing tasks were all specifically developed to assess children's ability to think flexibly about themselves in the future.

In contrast, children with ASD did not perform worse than TDC on the Zoo and Tomorrow tasks. The Zoo task appears to be very difficult for all but the oldest preschoolers (McColgan & McCormack, 2008). Indeed, neither the TDC nor the children with ASD solved more than one of two trials, which may have rendered it difficult to detect significant differences in performance between these two groups. In addition, this task requires children to imagine the future perspective of another person (the character in the zoo), rather than their own future perspective, which may fundamentally change the episodic nature of the task. As for the Tomorrow task, children with ASD performed nearly as well as TDC. This may be because talking about what one will be doing tomorrow is a skill that is specifically targeted in intervention programs for autism (children with ASD are taught to answer this question in Intensive Behavioral Intervention programs; Carbone, 2004). Alternatively, children with ASD might pass this task by simply reciting what usually does/does not happen tomorrow, therefore drawing on their strengths of knowing and following routines.

Finally, we explored the characteristics of two groups of children with ASD – those with relatively intact EpF skills (passed at least 3 of the EpF tasks) versus those who failed the majority of the EpF tasks. The main differences between these two groups were language ability and chronological age, not overall IQ or autistic symptomatology, suggesting that EpF ability, as measured by these tasks, at least in autism, may be highly dependent on language. In addition, the group of children with ASD with weaker EpF skills also had weaker ToM and EF skills, suggesting that EpF may in fact be related to ToM and EF ability in children with ASD; though this finding will need to be replicated in future studies where the sample is sufficiently large to conduct correlational and regression analyses.

Some significant differences between TDC and children with ASD (e.g., ToM and EF) found in previous research did not emerge in our study. This was likely due to our relatively small sample size and instances of insufficient power. Despite this, significant group differences emerged on several of the EpF tasks, suggesting that these tasks may be particularly sensitive measures of deficits in autism. However, these findings will need to be replicated with a larger sample and also using a test (e.g., Bonferroni) that corrects for multiple comparisons. Finally, our groups were relatively diverse and thus future studies should also strive to recruit groups that are matched more closely on chronological age and full-scale IQ. Despite these limitations, our study is an important starting point in determining whether deficits in EpF are present in children with ASD. Additional steps include further delineating children with ASD's strengths and weaknesses in EpF (and potential links to ToM and EF) by using the tasks in this study, along with ones developed more recently that specifically assess children's ability to plan for a future need (Russell, Alexis, & Clayton, 2010; Suddendorf, Nielsen, & von Gehlen, 2011). In addition, EpF overlaps considerably with episodic memory in TDC (Busby & Suddendorf, 2005), and studies have documented episodic memory deficits in ASD (Bruck, London, Landa, & Goodman, 2007; Crane, Goddard, & Pring, 2011). Testing the relation between EpF and episodic memory in ASD is an important direction for future research. Finally, linking EpF deficits to specific autistic symptoms, such as repetitive behaviors, could enhance the clinical significance of this research.

By increasing our understanding of the precise cognitive deficits that impede children with ASD's ability to interact with others, learn language, and successfully manage the demands of everyday life, we will be better able to target these deficits in interventions. Researchers and clinicians now recognize the importance of early intervention in ASD treatment, and given that EpF seems to develop significantly during the preschool years, it may prove an important target for intervention and certainly an important avenue for future research.

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Table 1

Task Descriptions

Task	Description
Episodic Foresight Tasks	
Sequencing (Busby Grant & Suddendorf, 2009)	Child judges the temporal distance of short- and long-term future life events (e.g., getting married, playing at the park).
Picture Book (Atance & Meltzoff, 2005)	Child selects items for imaginary trips to four novel locations (e.g., the desert).
Grocery/Beach (Hudson et al., 1995)	Child reports verbal plans for going to the grocery store and the beach.
Tomorrow (Busby & Suddendorf, 2005)	Child explains what they will and will not be doing tomorrow.
Zoo (McColgan & McCormack, 2008)	Child plans where to place a toy camera in zoo set-up, making inferences using temporal order information.
ToM Tasks	
Diverse Desires (Wellman & Liu, 2004)	Child chooses a "snack" for someone whose preference is stated to be opposite of that of the child's.
Diverse Beliefs (Wellman & Liu, 2004)	Child indicates where a character will search for her cat, after finding out that the character's belief is the opposite of the child's own belief.
Knowledge Access (Wellman & Liu, 2004)	Child sees inside a cupboard, which contains a stuffed dog, then is asked whether a character, who has not seen inside the cupboard, knows what is inside.
Contents False Belief (Wellman & Liu, 2004)	The true contents of a Band-Aid box (a pig) are revealed to the child, who is then asked what a naïve character will think is in the box.
Change in Location (Carlson & Moses, 2001)	A classic "Sally-Anne" task, where the child must assess a character's false belief.
EF Tasks	
Black/White (Simpson & Riggs, 2005)	Child is instructed to say "white" when presented with a black card, and "black" when presented with a white card.
Dimensional Change Card Sort (DCCS) (Zelazo, 2006)	Child learns to sort cards by color, and then is told to sort by a new dimension, shape.
Tower of Hanoi (Carlson, Moses, & Claxton, 2004)	Child must copy the experimenter's pattern in a classic tower task, while following several rules, including the rule that larger disks cannot be placed on top of smaller disks.
Truck Loading (Carlson et al., 2004)	Child must deliver "letters" to house on a pretend street, while respecting the rule that the letters must be loaded into a toy truck so that the first house's letter is placed in the truck last (so as to be on the top of the pile).
Fluency (Turner, 1999)	Child must generate as many animal names, then as many different food names, as possible in 30 seconds.
Backward Digit Span (Carlson, 2005)	Child is asked to repeat a series of numerical digits, in reverse order, beginning with sequences of 2 digits.
Count/Label (Carlson, 2005)	Child is instructed to first label (dog, car, tree), then count (1, 2, 3), and finally count and label objects at the same time (1 is a dog…)

Table 2

Means (M), Standard Deviations (SD), and Ranges for Test Scores

	Children with ASD (n = 25)			TDC (n = 25)			
Variable	*M*	*SD*	Range	*M*	*SD*	Range	
Chronological age	70.36	17.88	38-99	58.28	11.21	37-71	$t(24) = -4.18$, $p < .001$
FSIQ	85.71	21.00	42-121	109.12	8.03	97-128	$t(16) = 4.88$, $p < .001$
FSIQ age	62.05	13.38	35-80	61.44	10.32	39-78	$t(21) = -0.15$, $p < .88$
RV age	62.72	11.50	40-87	64.64	13.27	37-87	$t(24) = 1.02$, $p = .32$
PN age	62.17	17.10	31-87	59.80	15.72	34-87	$t(23) = -0.75$, $p = .46$
GLC age	62.92	12.31	40-87	62.22	12.98	39-87	$t(23) = 0.59$, $p = .56$
CARS-II score	30.34	3.11	23-39	16.54	1.89	15-23	$t(24) = -18.03$, $p < .001$

Note. All age variables are presented in months. FSIQ = Full Scale Intelligence Quotient, FSIQ age = Full Scale Intelligence Quotient age equivalent score, RV = Receptive Vocabulary, PN = Picture Naming, GLC = General Language Composite, CARS-II = Childhood Autism Rating Scale, 2nd Edition. The *n*s for individual tasks differed due to missing data.

Table 3

Mean Scores on Episodic Foresight, ToM, and EF Tasks

	ASD		TDC			Effect Size
	M	*SD*	*M*	*SD*		Cohen's D
Episodic foresight						
Picture Book Trip (range = 0-8)	3.64	2.56	5.20	2.00	$t(24) = 3.10, p = .005$	$d = 0.68$
Tomorrow (range = 0-4)	1.84	1.40	2.08	1.26	$t(24) = 0.54, p = .59$	$d = 0.18$
Grocery/Beach (range = 0-15)	5.13	3.60	7.35	3.45	$t(22) = 2.17, p = .04$	$d = 0.63$
Zoo (range = 0-2)	.57	.59	.65	.65	$t(22) = 0.53, p = .60$	$d = 0.13$
Sequencing (range = 0-6)	4.25	1.26	4.96	.96	$t(23) = 2.00, p = .06$	$d = 0.63$
Theory of mind						
Diverse Desires (range = 0-1)	.67	.48	.88	.34	$t(23) = 1.74, p = .10$	$d = 0.50$
Diverse Beliefs (range = 0-1)	.72	.46	.60	.50	$t(24) = -1.00, p = .33$	$d = 0.25$
Knowledge Access (range = 0-1)	.63	.49	.88	.34	$t(23) = 2.30, p = .03$	$d = 0.59$
Contents False Belief (range = 0-1)	.42	.50	.58	.50	$t(23) = 1.28, p = .21$	$d = 0.32$
Change in Location (range = 0-1)	.32	.48	.64	.49	$t(24) = 2.55, p = .02$	$d = 0.66$
Executive function						
Black/White (range = 0-21)	10.13	7.16	15.63	5.36	$t(23) = 2.66, p = .01$	$d = 0.87$
DCCS (range = 0-6)	4.48	2.45	5.13	2.05	$t(22) = 1.01, p = .33$	$d = 0.29$
TOH (range = 0-6)	2.21	2.08	2.79	1.96	$t(23) = 1.04, p = .31$	$d = 0.29$
Truck (range = 0-4)	2.96	1.51	2.80	1.53	$t(24) = -0.53, p = .60$	$d = 0.11$
Fluency (range = 0-18)	7.79	5.63	8.33	4.46	$t(23) = 0.56, p = .58$	$d = 0.11$
BKWD (range = 0-6)	1.80	1.96	2.00	1.32	$t(24) = 0.61, p = .55$	$d = 0.12$
Count/Label (range = 0-2)	1.29	0.91	1.46	0.88	$t(23) = 0.85, p = .41$	$d = 0.19$

Note. The *n*s for individual tasks differed due to missing data. DCCS = Dimensional Change Card Sort, TOH = Tower of Hanoi, BKWD = Backward Digit Span.

Table 4

Strong Versus Weak Episodic Foresight Group Comparisons

	Weak n = 11		Strong n = 11		
	M	*SD*	*M*	*SD*	Mann-Whitney *U*
Gender	-	-	-	-	$z = -0.61$, $p = .54$
Chronological age	59.57	14.84	74.42	7.61	$z = -2.60$, $p = .01$
GLC age	57.85	10.21	65.93	7.45	$z = -2.54$, $p = .01$
PN age	53.71	13.62	65.43	16.25	$z = -2.17$, $p = .03$
RV age	62.00	9.00	66.43	7.41	$z = -2.00$, $p = .05$
FSIQ	89.29	26.66	87.14	11.10	$z = -0.45$, $p = .65$
CARS-II score	29.57	3.32	30.29	1.44	$z = -1.32$, $p = .19$
ToM Composite	.46	.15	.70	.19	$z = -2.45$, $p = .02$[a]
EF Composite	.43	.30	.72	.09	$z = -2.13$, $p = .03$[b]

Note. All age variables are presented in months. GLC = General Language Composite, PN = Picture Naming, RV = Receptive Vocabulary, FSIQ = Full Scale IQ, CARS-II = Childhood Autism Rating Scale, 2nd Edition. Due to missing data, superscript (a) denotes a comparison with $n = 10$ (weak) and $n = 11$ (strong), while the comparison marked with superscript (b) denotes a comparison with $n = 8$ (weak) and $n = 10$ (strong).

Appendix

Episodic Foresight Tasks

Sequencing (modified from Busby Grant & Suddendorf, 2009). Children were shown a timeline, which consisted of a colored board with two Velcro pieces placed at either end of the timeline. Children were told that they were going to play a game involving "how long until things happen in the future." At one end of the timeline was a small black and white figure depicting a child-size person, and at the other end was a larger black and white figure, depicting an adult (although Busby Grant and Suddendorf's task included 3 time points, our pilot testing revealed that this was too complex for 3 year-olds; thus, only two time points were retained). The experimenter explained the timeline to the child ("this is a picture of a person as big as you, a 3/4/5-year-old, just like you are right now. We will put things here that are going to happen in a little time, like how big you are right now"). The experimenter also explained to children that they were to place items next to the appropriately-sized person. There were six target events, three for each of the two differently-sized people. For the child-sized person, these included "going home" (house), "having dinner" (plate with food), and "playing at the park" (playground)/"playing in the snow" (snowman; for use during winter testing). For the adult-sized person, these included "get married" (bride and groom), "go to work" (person with briefcase), and "cook dinner" (people cooking). The child was then asked to name each event and place it on the board. If children placed it midway between the two points, they were told that they could only choose one. Each card was removed before presenting the next card. The events were presented in random order, with the requirement that no more than two items from the same category be presented in a row. The number of correct placements was recorded (Total score: range = 0-6). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Picture Book (Atance & Meltzoff, 2005). Children were shown four large color photographs, one at a time, of four "trip" destinations: a waterfall, a desert with a long road, a mountain, and a river with large flat rocks. Children were told to pretend they were going to visit the location in the picture. They were then shown three pictures of items they could choose to bring with them. Children were asked: "Which one of these do you need to bring with you to (e.g., walk close to the waterfall)?". After selecting one item to bring with them, children were asked "How come you need to bring X?". The items for each photograph were Band-Aids, fish, pillow (river); water, present, plant (desert); raincoat, rocks, money (waterfall); and lunch, bowl, grass (mountain). Children received a score of 1 for each correct item chosen (i.e., Band-Aids, water, raincoat, and lunch). The correct items were those that could address a future state (e.g., water to satisfy potential thirst). Children also received a score of 1 for each correct explanation (e.g., "because I might get thirsty"). Their explanations were coded as correct only if they contained both a future referent (e.g., gonna, might, will) and a state referent (e.g., hungry, thirsty, hurt). For each trial, scores ranged from 0 to 2 (Total score: range = 0-8). Reliability coding resulted in an interclass correlation coefficient = .97, $p < .001$, indicating significant agreement.

Grocery/Beach (Hudson et al., 1995). This task assessed children's ability to discuss preparatory (planning) activities for two familiar events. After hearing a model plan for going on a picnic that emphasized preparatory activities, children were asked to tell the experimenter plans for the familiar activities of going to the beach and going grocery shopping. Children's responses were coded for the number of actions generated. A response was considered an action if it contained a verb (e.g., "you swim", "you buckle your seatbelt"), or if it included an optional or conditional action (e.g., "you could buy strawberries", "you might go swimming"). Repetitions of previously mentioned actions and nonsensical unrelated information (e.g., "I like dinosaurs") were not coded as actions. Reliability coding resulted in an interclass correlation coefficient = .98, $p < .001$, indicating significant agreement.

Tomorrow (Busby & Suddendorf, 2005). This task assessed children's ability to report things that they "will" and "will not" do tomorrow. Children were introduced to "Scruffles," a stuffed dog, who asked them "Can you tell me something you are going to do tomorrow?", and "Can you tell me something you are not going to do tomorrow?". Each question was asked twice. Children received a score of 1 for each specific event that they provided (range = 0-4). Parents, who were watching from another room, rated each response as an accurate or inaccurate account of the children's activities. The total number of plausible events was recorded (range = 0-4). Reliability coding resulted in an interclass correlation coefficient = .93, $p < .011$, indicating significant agreement.

Zoo (Modified from McColgan & McCormack, 2008). Two trials of McColgan and McCormack's task were administered. In each trial, an apparatus depicting either a zoo or an aquarium (counterbalanced) was displayed, with five "cages" or "tanks", and four lockers. In the first trial, there were lockers in front of the first, second, fourth, and fifth cages and, in the second trial, there were lockers in front of all cages except the second. Children were introduced to a cloth doll ("Molly" in the 1st trial, "Jake" in the 2nd), and were told that "Molly/Jake is going to the zoo/aquarium." Children were given a brief description of a "zoo" and told that "Molly has a camera with her that she wants to bring to the zoo." The experimenter then explained that Molly must follow the path through the zoo, and that she can only go through the zoo once. Children were asked to point to the start and end of the path (the direction of the path, left to right and right to left, was counterbalanced across participants), and were asked to name all the animals in order. Finally, children were told

"Molly wants to take a picture of the (animal) when she goes to the zoo." The animal selected was always the third animal in the first trial, and the second animal in the second trial. The actual animals in any given position varied because the placement of the animals was random. Children were asked to point to the animal selected to verify that they remembered/understood which it was, and the experimenter pointed out that there was no locker beside that animal's cage. Children were then told: "You could leave the camera in one of the other lockers and then Molly could get it when she goes to the zoo. Here is a sticker. Put this sticker on the locker that Molly should leave her camera in so she can take a picture of the (animal) when she goes to the zoo." Finally, children were asked two memory control questions to ensure that they recalled the direction Molly would travel around the path, and which animal she intended to photograph. To receive a score of 1 for each trial, children were required to place the camera in one of the lockers preceding the chosen animal's cage/tank and answer both memory questions correctly (range 0-2). Reliability coding resulted in an interclass correlation coefficient = 1.0.

ToM Tasks

Diverse Desires (Wellman & Liu, 2004). Children were shown a toy figure of an adult, a picture of a carrot, and a picture of a cookie. The experimenter said "Here's Mr. Jones. It's snack time, so, Mr. Jones wants a snack to eat. Here are two different snacks: a carrot and a cookie." They were then asked the own desire question: "Which snack would you like best?" Whichever snack they chose, they were told that Mr. Jones preferred the opposite snack. They were then asked the target question: "So, now it's time to eat. Mr. Jones can only choose one snack, just one. Which snack will Mr. Jones choose? A carrot or a cookie?" The order in which the snacks were named was counterbalanced across participants. To receive a score of 1, children had to respond to the target question with the opposite snack from the own-desire question (Total Score: range = 0-1). Reliability coding resulted in a Cohen's kappa = 1.0.

Diverse Beliefs (Wellman & Liu, 2004). Children were shown a toy figure of a girl and a picture of a house with a garage and a section of bushes. They were told, "Here's Linda. Linda wants to find her cat. Her cat might be hiding in the bushes, or it might be hiding in the garage." They were then asked the own-belief question: "Where do you think the cat is? In the bushes or in the garage?" Whichever location they chose, they were told that Linda thought her cat was in the other location. The target question was then asked: "So where will Linda look for her cat? In the bushes or in the garage?" The order in which the options were presented was counterbalanced across participants. To receive a score of 1, children had to answer the target question with the opposite response given to the own-belief question (Total Score: range = 0-1). Reliability coding resulted in Cohen's kappa = 1.0.

Knowledge Access (Wellman & Liu, 2004). Children were shown a miniature wooden cupboard, and told, "Here's a cupboard. What do you think is inside the cupboard?" Children could respond with any item, or by indicating that they did not know what was inside the cupboard. Next, the cupboard was opened and the child was shown the content of the cupboard: a small plush dog. The experimenter then closed the cupboard, with the dog concealed inside, and asked the check question: "Okay, what is inside the cupboard?" Children were then introduced to a toy figure of a girl, Polly, and told "Polly has never seen inside this cupboard. Now here comes Polly." They were then asked the target question, "So, does Polly know what is in the cupboard?", followed by a memory question, "Did Polly see inside the cupboard?". To receive a score of 1, the child had to answer "no" to both the target and memory questions (Total Score: range = 0-1). Reliability coding resulted in Cohen's kappa = 1.0.

Contents False Belief (Wellman & Liu, 2004). Children were shown a clearly identifiable Band-Aid box, and asked "What do you think is inside the Band-Aid box?". Next, the Band-Aid box was opened to reveal a toy pig, and the experimenter commented "Let's see… it's really a pig inside!". The Band-Aid box was then closed and children were asked the check question: "Okay, what is in the Band-Aid box?" Children were then shown a toy figure of a boy (Peter) and were told, "Peter has never seen inside this Band-Aid box. Now here comes Peter. So, what does Peter think is inside the Band-Aid box?" If children hesitated or did not respond, they were given a forced-choice question, "Band-Aids or a pig?". Finally, they were asked the memory question: "Did Peter see inside this box?". To receive a score of 1, children had to respond correctly to both the target ("Band-Aids") and memory ("no") questions (Total Score: range = 0-1). Reliability coding resulted in a Cohen's kappa = 1.0.

Change in Location False Belief (Carlson & Moses, 2001). Children were introduced to a red box and a blue box and to two character puppets: Ernie and Bert. Bert entered the scene and played with a bouncy ball. He then put the ball in one of the boxes (right or left, blue or red, counterbalanced across participants) and left to "go play outside". Ernie entered, retrieved the ball, and played with it. He then put the ball in the opposite box and left to go "outside". Bert returned and children were asked the false belief question: "Where does Bert think the ball is?" and the reality control question "Where is the ball really?". To receive a score of 1, children had to answer both the false belief and reality control questions correctly (Total score: range = 0-1). Reliability coding resulted in a Cohen's kappa =1.0.

EF Tasks

Black/White (Inhibitory Control; Simpson & Riggs, 2005). The experimenter showed the child a black card and said, "This card is black right? When you see this card, I don't want you to say 'black'. No, I want you to say 'white'." The same procedure was repeated with the white card. Children were then given two practice trials in which any errors were corrected. If necessary, up to six practice trials were given until the child could correctly label both a black ("white") and a white ("black") card. The 21 test cards were then administered, at a rate of approximately one card every second, with no additional rule reminders provided. The cards were presented in a fixed, pseudorandom order, with the restriction that no more than two cards of one color were presented in a row. Accuracy (number correct out of 21) was recorded (Total score: range = 0-21). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Standard Dimensional Change Card Sort (DCCS) (Cognitive Flexibility/Set-Shifting; Zelazo, 2006). Following the standard version of the DCCS, the two sorting boxes were placed in front of the children, and they were told that they were going to play a card game. The experimenter explained, "This is the color game. In the color game, all the yellow ones go here (points to the tray with the yellow star affixed to the front), and all the red ones go there (points to the box with the red truck affixed to the front)". The experimenter then demonstrated by sorting a yellow truck card into the yellow star box. Children were asked to sort a red card, and were either praised or corrected for their performance. Children were then asked to sort the six test cards, a mixture of yellow trucks and red stars, in pseudo-random order, with the exception that no more than two of one type were presented in a row. Children were instructed to place them face down into the boxes. Regardless of whether they sorted correctly or not, the experimenter proceeded to the next trial without correction. Each card was labeled according to the relevant attribute as it was handed to the child, e.g., "Here is a red one. Where does this one go?". The sorted cards remained in the boxes throughout the task. The experimenter then introduced the post-switch phase, explaining, "Now, we are going to play a new game. We're not going to play the color game anymore, now we are going to play the shape game." Children were then asked to sort six test cards according to the new criterion (i.e., shape), without any feedback. Again, each card was labeled with the relevant attribute as it was handed to the child (e.g., "Here is a truck. Where does this one go?"). Children's total score was the total number of correct post-switch card placements they made (Total score: range = 0-6). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Tower of Hanoi (Planning; Carlson et al., 2004). Children were presented with a small wooden structure with three pegs. Two wooden circles, referred to as "monkeys," were placed on the pegs, with the smaller one on top. The experimenter also explained the three rules: (1) the monkeys have to stay in the trees, and cannot go into the water (onto the table), (2) only one monkey can jump at a time, and (3) the larger monkey can never go on top of the smaller monkey. A rule check confirmed that children understood all the rules before the task began. The experimenter then produced an identical wooden structure, and explained that the children's monkeys were "copycat" monkeys and always wanted to look just like the experimenter's monkeys. Children were asked to copy the experimenter's pattern using the least possible number of moves. There were six levels of this task, of which the last three involved the addition of a third, smaller disk. The level of difficulty increased with each level of the task, ranging from two wooden disks and two moves to three disks and four moves required to duplicate the pattern. Children were allowed a maximum of two trials of each level and were required to pass one of the trials in order for the task to continue. Relevant rule reminders were provided when a child failed the first trial of a particular level (e.g., "Remember, only one monkey can jump at a time"). Children received a score of 0 to 6 based on the highest level they achieved (Total score: range = 0-6). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Truck Loading (Planning; Carlson et al., 2004). In this task, children played the role of a mail carrier, with the task of delivering five color-coded "party invitations" to five matching miniature houses on a miniature street. Children were asked to deliver the "party invitations" to the houses while following the four rules: (1) the street is a one-way street, so the delivery truck can only drive in one direction, (2) the invitations need to be delivered as quickly as possible, so the truck can only drive around the street once, (3) the color of the invitation has to match the color of the house, and (4) the invitations have to be taken off the top of the pile in the back of the truck. Following the warm up, there were four possible levels of the task, ranging from two to five houses. Children were given a maximum of two trials of each level, with relevant rule reminders given for the first failed trial of a particular level (e.g., "Remember, you can only take a letter off the top of the truck"). Self-corrections were allowed only during the loading stage; if they occurred after the child began "driving" the truck, then the trial was scored as a failure. Children received a score of 1 for each level if they correctly loaded the letters into the truck in reverse order. Scores ranged from 0 to 4, corresponding to the highest level achieved (Total score: range = 0-4). Reliability coding resulted in an interclass correlation coefficient = .99, $p < .001$.

Word Fluency (Generativity; Turner, 1999). To make this task sufficiently engaging for children, we used a stuffed dog, "Scruffles," to ask children the generativity questions. The experimenter explained that Scruffles was very curious and wanted to know all the animal names they knew. The experimenter then asked children to tell Scruffles as many animal names as they could think of, as fast as they could. After 30 seconds, the experimenter proceeded to the next trial, in which children were asked to name as many foods as they could in 30 seconds. The score reflected the number of novel animal names and foods generated within the time limits. Repetitions of previously mentioned animals or foods or vague categories, such as "snacks," were not included in the score, nor were any foods or animal names mentioned outside of the 30 seconds. (Total score = total number of items generated in both categories: range = 0-18). Reliability coding resulted in an interclass correlation coefficient = .93, $p < .001$.

Backward Digit Span (Working Memory; Carlson, 2005). Children were introduced to a doll named Jenny and were told that Jenny says everything the experimenter says, but says it backwards. The experimenter then demonstrated, saying "5-8", and making Jenny say "8-5". Children were given two practice trials with feedback, followed by two test trials each with an increasing number of digits, beginning with two digits. The task ended when children erred on both trials of a given level. Children were awarded a score of 1 for each successful trial (Total score – range = 0-5). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Count/Label (Working Memory; Carlson, 2005). In this task, the experimenter showed children three small, 2D wooden objects (e.g., a boat, an apple, and a bird) and children watched while the experimenter labeled them ("boat, apple, bird"). The experimenter then counted the objects out loud ("one, two, three"). Finally, she counted and labeled them each in turn (e.g., "one is a boat, two is an apple, and three is a bird"). Children were then asked to complete all three steps in two test trials using different objects. Children's ability to correctly count and label was awarded a score of 1 for each trial (Total score – range = 0-2). Reliability coding resulted in an interclass correlation coefficient = 1.0.

Study 2 Addendum

Because Study 2 was accepted for publication prior to receiving committee feedback, in what follows I outline how I address each of my committee member's requested changes to this Study.

p. 88, line 21: Dr. Vaillancourt wondered if the value of the gift was also $25. In fact, the gifts were valued between $5 and $15.

p. 90, line 1: Dr. Vaillancourt noted that convention has shifted away from the use of the term "marginally". This sentence should therefore read: "Group differences on the Sequencing task approached significance, $t(23) = 2.004$, $p = .057$ (See Table 3)."

p. 90, paragraph 2: Dr. Vaillancourt asked for the Cronbach's alpha for the composite scores. Several changes to the manuscript were made as a result. The new paragraph should read as follows:

Pattern of EpF Impairments in Children with ASD

To further analyze the nature of the EpF deficits in children with ASD, we created an EpF composite score, made up of an average of all five EpF tasks (after first averaging each task so that they all fell on the same scale) The Cronbach's alpha for this scale was $\alpha = .68$. The same procedure was used to create EF (Cronbach's $\alpha = .79$) and ToM (Cronbach's α =.54) composite scores. The ToM composite score included only three tasks: Knowledge Access, Change in Location, and Contents False Belief, as the inclusion of the other tasks rendered the Cronbach's alpha unacceptably low. We then compared the characteristics of children with ASD who had relatively intact EpF ability (i.e., fell above the median on the EpF composite score) with those who fell below the median. Due to the small sample size, non-parametric tests (Mann-Whitney *U*) were used to compare the groups. The two groups differed significantly in terms of language, as measured by their scores on the GLC, and chronological age. They did not however show significant differences in terms of Full Scale IQ or autistic symptoms (as measured by their CARS-II scores). Finally, the groups differed significantly on the EF composite scores, with lower EpF scores corresponding with lower EF scores (see Table 4). Group differences on the ToM composite score approached significance.

p. 91, paragraph 3: Dr. Fennell asked me to expand on the link between language and EpF in the discussion section of this study. Paragraph 3 on page 91 should therefore read:

Finally, we explored the characteristics of two groups of children with ASD – those with relatively intact EpF skills (passed at least 3 of the EpF tasks) versus those who failed the majority of the EpF tasks. The main differences between these two groups were language ability and chronological age, not overall IQ or autistic symptomatology, suggesting that EpF ability, as measured by these tasks, at least in autism, may be highly related to language. Dessalles (2007) argues that the purpose of episodic memory (a related cognitive skill) is actually to facilitate language production. Having memories, he argues, gives us something to talk about. If the link between EpF and language is similar, the connection between these cognitive skills may be particularly important to investigate in autism, a disorder in which the social aspects of language are strongly affected. In addition, the group of children with ASD with weaker EpF skills also had weaker EF skills and somewhat weaker ToM skills, suggesting that EpF may in fact be related to EF and ToM ability in children with ASD; though this finding will need to be replicated in future studies where the sample is sufficiently large to conduct correlational and regression analyses.

p. 92, paragraph 2: Dr. Kogan suggested I expand the clinical significance section of the dissertation. The following addition was made to the end of paragraph 1, p. 92:

Alternatively, the link between language and EpF could be a focus of study. Specifically, the directionality of the relation between EpF and language will be important to determine. That is, does EpF facilitate the development of language, or does language development facilitate the development of EpF? If, as Dessalles (2007) suggests, the purpose of episodic memory is to give us material to discuss in social exchanges, perhaps the purpose of EpF is similar. If this is the case, then enhancing EpF in children with ASD might have downstream effects on their language abilities.

p. 102, Table 4: Due to changes to the composite scores (see changes to p. 90, paragraph 1), the results as presented in Table 4 have changed. It should appear as follows:

Table 4

Strong Versus Weak Episodic Foresight Group Comparisons

	Weak n = 11		Strong n = 11		
	M	*SD*	*M*	*SD*	Mann-Whitney *U*
Gender	-	-	-	-	$z = -1.82, p = .30$
Chronological age	59.57	14.84	74.42	7.61	$z = -3.16, p < .01$
GLC age	57.85	10.21	65.93	7.45	$z = -2.19, p = .03$
PN age	53.71	13.62	65.43	16.25	$z = -1.81, p = .07$
RV age	62.00	9.00	66.43	7.41	$z = -1.80, p = .08$
FSIQ	89.29	26.66	87.14	11.10	$z = -0.13, p = .95$
CARS-II score	29.57	3.32	30.29	1.44	$z = -1.32, p = .19$
ToM Composite	.33	.31	.67	.30	$z = -1.87, p = .07$[a]
EF Composite	.43	.30	.72	.09	$z = -2.01, p < .05$[b]

Note. All age variables are presented in months. GLC = General Language Composite, PN = Picture Naming, RV = Receptive Vocabulary, FSIQ = Full Scale IQ, CARS-II = Childhood Autism Rating Scale, 2nd Edition. Due to missing data, superscript (a) denotes a comparison with *n* = 10 (weak) and *n* =11 (strong), while the comparison marked with superscript (b) denotes a comparison with *n* = 8 (weak) and *n* = 10 (strong).

General Discussion

This dissertation comprises the first empirical studies to examine the relation between several tasks developed to assess episodic foresight (EpF) in preschool children. In addition, it comprises the first attempt to systematically test the relation between these tasks and two other important cognitive domains critical to children's development: theory of mind (ToM) and executive function (EF). Finally, this dissertation addresses the extent to which children with ASD are capable of EpF. Below, I address each of the hypotheses outlined in the General Introduction and conclude by discussing important questions that remain for future research on the topic of EpF in both typically-developing children and children with ASD.

Hypotheses about Typically-Developing Children

Various tasks have been designed to assess EpF in typically-developing children. Results from these tasks suggest that the ability to think flexibly about the future self develops significantly between the ages of 3 and 5 (e.g., Atance & Meltzoff, 2005; Busby & Suddendorf, 2005; Suddendorf & Moore, 2011). However, until now, these tasks had not been administered together to one single group of children to determine whether they are related and thus measuring a unitary concept. The first main goal of this dissertation, and the focus of Study 1, was to examine whether a series of EpF tasks were related after controlling for age and language in a group of 3- to 5-year-old children.

I put forward four hypotheses in the General Introduction about EpF in typically-developing children. The first was that older children's performance on the EpF, ToM, and EF tasks would exceed that of younger children, thus replicating previous work in the field. For the most part, the results of Study 1 were consistent with previous research. However, one exception was the Zoo task. McColgan and McCormack (2008) found that 5-year-olds passed this task consistently, whereas we found that our group of 5-year-olds had equal amounts of difficulty with this task as did the other age groups. My qualitative observations of the testing session suggested that children did not always grasp the instructions and rules of the task. Moreover, this task was long and very verbal and may have overwhelmed preschool children when administered as part of a relatively long experimental protocol. It is perhaps a task best administered on its own without the competing distractions of other cognitive tasks. In addition, it is probably most appropriate for older children (i.e., age 5 and above) who are better able to manage the complex instructions and rules.

My second hypothesis was that tasks within each category (i.e., EpF, ToM, and EF) would be significantly correlated with each other. In Study 1, many of the ToM and EF tasks showed this pattern, and remained correlated when age and language were controlled (as is consistent with previous research in these areas). However, the EpF tasks did not remain correlated once age and language were controlled. This result was somewhat surprising, given that each of these tasks was designed to measure future thinking and, as I argued in the General Introduction, could also be argued to assess EpF more specifically. In addition, each task was sensitive to significant developmental change in the 3- to 5-year-old age range.

As discussed in Study 1, there are several possible explanations for this result. Although the tasks we selected were all developed to assess children's future thinking - they differ in terms of structure, content, and complexity. Moreover, because this is a new field of study, the researchers who developed these tasks did so without established guidelines or criteria describing what specifically constitutes an EpF task. Subsequent to the development of this dissertation, Hudson, Mayhew, and Prabhakar (2011) proposed three criteria that should characterize EpF tasks: (1) tasks must involve episodic thinking, that is, mental simulation of a specific episode and not simple inferences generated based on semantic knowledge; (2) tasks must include an "autonoetic" component, otherwise referred to as self-projection; and (3) tasks must involve thinking about a distinct temporal location, not simply a vague notion of "some time" in the future (Hudson et al., 2011). As we discussed extensively in Study 1, the tasks selected for this dissertation met some, but not all, of these criteria. For example, although Atance and Meltzoff's (2005) Picture Book Trip task requires children to imagine themselves in a distinct location in the future, Hudson et al. argued that it may not fully reflect EpF because children could have selected the items (to bring on each trip) based on semantic knowledge of what is associated with each future location (Hudson et al., 2011). Additionally, Hudson et al. argued that this task does not measure EpF because it involves a hypothetical situation that children may not have thought of as an actual event (and therefore did not imagine themselves actually participating in the event). Similarly, some have also argued that Busby and Suddendorf's (2005) Tomorrow task may not reflect EpF. Rather than thinking about specific future episodes, children may simply have been thinking about future events in general (Hudson et al., 2011), or may have relied on semantic knowledge of what typically happens day-to-day. The remaining EpF tasks we selected for Study 1 also may meet only some of Hudson et al.'s criteria. As such, an important direction for future research will be to continue to refine existing tasks or develop new tasks that closely fulfill agreed-upon criteria for what constitutes an EpF task.

Researchers have begun to pursue this goal, and have been particularly inspired by a scenario described by Tulving (2005) and now referred to as the "spoon test." In Tulving's scenario, a little girl dreams about attending a party where guests are being served a delicious chocolate pudding. Unfortunately, the young girl has not brought her own spoon and so she cannot have any. The next night, she falls asleep while holding a spoon in her hand to avoid making the same mistake again. Tulving predicted that children younger than age 4 would not succeed (i.e., would fail to bring the spoon) on a task structured to mirror his proposed scenario. The main reason for such a failure is argued to be an inability to anticipate a future need state that differs from one's current state. This type of scenario, if properly adapted into an EpF task, seems to fulfill Hudson et al.'s (2011) criteria. Specifically, the child in this scenario is likely engaging in EpF when she imagines herself (self-projection), attending a party (the specific episode), the next time she falls asleep (a distinct temporal location). Several researchers have developed new tasks similar to this scenario, including Suddendorf, Nielsen, and von Gehlen (2011), and Russell, Alexis, and Clayton (2010). Because my data collection began prior to the publication of these tasks, I was unable to include them in this dissertation.

Suddendorf et al. (2011) adapted Tulving's (2005) scenario with 3- and 4-year-olds in the following way: Children were shown a locked box with a triangular keyhole that could be opened by a red triangle key to obtain a sticker. They were then given the opportunity to use the key on two consecutive trials. A future need for a key was then created by having the experimenter pretend to break the existing one. At this point, children were guided to another room but were told that they would later return to the first room to play with the box. After a brief delay, children were asked to select one of four keys to take back to the first room. The majority of 4-year-olds (65%) selected the correct key, while significantly fewer 3-year-olds (29%) did so. This task may fulfill Hudson et al.'s (2011) criteria because, to solve it, children may need to project themselves into the future to imagine the point in time when they will need to open the box with the triangle-shaped key. Alternatively, it may be that the connection between a locked box and a key is based more strongly on semantic knowledge rather than on the mental simulation of a specific episode. Therefore, it is possible that this task does not adequately measure EpF, at least according to Hudson et al.'s (2011) criteria.

Russell, Alexis, and Clayton (2010) developed a task in which children must save items for future use, again similar to Tulving's "spoon test." In their task, 3-, 4-, and 5-year-olds played a game of "blow football" on a high table. One side of the table included a platform that children could stand on to reach the game, while the other side was lower, necessitating the addition of a step for children to reach it. Children played the game from the high side of the table, and then were told that they would be returning at a later date to play from the low side of the table. To succeed at the task, children had to successfully choose the two necessary items (a step to reach the table and a straw to blow the ball) from an array of six.

Russell et al. (2010) predicted that if children were truly envisioning a future state of the self, as outlined in the spoon-task scenario, they would be able to select items that would be useful on the "low" side of the table, even when they were currently situated on the "high" side of the table (i.e., when they did not currently need the step to play the game). Results indicated that 5-year-olds chose which items they would need to play the game in the future, while 3-year-olds did not. This task may also fulfill Hudson et al.'s (2011) criteria, because children are asked to mentally simulate a specific episode, occurring at a specific time in the future. In addition, to choose the correct items, children must imagine themselves playing the game from a different side of the table (i.e., self-projection).

As this field of research continues to evolve, adopting one precise set of criteria that describes the critical components of an EpF task will facilitate the creation and evaluation of new EpF tasks. Hudson et al.'s (2011) criteria seem to be helping to move the field towards a more coherent and consistent definition of EpF. However, it will be critical to test the various EpF tasks concurrently to determine whether they cohere, as has been done with other cognitive skills such as ToM and EF.

A third goal of the present dissertation was to test whether EpF, as measured by the selected tasks, would be related to ToM and EF after controlling for age and language. My two hypotheses in this respect were that, due to their close neurological ties and overlapping functional requirements, EpF, ToM, and EF composite scores would be at least moderately correlated, even after controlling for age and language ability. The second was that a significant amount of the variance in EpF ability would be predicted by ToM and EF ability.

The results of Study 1 also did not largely support these hypotheses. For the most part, correlations between the ToM and EF composites and the EpF tasks did not remain after age and language were controlled, and because we did not detect significant correlations, we were not able to test the fourth hypothesis. The exception to this was the Grocery/Beach task, which remained correlated with the EF composite. In addition, we found a correlation between the EF composite and a composite score made up of the five EpF tasks. This finding is necessarily preliminary and must be treated cautiously, however, because the tasks making up the EpF composite were not significantly correlated and resulted in a low Cronbach's alpha. Nonetheless, we explored this relation further by creating two EF composites, one consisting of the planning tasks, and the other consisting of the three working memory and inhibitory control tasks. It was this "inhibitory" composite that remained correlated with EpF after controlling for age and language. This is an interesting finding that is consistent with theories that inhibitory control is one aspect of EF likely to be related to EpF (Atance & Jackson, 2009; Suddendorf & Corballis, 2007).

The finding that ToM is not robustly related to EpF, at least as measured by the tasks used in this dissertation, was surprising given theories that the two types of tasks, both characterized by a need to switch perspectives, would be closely related in development. However, it is possible that newly-developed EpF tasks (e.g. Russell et al., 2010; Suddendorf et al., 2011) are more closely measuring the self-projection aspect of EpF and thus may be related to ToM. Should newer EpF tasks also not be related to ToM, a shift in the proposal that both involve the same type of perspective taking would need to occur. Thus far, researchers have proposed that ToM and EpF may be closely related, both in development and into adulthood. Certainly Buckner and Carroll’s (2007) review of the literature suggests neural overlap of the two in normal adults. However, Rosenbaum, Stuss, Levine and Tulving (2007) argue that ToM is independent of episodic memory. Their study of individuals with traumatic brain injuries showed that despite the inability to recollect any events from any period of their lives, K.C. and M.L. have no apparent difficulty in taking another person’s perspective and inferring their thoughts, feelings, and intentions (i.e., they are able to pass ToM tasks). The findings of Study 1 of this dissertation would thus be consistent with Rosenbaum et al.’s findings but would nonetheless need to be replicated in studies using regression and factor analyses.

The findings we outline in Study 1 constitute an important and well-timed addition to the literature on children’s future thinking. This study is the first to show that existing EpF tasks are not intercorrelated once age and language are controlled, and that EpF, as measured by these tasks, is more closely related to EF than to ToM. Future research should focus on the development of clearer guidelines about what constitutes EpF. In addition, these criteria should help guide the development and refinement of new and existing EpF tasks to better measure this skill in children. Finally, as the measurement of EpF becomes more precise, researchers can better focus on its relation to other cognitive skills, in particular EF.

Hypotheses about Children with ASD

Understanding cognitive development is best accomplished through the study of both typically- and atypically-developing children. For example, by studying ToM in children with ASD, Simon Baron-Cohen, Henry Wellman and many others have helped to clarify the components of ToM, and how this skill is critical to human interaction. Autism research has grown exponentially, with a great deal of the research focused on ToM and EF as aspects of cognition specifically affected by the disorder. I reviewed several lines of research in the General Introduction that show robust deficits in these cognitive capacities in children with ASD. However, neither of these theories completely explains the range of deficits seen in this disorder. As such, exploring other possible cognitive deficits in children with ASD is important for understanding typical and atypical development.

In Study 2, “Episodic Foresight in Autism Spectrum Disorder”, we explored whether children with ASD demonstrated deficits in EpF. First, I hypothesized that the EpF tasks would be significantly intercorrelated. Second, I hypothesized that ToM and EF tasks would be intercorrelated with EpF. However, due to the small sample size, we were unable to conduct correlational analyses within the ASD group and, therefore, Hypotheses 1 and 2 were not tested. The third hypothesis was that the children with ASD would perform significantly worse on the EpF tasks than a group of typically-developing children. This hypothesis did receive empirical support. Specifically, children with ASD had significantly more difficulty than typically-developing children on the Picture Book Trip task and the Grocery/Beach task, and a trend towards more difficulty on the Sequencing task (p = .06).

An important issue is thus why children with ASD were able to complete some of the EpF tasks while they struggled with others. Perhaps children with ASD are not impaired in their ability to think about the future in a global sense, but instead are specifically impaired in certain aspects of future thinking. We suggested in Study 2 that they are specifically impaired in their ability to project themselves into the future, a theory first espoused by Jackson and Atance (2008). And, indeed, the tasks that they had the most difficulty with are those that were specifically developed to measure this capacity: the Picture Book Trip, Grocery/Beach, and Sequencing tasks. As such, it seems that children with ASD who are known to have difficulty with knowledge and understanding of the self (Lind & Bowler, 2008; Mitchell & O'Keefe, 2008) also have difficulty with EpF tasks designed to measure self-projection. Although the findings of Study 2 would need to be replicated and further extended upon, they nonetheless highlight how studying EpF in atypically-developing children may help us understand what aspects of future thinking are being measured by existing EpF tasks.

The clinical applications of this research for ASD are vast. Rates of ASD are increasing and the importance of early intervention is clear. It is critical, then, to understand precisely which cognitive domains are impacted in autism so that interventions can be tailored to meet those needs. Just as research has shown deficits in ToM and EF in children with ASD, I expect that research will continue to find significant deficits in their ability to engage in EpF. Research with adults with ASD has already begun to demonstrate impairments in this domain (Lind & Bowler, 2010) and, similar to individuals with traumatic brain injury, who have lost the ability to project into the future, individuals with autism likely struggle with anticipating future consequences, planning, and communication and relationships. If a reliable and valid battery of EpF tasks can be compiled, it would be possible for clinicians to accurately measure the extent of deficits in this area thus paving the way for effective interventions.

Limitations

When designing these studies, I strove to examine all the relevant research conducted in the field of future thinking and EpF in both adults and children, and to select a group of tasks representative of the current thinking in the field. The tasks I selected, although not the only available future thinking tasks, were selected due to their prominence in the field and their emphasis on the EpF aspect of future thinking, while also being appropriate for children ages 3 to 5. A recent special issue of *Cognitive Development* (Suddendorf & Moore, 2011) also mentions these tasks as being highly relevant to the study of EpF. However, as Hudson et al. (2011) point out, for a task to be considered a true measure of EpF, it is not sufficient to establish that children are thinking about the future in general. Instead, they must be thinking about a specific future episode. Additionally, children must be able to imagine themselves in that specific episode, and anticipate what they might be thinking and feeling. As I discussed extensively in Study 1, some of the tasks used in this dissertation are approaching these goals, whereas others may be possible to solve without children relying on EpF (and may only be measuring future thinking more broadly). Subsequent to the development of this dissertation, several relevant EpF tasks were published, and one unavoidable limitation of the present dissertation is that these tasks were not included in the battery. As such, future research should more precisely identify critical components of EpF and develop tasks that measure this specific component of future thinking.

Our sample size in Study 1 was adequate and our results largely replicated developmental changes found in previous research. Nonetheless the children in our study were not entirely representative of the general population. Due to the demographic make-up of Ottawa, the sample was skewed towards a high-income, highly educated, and largely Caucasian sample of children. As such, our results are not likely generalizable to all cultural, ethnic, and socio-economic groups, and thus future research should strive to recruit a more varied sample of children.

The most significant limitation of Study 2 was the sample size of children with ASD. Recruiting this sample proved quite challenging, given the political and social aspects of

ASD in the local community. We encountered several roadblocks and were not able to set up an effective partnership with any of the public or private agencies working with children with ASD in the community. I was thus required to travel to a nearby community to access their database of participants. This venture was somewhat successful, but due to illnesses and other attrition factors, much of our sample did not return for a second session. Given more time, and perhaps a community more receptive to research partnerships, we may have been able to recruit a larger sample of children with ASD thus resolving the issues with power. Additionally, the sample of children with ASD was quite diverse. Children ranged in age from 3 to 8, and also had variable language abilities and intelligence. Thus, matching them with a group of typically developing preschoolers was difficult, and they could only be matched on verbal ability and gender, not on chronological age. The increased variability within and across groups may have made group differences between tasks more difficult to detect.

Finally, the diagnoses of the children with ASD were also quite diverse. Children had diagnoses of Autistic Disorder, Autism Spectrum Disorder, Pervasive Developmental Disorder, Not Otherwise Specified, and Asperger's Disorder. Although in the past, these were thought to constitute separable disorders, recent research has shown that they in fact constitute an interconnected spectrum of disorders, and in 2013, under the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition, they have been unified under one term: Autism Spectrum Disorder. For this reason, all children with a diagnosis on the autism spectrum were included in this study. Ideally, diagnoses would have been confirmed using the gold standards of diagnosis, the Autism Diagnostic Observation Schedule (Lord, Rutter, DiLavore, & Risi, 2002) and the Autism Diagnostic Interview (Lord, Rutter, & Le Couteur, 1994). However due to time and geographical constraints, confirming diagnoses in this way was not possible. Diagnoses were confirmed by reviewing clinical reports, whenever possible, and by the administration of a reliable and valid diagnostic measure, the Childhood Autism Rating Scale, Second Edition. Nonetheless the study was certainly impacted by important differences between children in terms of language and intellectual functioning. In the future, recruiting a more homogenous sample of children with ASD may help assess EpF skills more accurately.

Future Directions

EpF research is at a crossroads – will it follow in the footsteps of research about other cognitive capacities such as ToM and EF that have received a tremendous amount of attention, or will it remain a small niche field of research? The answer to this question likely depends on the accomplishment of several important research activities. If these activities can be successfully undertaken, I believe the field will grow exponentially, as has happened with ToM and EF research.

The first task facing EpF researchers is to work towards unifying the field. This process has been initiated nicely through the special issue in *Cognitive Development*, and especially through Suddendorf and Moore's (2011) suggestion that all researchers adopt the term "episodic foresight" to describe a specific aspect of future thinking. Part and parcel of this process however, is the need to define, describe, and measure EpF precisely. Without a specific set of tasks that can be used to measure the construct, the field lacks some validity and cannot be used clinically to understand and promote children's development. Therefore, in addition to developing new tasks and refining existing tasks to measure the construct precisely, researchers should also strive to create a battery of interrelated tasks useful for measuring the construct as a whole.

If such a battery could be created, researchers could also focus on the adaptive nature of EpF and, in the process, enhance the clinical utility of this field of research. The research with non-human animals has instigated this process nicely, exploring the nature of EpF and its utility to several species (Clayton, Bussey, & Dickenson, 2003; Raby, Alexis, Dickinson, & Clayton, 2007). Future research should continue to explore EpF in non-human animals, children, and special populations, such as children with ASD, to better understand how variability in EpF affects development. Specifically, investigating the links between EpF and other cognitive abilities, including language, EF and episodic memory will allow for the development of intervention strategies aimed at alleviating deficits and enhancing development of these critical cognitive skills.

One way to explore EpF ability in both typical and special populations could be through brain imaging research. Research with adults has detected important structural and functional brain connections between various cognitive capacities, including EpF, ToM, and memory (Buckner & Carroll, 2007; Spreng, Mar, & Kim, 2008; Spreng & Grady, 2009). Future research should continue to explore the relations between these important cognitive abilities in development, to determine how they might be related or dependent on one another.

Summary and Conclusion

This dissertation is composed of two original studies, each the first of its kind to explore several EpF tasks in typically-developing children and children with ASD. Study 1 examined the relation between various EpF tasks, and found that these tasks were not as closely related as previous theory had supposed. However, correlational analyses revealed that EpF may be related to EF skills, but not to ToM, at least in preschool children. Study 2 explored EpF in children with ASD. Results of this study lend further support to the theory first espoused by Jackson and Atance (2008) that children with ASD are specifically impaired in the ability to think about themselves in the future. This dissertation fits well with the current direction of the literature in the field of EpF and will hopefully help move the field towards unification and further highlight the importance of episodic foresight to children's development.

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Appendix A
Participant Information Card

CHILDHOOD COGNITION AND LEARNING LAB AT THE UNIVERSITY OF OTTAWA:

Child Participant Information

Child's name:___________________________________ **Gender:**_________ **D.O.B.** **(mm/dd/yy)**________________

Parent 1:____ Parent 2:__________________________________

Address:____ **City**:_______________________ **Postal Code:**______

Day phone: (___)_______________________ Eve: (___)_______________________ Email: ______________________

Referral source:__________________________ **First contacted (mm/dd/yy)**________________ Info pkg. sent:__

Best day/time for appointment (incl. Weekends/Eve)?____

May we contact you about opportunities for your child to participate in future studies? *Yes/No* Child's birth order: 1st___ 2nd___ 3rd___ Other___ # of children ___

Other children (and D.O.B):____

Birth history: weight:________________ pregnancy length (in wks)____________________ Any ear infections?____

Any major health or speech problems? Y/N:____

Exposure to other language: *Y/N* Languages:__________________________________ By whom____________

How many days per week? ______ Hours per day?______________________ Since what age (in months)?_________

Occupation: Mother:____ Father:______________________________

Ethnic Background (Asian, Black, Hispanic, White): Mother:__________________________ Father:____________

Comments:____

Appendix B
History Questionnaire

Date: ______________________________

Child's name: ______________________________

Birth date (MM/DD/YYYY): ______________________________

Age: _____________

We are interested in your child's personal history because it may help us better understand the results of our study. Please do not hesitate to skip questions you do not feel comfortable answering, or for which you do not know the answer. All answers will be kept confidential.

Interests:

What are some of your child's primary interests?

____

What activities does your child enjoy doing?

____

What activities does your child find annoying or frustrating?

____

How many siblings does your child have? __________________

Language:

Languages spoken (in order of fluency): ______________________________

Primary language: ______________________________

At what age did your child first learn to speak? ______________________________

At what age did your child begin to speak fluently (in sentences)?___________________

Does your child use words like *if*, *might*, *in case*? If possible, please give an example.

____

____

Does your child make plans for the future? If possible, please give an example.

____

Does your child accompany you to the grocery store? If so, how often?

____

Has your child ever visited a beach? If so, how often?

____

Medical history:

Does you child suffer from: Visual problems ☐

Unconsciousness ☐

Seizures ☐

Diabetes ☐

Motor difficulties ☐

Other medical problems ____________________________

What is your child's diagnosis (please be exact)?____________________________

When was your child diagnosed? ____________________________

Who diagnosed your child? ____________________________

What is their profession designation? (e.g. physician, psychologist, etc.) ___________________

What measures were used to diagnose your child? (e.g. ADOS, ADI, etc.)

____

Has your child been diagnosed with any other psychiatric conditions (e.g. anxiety, ADHD, depression, OCD, etc.)?

____

____

Has your child been on any medication directly related to his/her diagnosis?

____

____

What other treatment has your child received?

Select all Programs/Services/Activities in which your child has been involved in the past year:

	Check (√) **all that apply** **to your child in the past 12 months**	**Hours per week**	**Duration in weeks** **Number of weeks in the past 12 months**
Structured/Systematic teaching with specific goals (one-on-one or group setting) This includes any teaching program based on Applied Behaviour Analysis (ABA) which also may be known as Pivotal Response Treatment, IBI, EIBI, etc.	○		
Intervention/Consultation for Challenging Behaviour (one-on-one or group setting) This includes any program aimed at reducing problem behaviors such as aggression, tantrums, screaming, etc.	○		
Speech / Language / Communication Therapy This includes any program addressing either verbal or augmentative communication (e.g., PECS)	○		
Occupational Therapy	○		
Physiotherapy	○		

Relationship – Based Intervention This includes DIR/Floor time, Relationship Development Intervention (RDI) and other interventions that are relationship-based.	○		
Alternative Medicine This includes but is not limited to Cranial sacral therapy, Chelation therapy, Homeopathy, Hyperbaric oxygen therapy, Massage, Naturopathy, Neuromuscular reorganization, etc.	○		
Dietary Interventions This includes but is not limited to gluten-free casein-free diet and megavitamins.	○		
Tutor for Academics	○		
Feeding intervention for eating problems	○		

School Situation:

What type of schooling is your child currently receiving?

Home schooling ☐ Other: ____________________

Public School ☐

Private School ☐

What grade is your child currently in? ________________.

What is your child's classroom situation?

Fully integrated ☐ Other: ____________________

Integrated with an aide ☐

Special Needs class ☐

Is there anything else that you feel may influence your child's responses today in the study, including any events that may have occurred recently?

____
____
____
____
____

Appendix C
Demographic Questionnaire

The academic journals to which we submit our research findings often ask us to report about various aspects of our sample of children including their ethnicity, their parents' income, education, and profession, and the languages spoken in the home. However, these journals also recognize that it is not always possible to obtain this information from parents. Thus, although it would be helpful to us if you would be willing to fill out the information below, if you do not feel comfortable doing so, then you are in no way obligated to do so. Please know that the information that you provide will be kept separate from your consent form, making it impossible to link it to you in any way. Rather, the information that you provide will simply be pooled with other participant information so that we can provide overall percentages for reporting purposes (e.g., 80% of our sample was White, 10% was Black, 10% was Asian).

Name of Study: _Future Thinking Skills in Typically-Developing Children and Children with Autism_______

Child's ethnicity: ____________________

Languages spoken in the home:

First language: _____ Amount of exposure (hrs/day): ________ By whom? ____________
Language 2: ________ Amount of exposure (hrs/day): ________ By whom? ____________
Language 3: ________Amount of exposure (hrs/day): ________ By whom? ____________
Language 4: _________Amount of exposure (hrs/day): ________ By whom? ____________

Annual household income: (Please circle one)

less than 20 000$	20 000$-40 000$	40 000$-60 000$
60 000$-80 000$	80 000$-100 000$	more than 100 000$

Education level and occupation of parents/guardians:

Please check highest level of education attained, and indicate any professional designations (e.g., MD, CPA, etc.) and type of occupation for each parent/guardian:

Mother/Guardian:

- Did not complete high school ☐
- High school degree ☐
- College degree ☐
- University degree ☐
- Graduate degree ☐

Professional Designation: ____________
Occupation: ______________________

Father/Guardian:

- Did not complete high school ☐
- High school degree ☐
- College degree ☐
- University degree ☐
- Graduate degree ☐

Professional Designation: ____________
Occupation: ______________________

Appendix D
Parent Form – Tomorrow Task

Parents: Here's a task for you! If you don't mind, could you please write down your child's answers to this game when we play it, and confirm whether or not they are accurate? Below each one is a space for you to write any comments you might have (e.g. if you child says "Tomorrow I will go to school", and this is usually true, but tomorrow happens to be a vacation day, please mark that in the comments so we can take it into account). Thanks for your help!

TOMORROW TASK

Can you tell me something you are going to do Tomorrow?

Event One____ Accurate____
Comments ____

Can you tell me something else you are going to do Tomorrow?

Event Two____ Accurate____
Comments ____

Can you tell me something you are **not** going to do Tomorrow?

Event One____ Accurate____
Comments ____

Can you tell me something else you are **not** going to do Tomorrow?

Event Two____ Accurate____
Comments ____

Can you tell me something that you did yesterday?

Event One____ Accurate____
Comments ____

Can you tell me something else you did yesterday?

Event One____ Accurate____
Comments ____

Can you tell me something that you didn't do yesterday?

Event One____ Accurate____
Comments ____

Can you tell me something else that you didn't do yesterday?

Event One____ Accurate____
Comments ____

Appendix E
Coding Scheme

Grocery/Beach Planning

1) Record all of child's responses verbatim.

2) Code the total number of actions children report for each condition. Actions = any mention of an action (e.g. "you go there", "you swim", "you get milk"), & any mention of optional and conditional actions (e.g. "usually you wait in line", "after we go swimming…").

Do not include repetitions of previously mentions information within each condition (i.e. only code information from following the "Tell me the first thing you have to do" if it is new information.

Examples of possible answers:

Onset:
Bring bags
Go/drive there
Park car/go in
Get cart

Main event:
Buy/get food
Look for items
Pay/Check out

Ending:
Leave/go to car
Drive/go home
Put groceries away

Onset:
Go/drive there
Change/put on suit
Park/pay/go in
set up/put on lotion

Main event:
Swim/play in water
Play in sand
Eat/drink
General Play (mention of play without mention of water or sand)
Other activities (taking photos, walking on boardwalk, hunting for shells)
Sit/relax

Ending:
Finish swimming
Dry off
Drive/go home

3) Recode responses as either onset, main event, or ending activities (excluding mishaps)

4) Code specific planning activities in each section as advanced preparations & decision-making activities (excluding mishaps) – see table below

Grocery Store	*Beach*
Advanced preparation:	*Advanced preparation:*

Get money *Bring bags* *Get coupons* *Get shopping cart/basket*	*Get beach things (suit, towel, etc)* *Pack your things* *Put on your bathing suit* *Put on sun screen* *Set up beach blanket, chairs, towel*
Decision making:	*Decision making:*
Seeking information: *Check what you need* *Check what's on sale* *Check coupons* *Deciding something:* *Decide what food to get* *Make a list* *Scheduling:* *Take a nape before you go* *Eat before you go* *Decide when to go*	*Seeking information:* *Check the weather* *Deciding something:* *Decide where to go* *Decide if you want to go swimming* *Scheduling:* *Wake up early* *Take a nap before or after* *Decide when to go* *Decide when to leave*

5) Code each mishap category ("What could you do if…"):

- No response (= 0)

-Focus on consequences – describe the consequences of the mishap without suggesting a remedy (e.g. "you would be sad", "you would be hungry") (= 1)

-Simple solution – if they report what is needed to remedy the situation (e.g. "get more money") but do not describe steps (= 2)

-Remedy plan – if provide realistic plan to solve mishap (e.g. if a friend of yours is there, borrow money from him, build a new sand castle, etc.) (= 3)

-Prevention plan – e.g. "put a cooler out by the front steps", "watch over your sand castle or build it on top of something big") (= 1)

Tomorrow Task:

Score 1 for each event if they generate a specific event, regardless of whether this did or would actually occur (need not be an entire sentence, just a term that was interpretable as an activity) "I don't know" or no answer given – score 0

Indicate number of events generated and number of events judged as plausible by parent.

note: responses given to prompts (i.e. are you going to play tomorrow?) do not count

Picture Book Trip Task:

Item choice: – if correct – score 1
- if incorrect – score 0

Correct items:
River – bandaids

Road – water bottle
Mountain – lunch bag
Waterfall – raincoat

Explanation: -if item choice is incorrect – score 0 regardless of explanation

-future state – 1 if present, 0 if not present. Explanation must include **both** a **future referent** which could include: gonna/going to, will, could, should, can, when, might, maybe, incase, if **and** a **state reference** which would include:

-River: hurt, owie, bleeding, scraped (not fall, trip)
-Road: thirsty, hot, tired
-Mountain: hungry, tired, thirsty
-Waterfall: wet, water on me, rain in eyes, be dry (but not "my clothes are gonna get wet")

Zoo Future Task:

Score 1 or 0 for each question child is asked (responses can be non-verbal, i.e., pointing).

Sequencing

-score 1 for every correctly placed item

Young: House, plate with food, park equipment/snowman
Old: people kissing, person working, people cooking

Diverse Desires:

Record Child's response to Own-desire question.

Place check mark next to child's choice and appropriate response (e.g. if child selects cookie as their favorite, mark beside the line that begins "*if child chooses cookie…*")

Score 1 or 0 beside "*Target Question*". 1 if child chooses item that is opposite their own choice.

Diverse Beliefs

Record child's response to own-belief question.

Place check mark next to child's choice and appropriate response (e.g. if child selects bushes, mark beside the line that begins "*if child chooses the bushes…*")

Record child's response to target question. Score 1 or 0. To be correct, the child must answer the target question opposite from his or her answer to the own-belief question.

Knowledge Access Task:

Record child's responses to all questions.

Score 1 or 0 to "what is in the drawer" question. 1 = a dog, a doggie, a puppy

Score 1 or 0 to target question, 1 = no, 0 = any other response

Score 1 or 0 on memory control question, 1 = no, 0 = any other response

Contents False Belief:

Record child's responses to all questions.

Score 1 or 0 for "what is in the band-aid box?" 1 = a pig, piggie, 0 = any other response

Score 1 or 0 for target question, 1 = band-aids, 0 = any other response

Score 1 or 0 for memory question, 1 = no, 0 = any other response

Change in Location:

Record child's responses to all questions verbatim.

Score 1 for "where do Bert think the ball is?" if child answers correctly (the original placement)
Score 1 for forced-choice question if child responds correctly.
Score 1 for reality question if child answers correctly (place where Ernie moved the ball to)

Black/White

Score 1 or 0 for two warm-up questions.

Indicated # of trials for first two cards.

Circle response for each trial, score 1 or 0.

Record total # of correct trials.

Standard DCCS

Indicate number of correct and incorrect trials for pre-switch and post-switch phases.

Tower of Hanoi

Children get two chances on each trial – if their first attempt is wrong, they can try again. If they fail both attempts, the task is discontinued. If they succeed, they move on to the next level.

-If correct, indicate trial # in *trial* column, and 1 under *indicate* column – next to CORRECT line
-If incorrect, indicate trial # in *trial* column, and 0 under *indicate* column – next to the appropriate INCORRECT line, depending on what rule was violated

At end, tally up total number of trials attempted (1-12) and highest level correctly achieved (1-6)

Truck Loading

Children get two chances on each trial – if their first attempt is wrong, they can try again. If they fail both attempts, the task is discontinued. If they succeed, they move on to the next level.

-If correct, indicate trial # in *trial* column, and 1 under *indicate* column – next to CORRECT line
-If incorrect, indicate trial # in *trial* column, and 0 under *indicate* column – next to the appropriate INCORRECT line, depending on what rule was violated

At end, tally up total number of trials attempted (1-8) and highest level correctly achieved (1-4)

Note: yellow & purple house trial is a demo. Can ignore rule explanation coding

Word Fluency

Record child's responses.

Code number of novel animal names and food names generated. Only code each animal or food once (i.e. if child says "giraffe, frog, elephant, giraffe", code = 3)

Count/Label

Check off box if child counts and labels items on the last part of each trial.

Example of correct answers:
"One is a dog, two is a tree…"
"Dog one, tree two…"
"One dog, two tree…"

In Correct answers:
"One is a dog, One is a tree, One is a car"

Backward Digit Span

Record child's responses verbatim. Indicate when child fails two trials of one level.

Appendix F
PROTOCOL

The Relation between Future Thinking, Theory of Mind, and Executive Function Skills in Typically-Developing Children and Children with Autism

FUTURE THINKING TASKS

GROCERY/BEACH PLANNING

Model Plan
"Let's talk about a plan for going on a picnic. You have to get up early. And you have to bring your lunch and camera. For your lunch you have to pack sandwiches, a drink, and a snack. Then you put all the food in a picnic basket. And you have to bring a blanket to sit on. Then you have to put on sunscreen in case it is sunny. Then you have to get in the car and buckle your seatbelt. Then you can go on a picnic."

"Can you think of anything else you could do?"

Child's response
.

"Now can you tell me a plan for going to the beach? Tell me the first thing you have to do."
____
____
____
____
____
________________________.

"What do you have to do next?"
____
____
______.

"Anything else?" (max of 3)

____
____

____
____________.

(Child indicates they are done)

Number of actions: ___ Onset:_____Main event:________Ending:______.
Advanced planning________decision making___________.

What could you do if you were at the beach and you got hungry, but you forgot to bring food with you?

____

____

No response________Focus on consequences_____Simple solution______Remedy plan____.

What could you do next time you went to the beach to make sure that didn't happen again?

____

____

No response________Repeat ______Prevention plan_____.

What could you do if you were at the beach and a wave knocked over your sand castle?

____

____

No response________Focus on consequences_____Simple solution______Remedy plan____.

What could you do next time you went to the beach to make sure that didn't happen again?

____

____

No response________Repeat ______Prevention plan_____.

"Now can you tell me a plan for going to the grocery store? Tell me the first thing you have to do"

____

____

____

____
___________________.

"What do you have to do next?"
____
____
______.

"Anything else?" (max of 3)
____
____
____
____________.

(Child indicates they are done)

Number of actions: ___ Onset:_____Main event:_________Ending:______.
Advanced planning_________decision making___________.

What could you do if you were at the grocery store and you forgot to bring your shopping list to the store with you?

____

____

No response_________Focus on consequences_____Simple solution______Remedy plan____.

What could you do next time you went to the store to make sure that didn't happen again?

____

____

No response_________Repeat ______Prevention plan_____.

What could you do if you were at the grocery store and you went to pay for your groceries and you didn't have enough money?

____

____

No response_________Focus on consequences_____Simple solution______Remedy plan____.

What could you do next time you went to the store to make sure that didn't happen again?

____

____

No response________Repeat ______Prevention plan_____.

TOMORROW TASK

Scruffles is very curious about what kinds of things kids like to do. Scruffles is wondering what you are going to do Tomorrow (try to get 2 things from child – then check plausibility w Mom)

Can you tell me something you are going to do Tomorrow?

Event One____ Plausible____

Can you tell me something else you are going to do Tomorrow?

Event Two____ Plausible____

Can you tell me something you are **not** going to do Tomorrow?

Event One____ Plausible____

Can you tell me something else you are **not** going to do Tomorrow?

Event Two____ Plausible____

(max of 2 prompts given if no response to the initial question)

Eg) I played – What did you play yesterday?

Can you tell me something that you did yesterday?

Event One____ Plausible____

Can you tell me something else you did yesterday?

Event One____ Plausible____

Can you tell me something that you didn't do yesterday?

Event One____ Plausible____

Can you tell me something else that you didn't do yesterday?

Event One____ Plausible____

*Number of events:*__________*Number of events judged as plausible:*   .

PICTURE-BOOK TRIP TASK

Now, we're going to play a trip game! I'm going to show you some pictures of different places we can go on our trip. Then, I'm going to ask you some questions about what sort of things we should bring on our trip. Ready?

Walk up mountain

What's this a picture of? *(if child doesn't say "mountain," etc. correct them).* It takes a long time to walk up this mountain! Now, I want you to pretend that you're going to walk up this mountain. Okay, it's time to get ready to go. Which one of these do you need to bring with you to go walk up the long mountain?

____ grass, lunch, bowl

____ How come you need to bring X? ____

Walk close to waterfall

What's this a picture of? *(if child doesn't say "waterfall," etc. correct them).* Now, I want you to pretend that you're going to go walk by the waterfall. Okay, it's time to get ready to go. Which one of these do you need to bring with you to go walk close to the waterfall?

____ rocks, money, raincoat

____ How come you need to bring X? ____

Walk across river

What's this a picture of? *(if child doesn't say "river and rocks," etc. correct them).* Now, I want you to pretend that you're going to go walk across the rocks. Okay, it's time to get ready to go. Which one of these do you need to bring with you to go walk across the river?

____ fish, Band-Aids, pillow

____ How come you need to bring X? ____

Walk in hot sun

What's this a picture of (pointing to road)? *(if child doesn't say "road," etc. correct them).* It takes a long time to walk down this road. Now, I want you to pretend that you're going to walk down this road. Okay, it's time to get ready to go. Which one of these do you need to bring with you to go walk down the long road?

____ plant, present, water

____ How come you need to bring X? ____

ZOO FUTURE TASK

Set up zoo task as follows: Place mat on table and put 5 cages around the path so that there is one in the middle, two at the corners and two at the ends. Place lockers in front all the cages, except for the middle cage. Make sure that all the lockers are unlatched. Ask child to put the animals in the cages.

(Take out female doll). "This is my friend Molly. Molly will be going to the zoo. Do you know what a zoo is? A zoo is a place where you go and see animals. Lots of different animals live in the zoo, and sometimes these animals live in **cages**."

"Molly has a **camera** with her that she wants to bring to the zoo. Look at this camera. Let's take a picture of Molly *(take photo)*."

"Molly doesn't have her backpack with her, so she can't carry her camera around the zoo with her. But look, there are these lockers in front of some of the cages at the zoo. These **lockers** can be opened up and we can put things inside them. Let's look inside all of them…"

"You could **leave** the camera in one of these lockers and then Molly could get it when she's going to the zoo."

"Look, there is a **path** in the zoo that Molly has to walk on. *(Trace the path with your finger,* ***Counterclockwise)***

Molly must always follow this path *(trace the path with finger)*, and she can only go around the zoo **once**. She cannot go back and visit any of the animals again."

"Can you point to the start of the path?_______________. Score:_________.
(Correct child if wrong answer: e.g. "oh no, the start of the path is over here")

Can you point to the end of the path? _______________. Score:_________.
(Correct child if wrong answer: e.g. "oh no, the end of the path is over here")

And which way is Molly going to walk around the zoo?________________. Score:_______.
(Correct child if wrong answer: e.g. "oh no, Molly is going to walk this way around the zoo" (trace path with finger)

What animals is Molly going to see?
. ____*(Correct if necessary, children must name them in order)*. Score:_________.

"Molly wants to take a picture of the (*choose middle animal*) when she goes to the zoo. Can you point to the (*animal chosen*)? __________. Score:___________.

There is no locker in front of the (*animal chosen)'s* cage *(point to cage)*, so there is no place to leave her camera."
(*open all 4 lockers*)

"You could leave the camera in one of the other lockers and then Molly could get it when she goes around the zoo. Here is a **sticker**. Can you put this sticker on the locker that Molly should leave her camera in, so she can take a picture of the (*animal chosen)* when she goes to the zoo?"

(*DO NOT ALLOW CHILD TO ACT OUT SEQUENCE, INCLUDING PUTTING CAMERA IN LOCKER)

Child's response:____ Score:__________.

If no response, say: "Can you put this sticker on the locker that Molly should leave the camera in?"

"What direction is Molly going to go round the zoo?"
Child's response ____. Score:__________.
(If child gets it wrong, no need to correct)

"What animal does Molly want to take a photo of?"
Child's response ____. Score:___________.
(If child gets it wrong, no need to correct)

Trial 2

Set up aquarium task as follows: Place mat on table and put 5 containers around the path so that there is one in the middle, two at the corners and two at the ends. Place the lockers in front of all containers, with the exception of the second container (see below for direction). Make sure that all the lockers are unlatched. Ask child to put the animals in the "tanks".

(Take out brown haired doll). "This is my friend Jake. Jake will be going to the aquarium. Do you know what an aquarium is? An aquarium is a place where you go and see sea animals and fish. Lots of different sea animals and fish live in the aquarium, and sometimes these animals and fish live in fish tanks."

"Jake has a camera with him that he wants to bring to the aquarium. Jake doesn't have his backpack with him, so he can't carry his camera around the aquarium with him. But look, there are these lockers in front of some of the tanks in the aquarium. These lockers can be opened and we can put things inside them."

"You could leave the camera in one of these lockers and then Jake could get it when he's going to the aquarium."

"Look, there is a path in the aquarium that Jake has to walk on. *(Trace the path with your finger,* ***clockwise****)*

Jake must always follow this path *(trace the path with finger)*, and he can only go around the aquarium once. He cannot go back and visit any of the animals again."

"Can you point to the start of the path?______________. Score:_________.
(Correct child if wrong answer: e.g. "oh no, the start of the path is over here")

Can you point to the end of the path?_______. Score:___________.
(Correct child if wrong answer: e.g. "oh no, the end of the path is over here")

And which way is Jake going to walk around the aquarium?___________. Score:________.
(Correct child if wrong answer: e.g. "oh no, Jake is going to walk this way around the aquarium" (trace path with finger)

What animals is Jake going to see?____.
(Correct if necessary, children must name them in order)." Score:________.

"Jake wants to take a picture of the (***pick 2nd animal***) when he goes to the aquarium.

"Can you point to the (*animal chosen*)? __________. Score:____________.

"There is no locker in front of the (*Animal chosen*)'s tank *(point to tank)*, so there is no place to leave his camera."
(open all 4 lockers)

"You could leave the camera in one of the other lockers and then Jake could get it when he goes around the aquarium. Here is a sticker. Can you put this sticker on the locker that Jake should leave his camera in, so he can take a picture of the (*animal chosen*) when he goes to the aquarium?"

Child's response:____. Score:_______.

If no response, say: "Can you put this sticker on the locker that Jake should leave the camera in?"

"What direction is Jake going to go round the aquarium?"
Child's response ____. Score:_______.

(If child gets it wrong, no need to correct)

"What animal does Jake want to take a photo of?"
Child's response ____. Score:_______.
(If child gets it wrong, no need to correct)

Act out sequence of events if child indicates desire to.

SEQUENCING TASK

Child seated next to experimenter, closest to the nearest point on the timeline

"Today, we're going to play a game about how long until things happen in the future"

"Look at this board, this shows us how long until things happen"

"Look at this picture here [*closest cue card*], this is a picture of a person as big as you… a [*3,4,5*] year old, like you are right now. We put things here that are going to happen in only a little time, like around how big you are now."

"Look at the picture over there [*largest cue card*], this is a picture of a really big person, like you when you are going to be really really big, like when you are like [*mom or dad*]. We will put things over there that are going to happen in a really, really long time, like when you are really big."

"So, remember we put things here, when they are going to happen in a little time and over there when they are going to happen in a really long time [*gesturing to appropriate cue cards*]."

"So, let's play the game – look at this picture, what is this a picture of? It's a picture of a… [*e.g. man/woman going to work],* like when you…[*are going to go to work*]. When are you going to …[*go to work*]? Put it where you think it should go…(*If no response, prompt by saying* "In a little time or a long time?") (*Correct 1st trial (furthest category) if wrong)*

Then repeat with 5 following items

Items placed in near category:____

Items places in far category*:* ____

-if placed midway, encourage child to select one point

The first item presented is always an item from the far distant category.
The remaining five items are presented in random order, with the restriction that no more than two items of the same category are presented in a row.

Child- going home (house), having dinner (plate with food), playing at the park (park equipment) or playing in the snow (snowman) – (for use in winter testing), and Adult - getting married (couple kissing), going to work (person in front of a computer- woman for girl, man for boy), cooking dinner (people cooking).

THEORY OF MIND TASKS:

DIVERSE DESIRES

Children see a toy figure of an adult, a picture of a cookie, and a picture of a carrot.

Own-desire question - "Here's Mr. Jones. It's snack time, so Mr. Jones wants a snack to eat. Here are the two different snacks: a carrot and a cookie. Which snack would you like best? Would you like a carrot or a cookie best?"____.

__*If the child chooses the carrot*: "Well, that's a good choice, but Mr. Jones really likes cookies. He doesn't like carrots. What he likes best are cookies."

__*If the child chooses the cookie*: "Well that's a good choice, but Mr. Jones really likes carrots. He doesn't like cookies. What he likes best are carrots."

__*Target question* – "So, now it's time to eat. Mr. Jones can only choose one snack, just one. Which snack will Mr. Jones choose? A carrot or a cookie?"____________________________.

To be scored as correct the child must answer the target question opposite from his or her answer to the own-desire question.

DIVERSE BELIEFS

Children see a toy figure of a girl and a sheet of paper with bushes and a garage drawn on it.

Own-belief questions: "Here's Linda. Linda wants to find her cat. Her cat might be hiding in the bushes or it might be hiding in the garage. Where do you think the cat is? In the bushes or in the garage?

Child's response:____.

__*If the child chooses the bushes*: "Well that's a good idea, but Linda thinks her cat is in the garage. She thinks her cat is in the garage."

__*If the child chooses the garage*: "Well that's a good idea, but Linda thinks her cat is in the bushes. She thinks her cat is in the bushes."

Target Question: "So, where will Linda look for her cat? In the bushes or in the garage?"

__Child's response:____.

To be correct, the child must answer the target question opposite from his or her answer to the own-belief question.

KNOWLEDGE ACCESS TASK

Children see a nondescript wooden cupboard containing a small plastic toy dog inside the closed drawer.

"Here's a cupboard. What do you think is inside the cupboard?"

.

(Can be anything, or can indicate that they do not know)

Open the drawer: "Let's see … it's really a dog inside!"

__*Close the drawer*: "Okay, what is in the cupboard?"

.

A toy figure of a girl is produced.

__"Polly has never ever seen inside this cupboard. Now here comes Polly. So, does Polly know what is in the cupboard?" (*target question*)

.

__Did Polly see inside this cupboard? (*memory control*)

.

(Both correct answers are no)

CONTENTS FALSE BELIEF TASK

(Child sees a band-aid box, closed with a plastic toy pig inside)

"Here's a band-aid box. What do you think is inside the band-aid box?

_________________.

Open box: "Let's see… it's really a pig inside!"

__*Close box*: "Ok, what is in the band-aid box?" __________________________________.

(A toy figure of a boy is produced):

__"Peter has never ever seen inside this band-aid box. Now here comes Peter. So, what does Peter think is inside the box? (*Target question*) ________________. (*If no response*: Band-aids or a pig?")

(Correct Answer – Band-Aids)

__"Did Peter see inside this box?" (*Memory question*)_____________________________.

(Correct Answer – No)

CHANGE IN LOCATION

"Here's Bert and here's Ernie. And, here's a **blue box** and here's a **red box**. Bert is playing with this ball. Then, Bert puts the ball in this **blue box** and leaves to go outside (*Bert is shown leaving and is then placed out of sight).*

"Now Ernie wants to play with the ball, so he goes over to the blue box, gets out the ball, and starts to play with it. And when he's done playing with the ball, he goes over to the **red box**, puts the ball in there, and he goes outside." *(Ernie is shown leaving and then is placed out of sight).*

"Look, Bert is back and wants to play with the ball."

"Where does Bert think the ball is?"
____ *(correct answer: blue)*

If child doesn't respond then ask the following forced-choice question: "Where does Bert think the ball is? Does he think it's in the **blue box** or does he think that it's in the **red box**?"
____

Reality question **(all children need to be asked this question)**: "Where is the ball really?"
____ *(correct answer: red)*

EXECUTIVE FUNCTIONS TASKS:

BLACK/WHITE STROOP

Now we're going to play a different game!

- SHOW BLACK. This card is black, right? When you see this card, I don't want you to say 'black'. No, I want you to say 'white'.
- REMOVE BLACK; SHOW WHITE. This looks like white, right? When you see this card, I don't want you to say 'white'. No, I want you to say 'black'.

Training:

- SHOW WHITE. (IF HESITATION, What do you say for this one?)
  [W] [B] (Good.)

- SHOW BLACK. (IF HESITATION, What do you say for this one?)
  [W] (Good.) [B]

IF WRONG OR NO RESPONSE ON EITHER TRIAL, REPEAT RULES AND TRAINING. **MAX. OF 3 TRAINING SESSIONS**. **ALWAYS CONTINUE WITH TEST TRIALS.**

Testing *(No feedback)*

1	W	**B**	________	8	**W**	B	________	15	W	**B**	________
2	**W**	B	________	9	**W**	B	________	16	**W**	B	________
3	**W**	B	________	10	W	**B**	________	17	W	**B**	________
4	W	**B**	________	11	**W**	B	________	18	W	**B**	________
5	**W**	B	________	12	W	**B**	________	19	**W**	B	________
6	W	**B**	________	13	W	**B**	________	20	**W**	B	________
7	W	**B**	________	14	**W**	B	________	21	W	**B**	________

STANDARD DCCS

Instructions
(*E places file boxes on table. Yellow Star on tray to child's left, red truck on tray to child's right.*)

"Here's a yellow star and here's a red truck. Now we're going to play a card game. This is the COLOUR game. In the COLOUR game, all the yellow ones go here [*pointing to the tray on the left*], and all the red ones go there [*pointing to the tray on the right*]."

Sort one test card, by colour, saying: "See here's a yellow one. So it goes here" [*place it* ***face down*** *in the correct tray*].

"If it's yellow it goes here, but if it's red it goes there."

Show children the other type of test card (e.g. a red truck). "Now here's a red one. Where does this one go?"

If they sort correctly, say: "Very good. You know how to play the colour game."

If they point correctly, say: "Very good. You know how to play the colour game. Can you help me put this red one down?"

Ensure card is placed face down in the appropriate tray, turning it over if necessary.

If child sorts incorrectly, say: "No, this one's red, so it has to go over here in the colour game. Can you help me put this red one down?"

Ensure that the card is placed face down in the appropriate tray.

<u>Pre-switch phase </u>(6 correct trials)

"Now it's your turn. So remember, if it's yellow it goes here, but if it's red it goes there."

"Here's a red/yellow one. Where does it go?"

Whether or not the child sorts correctly, simply say:
"Let's do another one." Or "Let's do it again" or "How about another one"

On each pre-switch trial, repeat the pre-switch rules, select a test card, label it by the appropriate dimensions and ask the child where it goes.

"Remember, if it's yellow it goes here, but if it's red it goes there." "Here's a red/yellow one. Where does it go?"

If the child only points, you may sort the card for them.
-random order, make sure no more than 2 of same card in a row

Total Number Correct sorts: ______ **Number of Colour Errors**: ______

<u>Post-switch phase </u>(6 Trials – 5/6 = a pass)
"Now we are going to play a new game. We're not going to play the colour game anymore. We're going to play the SHAPE game. In the shape game, all the stars go here [*pointing to the tray on the left*], and all the trucks go there [*pointing to the tray on the right*]. Remember if it's a star, put it here, but if it's a truck, put it there. Okay?"

(Do not remove the target cards or the cards that were sorted during pre-switch)

"Here's a truck/star. Where does this one go?"

"Let's do another one."

Total Number shape trials: ______ **Number shape errors**: ______

TOWER OF HANOI

Warm-up with 2 circles
*(Set up the 2 circle Tower of Hanoi, **horizontally in front of the child**, with C's **tower on** the **left peg**.)*

O.K. Now we're going to play a game where we pretend that these wooden circles are monkeys. This small circle is a boy monkey *(point to small circle)* and this large circle is a daddy monkey *(point to large circle)*.

See the boy monkey is sitting on the daddy's back. And we're going to pretend that these pegs *(point to pegs)* are trees. Now you know that monkeys like to jump from tree to tree, right?

Well, these monkeys love to jump from tree to tree. But only one monkey can jump at a time and the daddy monkey can never go on the back of the boy monkey, because you know what would happen?

The daddy is much heavier than the boy and the daddy monkey would smush the boy monkey and we don't want that to happen, do we? But the boy monkey can go on the back of the daddy monkey just like he is now (*point to circles*), because the boy is much smaller than the daddy.

Now there is water all around these trees, so the monkeys always have to stay in the trees and can only jump from one tree to another and never into the water.

Rule #1-- Identification

So would you like to play the monkey jumping game? O.K. Can you point to the boy monkey?

____CORRECT
That's right!

____INCORRECT
Whoops! That monkey is the daddy monkey. Can you point to the boy monkey?
# of tries until correct______

Can you point to the daddy monkey?

____CORRECT
That's right!

____INCORRECT
Whoops! That monkey is the boy monkey. Can you point to the daddy monkey?
# of tries until correct______

Rule #2 – Jumping Rules

Now watch, the boy monkey is going to jump to this tree, like this**. (*move small circle to second peg*)** Remember, the boy monkey can go on the daddy's back, but daddy monkey can never go on the boy's back. Now, where should the daddy jump?

____CORRECT
That's right, cause if he moved here (*point to second peg*), then he would smush the boy monkey and if we moved here (*point to table top*), then he'd fall in the water and we don't want that to happen do we? No way!

____INCORRECT *(repeat until correct)*

Whoops! Oh no, the boy monkey is being smushed*. (remove large circle and **keep in hand***) Remember that the boy can go on the daddy's back, but the daddy can never go on the boy's back. (*Replace large circle on **left peg***) Now where should the daddy jump?
# of tries until correct_____

LEVEL 1— 2 disks, ONE MOVE

(Bring out **E's tower with circles stacked on right peg**. Place parallel to C's board.)

Now look, I've got some just like yours. (*point to E's*) Did you know that monkeys like to copy each other? Well, your monkeys are copycat monkeys (*point to C's*) and they always want to look just like my monkeys (*point to E's*). So, can you make your monkeys look just like my monkeys, so that your monkeys are sitting in this tree *(point to C's right peg*), just like my monkeys are sitting in this tree (*point to E's right peg*).

Indicate Trial #

____ ____**CORRECT # of moves** (1)
That's right! Now your monkeys look exactly like my monkeys. Your monkeys sure are good copycats!

____ ____**COMPLETED TASK IN TOO MANY MOVES** (# of moves made _______)
Now your monkeys look exactly like my monkeys, but maybe they can do it without so much jumping. Let's try again.

INCORRECT (remind of rule broken and indicate which trial)
___ ___ Remember, only **one monkey** can jump at a time.
____ ____ Remember, the monkeys need to be **in the trees**, they can't swim in the water.
____ ____ Whoops! Now the boy monkey is being **smushed by the daddy** monkey. Remember, the boy monkey can be on the back of the daddy monkey, but the daddy monkey can never be on the back of the boy monkey.
____ ____ Whoops! Your monkeys **don't look exactly** the same as mine. See, (state why).

____ ____ Whoops! **My monkeys need to stay** in this tree. They just sit and watch your monkeys jump.
____ ____ Whoops! **Your monkeys need to stay** over in your trees there.
____ ____ Whoops! These **trees can't move.** They need to stay just like this. (turn trees back)

This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level) FAIL (repeat)

TRIAL 2: PASS (go to next level) FAIL (stop)

LEVEL 2 – 2 disk, TWO MOVE

(*Take off C's circles* ***one at a time*** *and* ***place in hands***.) O.K., now I'm going to move your monkeys back over to this tree. ***(place one at a time*** *from hand, with* ***large disk on botToM on C's left peg***). Let's say that the boy monkey jumps to this tree (***move small circle to middle peg***). Now remember, your monkeys (*point to C's board*) like to copy my monkeys (*point to E's board*) Can you make your monkey's look exactly like my monkeys?

Indicate Trial #

____ ____**CORRECT** # of moves (2)
That's right! Now your monkeys look exactly like my monkeys. Your monkeys sure are good copycats!

____ ____**COMPLETED TASK IN TOO MANY MOVES** (# of moves made _______)
Now your monkeys look exactly like my monkeys, but maybe they can do it without so much jumping. Let's try again.

INCORRECT (remind of rule broken and indicate which trial)
___ ___ Remember, only **one monkey** can jump at a time.

____ ____ Remember, the monkeys need to be **in the trees**, they can't swim in the water.
____ ____ Whoops! Now the boy monkey is being **smushed by the daddy** monkey. Remember, the boy monkey can be on the back of the daddy monkey, but the daddy monkey can never be on the back of the boy monkey.
____ ____ Whoops! Your monkeys **don't look exactly** the same as mine. See, (state why).

____ ____ Whoops! **My monkeys need to stay** in this tree. They just sit and watch your monkeys jump.
____ ____ Whoops! **Your monkeys need to stay** over in your trees there.
____ ____ Whoops! These **trees can't move.** They need to stay just like this. (turn trees back)

This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level) FAIL (repeat)

TRIAL 2: PASS (go to next level) FAIL (stop)

LEVEL 3 – 2 disk, THREE MOVE

(*Take off C's circles* ***one at a time*** *and* ***place in hands***.) O.K., now I'm going to move your monkeys back over to this tree. (***place one at a time from hand, with large disk on botToM on C's left peg***). O.K., now can you make your monkeys look exactly like my monkeys?

Indicate Trial #

____ ____**CORRECT** # of moves (3)
That's right! Now your monkeys look exactly like my monkeys. Your monkeys sure are good copycats!

____ ____**COMPLETED TASK IN TOO MANY MOVES** (# of moves made _______)
Now your monkeys look exactly like my monkeys, but maybe they can do it without so much jumping. Let's try again.

INCORRECT (remind of rule broken and indicate which trial)
___ ___ Remember, only **one monkey** can jump at a time.
____ ____ Remember, the monkeys need to be **in the trees**, they can't swim in the water.
____ ____ Whoops! Now the boy monkey is being **smushed by the daddy** monkey. Remember, the boy monkey can be on the back of the daddy monkey, but the daddy monkey can never be on the back of the boy monkey.
____ ____ Whoops! Your monkeys **don't look exactly** the same as mine. See, (state why).

____ ____ Whoops! **My monkeys need to stay** in this tree. They just sit and watch your monkeys jump.
____ ____ Whoops! **Your monkeys need to stay** over in your trees there.

____ ____ Whoops! These **trees can't move.** They need to stay just like this. (turn trees back)

This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level) FAIL (repeat)

TRIAL 2: PASS (go to next level) FAIL (stop)

LEVEL 4 – 3 disk, TWO MOVE

(Take off C's circles ***one at a time*** *and* ***place in hands****.)* Now look who wants to play. This is the new little baby sister monkey. (*Take out tiny circle and place on top of E's other two circles*). Isn't she tiny? Since she's so tiny, the boy monkey can't jump on her back, cause he would smush her, and the daddy monkey can't jump on her back, cause then he would really smush her. But the baby sister monkey can jump on the daddy's back and on the brother's back.

Look, you have a baby sister monkey too. Now let's pretend that the daddy monkey is sitting in this tree (***place large circle on right peg***) and the boy monkey is sitting in this tree (***place small circle on middle peg***) and the baby monkey is sitting in this tree (***place tiny circle on left peg***).
Now remember, your monkeys are copycat monkeys and they like to copy my monkeys.
Can you make your monkeys look exactly like my monkeys?

Indicate Trial #

____ ____**CORRECT** # of moves (2)
That's right! Now your monkeys look exactly like my monkeys. Your monkeys sure are good copycats!

____ ____**COMPLETED TASK IN TOO MANY MOVES** (# of moves made _______)
Now your monkeys look exactly like my monkeys, but maybe they can do it without so much jumping. Let's try again.

INCORRECT (remind of rule broken and indicate which trial)
___ ___ Remember, only **one monkey** can jump at a time.
____ ____ Remember, the monkeys need to be **in the trees**, they can't swim in the water.
____ ____ Whoops! Now the boy monkey is being **smushed by the daddy** monkey. Remember, the boy monkey can be on the back of the daddy monkey, but the daddy monkey can never be on the back of the boy monkey.
____ ____ Whoops! Your monkeys **don't look exactly** the same as mine. See, (state why).

____ ____ Whoops! **My monkeys need to stay** in this tree. They just sit and watch your monkeys jump.

____ ____ Whoops! **Your monkeys need to stay** over in your trees there.

____ ____ Whoops! These **trees can't move.** They need to stay just like this. (turn trees back)

This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level) FAIL (repeat)

TRIAL 2: PASS (go to next level) FAIL (stop)

LEVEL 5 – 3 disk, THREE MOVE

(*Take off C's circles **one at a time** and **place in hands**.*) O.K., let's do another one. Let's pretend that the daddy monkey is sitting in this tree (*place **large circle** on **right peg***) and the boy monkey is sitting in this tree (*place **small circle** on **middle peg***) and the baby sister monkey is sitting on the back of the boy monkey (*place **tiny circle on top of small circle***). Now, can you make your monkeys look exactly like my monkeys?

Indicate Trial #

____ ____**CORRECT** # of moves (3)
That's right! Now your monkeys look exactly like my monkeys. Your monkeys sure are good copycats!

____ ____**COMPLETED TASK IN TOO MANY MOVES** (# of moves made _______)
Now your monkeys look exactly like my monkeys, but maybe they can do it without so much jumping. Let's try again.

INCORRECT (remind of rule broken and indicate which trial)

___ ___ Remember, only **one monkey** can jump at a time.

____ ____ Remember, the monkeys need to be **in the trees**, they can't swim in the water.

____ ____ Whoops! Now the boy monkey is being **smushed by the daddy** monkey. Remember, the boy monkey can be on the back of the daddy monkey, but the daddy monkey can never be on the back of the boy monkey.

____ ____ Whoops! Your monkeys **don't look exactly** the same as mine. See, (state why).

____ ____ Whoops! **My monkeys need to stay** in this tree. They just sit and watch your monkeys jump.

____ ____ Whoops! **Your monkeys need to stay** over in your trees there.

____ ____ Whoops! These **trees can't move.** They need to stay just like this. (turn trees back)

This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level)   FAIL (repeat)

TRIAL 2: PASS (go to next level)   FAIL (stop)

LEVEL 6 – 3 disk, FOUR MOVE

(*Take off C's circles* ***one at a time*** *and* ***place in hands***.) All right, let's do another one. Let's pretend that the daddy monkey is sitting in this tree (*place* ***large circle on left peg***) and the boy monkey is sitting in this tree (*place* ***small circle*** *on* ***middle peg***) and the baby sister monkey is sitting on the back of the boy monkey (*place* ***tiny circle on top of small circle***). Now can you make your monkeys look exactly like my monkeys?

Indicate Trial #

____ ____**CORRECT #** of moves (4)
That's right! Now your monkeys look exactly like my monkeys. Your monkeys sure are good copycats!

____ ____**COMPLETED TASK IN TOO MANY MOVES** (# of moves made _______)
Now your monkeys look exactly like my monkeys, but maybe they can do it without so much jumping. Let's try again.

INCORRECT (remind of rule broken and indicate which trial)
___ ___ Remember, only **one monkey** can jump at a time.
____ ____ Remember, the monkeys need to be **in the trees**, they can't swim in the water.
____ ____ Whoops! Now the boy monkey is being **smushed by the daddy** monkey. Remember, the boy monkey can be on the back of the daddy monkey, but the daddy monkey can never be on the back of the boy monkey.
____ ____ Whoops! Your monkeys **don't look exactly** the same as mine. See, (state why).

____ ____ Whoops! **My monkeys need to stay** in this tree. They just sit and watch your monkeys jump.
____ ____ Whoops! **Your monkeys need to stay** over in your trees there.
____ ____ Whoops! These **trees can't move.** They need to stay just like this. (turn trees back)

This one is a hard one. Let's try again.

TRIAL 1: PASS (stop)   FAIL (repeat)

TRIAL 2: PASS (stop) FAIL (stop)

OK! We're all done with this game. You're doing really well!

TOTAL NUMBER OF TRIALS: ____ HIGHEST LEVEL ACHIEVED: ____

TRUCK LOADING TASK

(*place road on table, place yellow house on block, have yellow envelope in hand, place mail truck, other houses, and envelopes at feet*)

"O.K. Now we're going to play a new game. Let's pretend that you're a mail carrier. We're going to have a party and I need you to deliver this party invitation to this house" *(point to house with invitation).*

(*Point to letter and house again as you say the following*) "See, the yellow invitation goes to the yellow house. First we need to load the truck*" (let child place yellow invitation in back of truck*)

"Now this is a one-way street which means that you can only drive this way with the truck (point with finger). You have to follow the arrows *(point with finger again)*. Why don't you deliver the yellow invitation to the yellow house?" *(place truck at starting point on the road, and make sure child drives the truck all the way around the road).*

Rule 2- direction rule

(Correct as needed) "O.K. remember this is a one-way street, so you need to drive around like this" (*demo*). "Why don't you try again?"

Total # of tries until correct:_____________

"O.K.!"(*take back yellow invitation*)

(place purple house on block with yellow house)

(*demo and explain at the same time for the following section*)

"Now there are two houses that we want to invite to the party. The yellow invitation goes to the yellow house and the purple invitation goes to the purple house" *(point to each house with same color invitation).*

"Now, we need to deliver these party invitations fast so that everyone will be able to come to the party. The fastest way is to drive around the block only one time."

"We need to put the invitations in the back of the truck so that the top letter goes to the house that you are driving by. You always have to take the letter off the top of the truck so that the top invitation goes to the first house and the next invitation goes to the next house."

"So now we need to load the truck. Let's see here, it looks like the first house you will drive by is the yellow house, so the yellow invitation has to go on the very top."

"And the second house you will drive by is the purple house, so the purple invitation needs to go on the bottom."

"So first let's put in the purple invitation and then put in the yellow invitation."

Rule#3—order rule

(*Pile the 2 invitations into back of truck,* ***one at a time***.)
"Now, remember, we can only take an invitation from the top of the truck, but we can never take an invitation from the bottom of the truck. So _______ can I take one from the bottom like this?" (*demo*)

Circle one: YES NO

No way!

If child says yes, repeat until child says no (max 3 times, then move on to level 1)
Total # of tries until correct:______________

"Now let's deliver the invitations. Why don't you drive?" (*try and have C deliver the invitations, but help if needed:* "See,________, now as I drive by, I can first deliver the yellow invitation to the yellow house and then next I can deliver the purple invitation to the purple house. Yeah, now everyone can come to the party!")

LEVEL 1: 2 houses

(*Place* ***red*** *house and* ***green*** *house on street so that* ***red house is first****. Then point to each house with the same color invitation saying,* "Here's a red invitation for the red house and a green invitation for the green house" *and then pick up invitations and hold in hand*)

"Now it's your turn to deliver the party invitations to all of the houses on the block so that everyone can come to the party. O.K., remember the rules, each color invitation goes to the same color house, and you need to follow the arrows around the block because this is a one-way street. And when delivering the invitations, you can only take the top invitation; you can never take one from the bottom."

"Here are the invitations." *(Place red card down in front of child, slightly to child's left, and the green card slightly to child's right)*

"O.K., now it's your turn to load the truck."

Indicate Trial #

____ ____ CORRECT
Good job! Let's add another house.

INCORRECT (remind of rule broken and circle)
____ ____ [rule 1—**color matching**] Whoops! Remember each color invitation goes to each color house
____ ____ [rule 2 –**direction rule**] Whoops! Remember this is a one-street, so you have to follow the arrows. You can only drive in one direction, no backing up.
____ ____ [rule 3 –**order rule**] Whoops! Remember you can only take an invitation from the top of the truck. You can never take an invitation from the bottom of the truck.
____ ____ [**tries to drive around block another time**] Whoops! We ran out of time. It's time for the party to start. Remember you can only drive around the block one time.
This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level) FAIL (repeat)

TRIAL 2: PASS (go to next level) FAIL (stop)

LEVEL 2: 3 houses

"Now let's pretend that there are 3 houses on the block and you want to invite all 3 houses to the party." (*place 3 houses on the block so that the order is* ***blue, yellow, green*** *and point to each house using the same color invitation saying "*Here's a blue invitation for the blue house,….."*and then pick up the cards again*)

"Here are the invitations" (***place green*** *invitation down slightly to C's left*, *place* **blue** *invitation in front of C and then place* ***yellow*** *invitation down slightly to C's right*)
"Go ahead and load up the truck."

Indicate Trial #

____ ____ CORRECT
Good job! Let's add another house.

INCORRECT (remind of rule broken and circle)

____ ____ [rule 1—**color matching**] Whoops! Remember each color invitation goes to each color house

____ ____ [rule 2 –**direction rule**] Whoops! Remember this is a one-street, so you have to follow the arrows. You can only drive in one direction, no backing up.

____ ____ [rule 3 –**order rule**] Whoops! Remember you can only take an invitation from the top of the truck. You can never take an invitation from the bottom of the truck.

____ ____ [**tries to drive around block another time**] Whoops! We ran out of time. It's time for the party to start. Remember you can only drive around the block one time.

This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level) FAIL (repeat)

TRIAL 2: PASS (go to next level) FAIL (stop)

Level 3: 4 houses

"Now let's pretend that there are 4 houses on the block and you want to invite all 4 houses to the party." (*place 4 houses around the block so that the order is* ***purple, green, blue, yellow,*** *and point to each house using the same color invitation saying "*Here's a purple invitation for the purple house,…." *And then collect up all of the cards)*

"Here are the invitations." *(place the cards from left to right in the following order so they are centered in front of child in a horizontal line****: green, blue, purple, yellow)***

"Go ahead and load up the truck."

Indicate Trial #

___ ___ CORRECT

Good job! Let's add another house.

INCORRECT (remind of rule broken and circle)

____ ____ [rule 1—**color matching**] Whoops! Remember each color invitation goes to each color house

____ ____ [rule 2 –**direction rule**] Whoops! Remember this is a one-street, so you have to follow the arrows. You can only drive in one direction, no backing up.

____ ____ [rule 3 –**order rule**] Whoops! Remember you can only take an invitation from the top of the truck. You can never take an invitation from the bottom of the truck.

____ ____ [**tries to drive around block another time**] Whoops! We ran out of time. It's time for the party to start. Remember you can only drive around the block one time.

This one is a hard one. Let's try again.

TRIAL 1: PASS (go to next level) FAIL (repeat)

TRIAL 2: PASS (go to next level) FAIL (stop)

Level 4: 5 houses

"Now let's pretend that there are 5 houses on the block and you want to invite all 5 houses to the party." *(place 5 houses on the block so that the order is **green, yellow, red, purple, blue**)*

"Here are the invitations." *(place the cards from left to right in the following order so they are centered in front of child in a horizontal line: **green, blue, purple, red, yellow**)*

"Go ahead and load up the truck."

Indicate Trial #

____ ____ CORRECT
Good job!

INCORRECT (remind of rule broken and circle)
____ ____ [rule 1—**color matching**] Whoops! Remember each color invitation goes to each color house
____ ____ [rule 2 –**direction rule**] Whoops! Remember this is a one-street, so you have to follow the arrows. You can only drive in one direction, no backing up.
____ ____ [rule 3 –**order rule**] Whoops! Remember you can only take an invitation from the top of the truck. You can never take an invitation from the bottom of the truck.
____ ____ [**tries to drive around block another time**] Whoops! We ran out of time. It's time for the party to start. Remember you can only drive around the block one time.
This one is a hard one. Let's try again.

TRIAL 1: PASS (stop) FAIL (repeat)

TRIAL 2: PASS (stop) FAIL (stop)

OK! We're all done with this game. You're doing really well!

TOTAL NUMBER OF TRIALS: ________

HIGHEST LEVEL ACHIEVED: _______

WORD FLUENCY TASK

If child has not yet completed the Tomorrow Task: “This is my friend Scruffles. He is very curious. He would like to know how many animal names you know. Can you tell him the name of one animal? ________________(If no response, prompt: “What kind of animal is Scruffles? That’s right Scruffles is a dog”). Can you tell Scruffles as many animals as you can, as fast as you can? Ready, it’s a race. Tell Scruffles all the animals you can think of. Ready? Go!”

If child has already completed Tomorrow Task: “Remember my friend Scruffles? He would like to know how many animal names you know. Can you tell him the name of one animal? .__________(If no response, prompt: “What kind of animal is Scruffles? That’s right Scruffles is a dog”).Can you tell Scruffles as many animals as you can, as fast as you can? Ready, it’s a race. Tell Scruffles all the animals you can think of. Ready? Go!”

Record names of animals for 30 seconds (using a timer but don’t let it beep):

If no response, prompt only once: “Tell Scruffles the names of some animals!”

Number of novel animal names generated:________.

“Great job! Now Scruffles would like to know how many names of foods you know. Can you tell him the name of a food?____________(If no response, prompt with “Scruffles likes bacon, that’s a food. Can you think of another food?”). Can you tell Scruffles as many foods as you can, as fast as you can? Ready, it’s a race. Tell Scruffles all the foods you can think of. Ready? Go!”

Record names of foods for 30 seconds (using a timer but don’t let it beep):

Number of novel food names generated:__________.

Counting and Labeling

“Now I’m going to show you some little things.”

Set out Boat, Apple and Bird. (Point to each toy as it’s mentioned and counted)

"I'm going to name these toys: Boat, Apple, Bird."

"Now I'm going to count them: One, Two, Three."

"Now I'm going to count and name them at the same time:"

"One is a Boat, Two is an Apple, Three is a Bird."

Set out Dog, Tree and Car.

"It's your turn now. Can you name these toys?" (correct if needed)

"Can you count them?" (correct if needed)

"Now count and name them at the same time." (**do not correct**)

☐ (√ or x)

Set out Star, Train and Cat

"It's your turn again. Can you name these toys?" (correct if needed)

"Now count them." (correct if needed)

"Now count and name these toys at the same time." (**do not correct**)

☐ (√ or x)

BACKWARD DIGIT SPAN

Instructions: Say one digit per second. Stop when child makes an error on both strings of the same length (e.g., when <u>both</u> items 5 <u>and</u> 6 are incorrect). Provide no feedback after 2 training trials.

"This is my friend, Jenny. Whenever I say numbers, Jenny says them backwards. Listen: **5 – 8**. (*Jenny says*:) **8 – 5**. Now I want you to do the same as Jenny and say my numbers backwards. Do you understand? Let's try one. Ready? Listen carefully. Remember to say the numbers backwards. **2 – 4**." *(score below, correct if needed)*

"Let's try another one. Remember to say the numbers backwards. **7 – 1**." *(score below, correct if needed)*

Child must get at least one training trial correct in order to move on to test trials (if both training trials are incorrect, repeat rules and training max 3 times, then proceed with test trials)

	Digits Forward	Child's Response
i.	**2 – 4** ("That's right!" or correct the mistake)	____ – ____ ; ____ – ____
ii.	**7 – 1** ("That's right!" or correct the mistake)	____ – ____ ; ____ – ____

1.	**6 – 3**	_____ – _____
2.	**4 – 9**	_____ – _____
3.	**2 – 9 – 5**	_____ – _____ – _____
4.	**8 – 1 – 6**	_____ – _____ – _____
5.	8 – 5 – 2 – 6	_____ – _____ – _____ – _____
6.	4 – 9 – 3 – 7	_____ – _____ – _____ – _____
7.	**8 – 1 – 3 – 7 – 9**	_____–_____–_____–_____–____
8.	**4 – 2 – 5 – 8 –1**	_____–_____–_____–_____–____
9.	9 – 3 – 5 – 1 – 8 – 4	_____–_____–_____–_____–_____–_____
10.	6 – 5 – 8 – 4 – 2 – 7	_____–_____–_____–_____–_____–_____