

Preschoolers' Saving: A Behavioural Manifestation of Episodic Foresight

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ABSTRACT

The aim of this dissertation was to develop a novel behavioural method to assess young children's capacity for episodic foresight. Specifically, I developed a marble game paradigm to assess whether 3-, 4-, and 5-year-old children would save marbles for future enjoyment. Study 1 demonstrated that preschoolers will save more spontaneously when they can draw on a recent past experience compared to when the context is completely novel. Results from study 1 also suggest that preschoolers are sensitive to the relative value of future rewards. Study 2 revealed that providing children with a verbal prompt alerting them to their possible courses of action (i.e., saving or spending) facilitated saving, that 5-year-olds saved more than 3-year-olds, and that children's performance on this behavioural (i.e., nonverbal) measure of saving was independent of their language proficiency. Children's saving was not associated with other capacities hypothesized to relate to episodic foresight (theory of mind, inhibitory control, and working memory). Implications for children's saving, the development of episodic foresight, and future research are discussed.

Preschoolers' Saving: A Behavioural Manifestation of Episodic Foresight

There has been a surge of research in the last decade on humans' capacity for episodic foresight: the cognitive process that allows humans to mentally project themselves forward in time. The main goal of my doctoral research was to develop a novel behavioural paradigm to assess young children's capacity for episodic foresight. More specifically, children's saving behaviour became my phenomenon of interest for two reasons. First, human saving behaviour, defined here as "reserving resources for future enjoyment" (Metcalf & Atance, 2011), arguably reflects - or at least involves - episodic foresight. Second, research on young children's capacity for saving is noticeably absent from the developmental literature. To address this gap in the literature, I developed a marble game paradigm to assess whether 3-, 4-, and 5-year-old children (i.e., "preschoolers") would save marbles for future enjoyment. The specific research questions for this dissertation were as follows (1) Will preschoolers save spontaneously (i.e., without being prompted to do so) in a novel context that involves opportunities to "spend" in the present? (2) Will preschoolers save more spontaneously when they can draw on a recent past experience (i.e., in a familiar context) compared to when the context is completely novel? (3) Will preschoolers save less when spending (i.e., using marbles) in the anticipated future context will yield less enjoyment than spending in the present? (4) Does providing children with a verbal prompt alerting them to their possible courses of action (i.e., saving or spending) facilitate saving? (5) Is preschoolers' saving associated with other capacities purportedly related to episodic foresight including, theory of mind (ToM), inhibitory control (IC), and working memory (WM)? (6) Is preschoolers' performance on this behavioural (i.e., nonverbal) measure of saving independent of their language proficiency? (7) Does saving increase with age among 3- to 5-year-olds?

Organization of the Introduction

I begin by discussing why saving is an important topic for empirical investigation, followed by an overview of the small body of previous research on specific forms of saving among children. Next, I introduce the topic of episodic foresight more broadly, beginning with an overview of relevant terminology and the conceptualization of the construct. A review of previous research on episodic foresight follows, focusing most heavily on methods designed to assess this capacity in young children. Finally, I discuss the limitations of previous developmental studies of episodic foresight and how certain existing methods inspired the development of the new paradigm that is the focus of this dissertation.

Why Study Saving?

Saving for the future is a highly adaptive human behaviour. The word “saving” may elicit thoughts of piggy banks, retirement accounts, and college funds, but the benefits of saving extend to many life domains. For example, saving underlies actions such as rationing food, storing a child’s outgrown clothes for future children, and refraining from enjoying a bottle of champagne one is saving for a special occasion. Upon realizing that all of our fresh produce won’t get eaten before it perishes, we freeze it to make soup in the future, rather than throwing it away. Similarly, traditional farming involves saving seeds to plant the following season. Even time can be saved, as in the case of an employee who avoids taking single vacation days throughout the winter in order to enjoy a long holiday come summertime.

When it comes to money, saving varies considerably, even among households with similar socioeconomic characteristics (Venti & Wise, 1998; Bernheim, Skinner, & Weinberg, 2001). Overall, however, people tend to save less than what experts recommend (Bernheim, 2000). Indeed, saving rates have been, and continue to be, on the decline in a number of

countries including Canada, Australia, the United Kingdom, the United States, and Japan (Organization for Economic Co-operation and Development, 2012; Pasquali & Aridas, 2013). In Canada, for example, personal savings rates fell from over 20% in 1981 to below 2% by 2005 (TD Bank Financial Group, 2013). Current RRSP trends are equally concerning in this country: Participation in RRSP plans fell from 41% in 1997 to 34% in 2008, reflecting decreased participation from all age groups and income levels (Moussaly, 2010). Similarly, in the United States, the percentage of workers projected to have adequate funds to maintain their lifestyle through retirement decreased from 53% in 1983 to 31% in 2010 (Munnell, Webb, Golub-Sass, 2012). Based on these trends, today's children will need to exercise greater thrift in young and middle-adulthood in order to avoid the pitfalls currently faced by today's adults. Preparing young children for a life of increased thrift requires not only an understanding of their capacity to save, but also what factors might facilitate saving and future-oriented decision making in general among young children.

Children's Saving: Insights from Economic psychology

Despite the absence of research on saving in the developmental psychology literature, some economic psychologists have attempted to study children's saving behaviour from a developmental perspective. Sonuga-Barke and Webley (1991) developed a "play economy" paradigm to study the saving behaviours of 4-, 6-, 9-, and 12-year-old children. Sixteen girls (four in each age group) began each of three weekly experimental sessions earning tokens in a lever-pressing game. Each token they earned was recorded as a checkmark on a grid on a blackboard. The play economy consisted of a board game and three stations arranged around a room representing a "toy shop" and a "candy shop" (where children could spend tokens), as well as a "bank" (where children could save tokens). The toy shop, the candy shop, and the bank, as

well as a burglar and a tollbooth, were each represented by squares on the board game. Children completed one circuit around the board game per visit, during which they moved from one square to another in a clockwise fashion. As they moved around the board, children encountered the first bank square, the robber, the second bank square, the sweetshop, the third bank square, the tollbooth, the fourth bank square, and finally the toyshop. When children landed on the square associated with the candy shop, they could choose to buy candies or not (each candy cost one token). Children who had tokens on their person lost one when they landed on the robber square and all children had to pay one token at the tollbooth in order to continue. Bank squares were positioned so that they preceded squares where children could lose or spend money. For example, children who anticipated losing a token to the robber or being tempted to buy candies could deposit all of their tokens in the bank before landing on these squares. Similarly, children could withdraw tokens from the bank before landing on the tollbooth or toyshop. Each time children spent or lost a token, a checkmark was removed from the blackboard. The goal of the game was to save (i.e., avoid spending or losing) enough tokens to buy a target toy from the toy shop at the end of the circuit. Of interest was whether children would make use of the bank to save tokens in anticipation of temptation or theft. Across the three visits, the number of times children had all their tokens in the bank as they passed the robber and the sweet shop increased significantly with age. Children's withdrawal of tokens from the bank before the tollbooth also increased with age. The largest differences occurred between 6- and 9-year-olds. These findings indicate that older children were more likely to act in the present to solve a problem they anticipated encountering in the future (e.g., the threat of robbery or their own temptation, and the need to pay the toll to reach the target). The authors reported that no practice effects were found from one visit to the next.

More recently, Otto, Schots, Westerman, and Webley (2006) extended this approach to examine the saving behaviours of a larger sample of school children. Thirty six boys between the ages of 6 and 11 years played a board game which functioned as an artificial economy. The structure of the board game was similar to Sonuga-Barke and Webley's (1991) in that it included opportunities for children to spend and save tokens. Again, the goal was for children to save enough tokens to purchase a desirable target toy at the end of the circuit. Analyses of children's performance revealed that older children (10- to 11-year-olds) were not significantly more successful than younger children (6- to 8-year-olds) at saving enough tokens to buy the target toy. Although children's success rates did not yield the expected age differences, the authors reported significant differences in the saving *strategies* used by younger and older children. Specifically, older children tended to maintain a reserve of tokens they could draw on if they encountered losses, while younger children tended to adopt the precautionary strategy of spending little or no tokens during the board game.

Although these studies do not provide insight into whether, when, or how saving behaviour emerges among younger children, they do offer clever paradigms for assessing the future-oriented behaviour of children in a specific context (i.e., a play economy). With the exception of these studies, most of the literature on saving has focused on the economic behaviour of adults (Benartzi & Thaler 2007; Hershfield et al., 2011; Joireman, Sprcott, & Spangenberg, 2005; McClure, Laibson, Loewenstein, & Cohen, 2004; Thaler & Benartzi, 2004). In this literature, saving is defined as the postponement of some consumption to the future, which implies awareness of future needs (Otto, Schots, Westerman, & Webley, 2006; Warneryd, 1999). Indeed, despite their differences, all theories of saving acknowledge that saving requires overcoming a conflict between our present and future selves (see Otto, Davies, & Chater, 2007

for a review). In this sense, saving arguably reflects one of our species' most advanced cognitive abilities: episodic foresight (Suddendorf, 2010). In the sections that follow, I describe how the construct of episodic foresight was shaped by related ideas about "mental time travel" and established theories about episodic memory.

Defining and Conceptualizing Episodic Foresight

Mental time travel and episodic memory. *Mental time travel* (Suddendorf & Corballis 1997, 2007; Tulving, 1983, 1999) describes the cognitive process that allows humans to mentally project themselves backwards or forwards in time. Tulving conceived of mental time travel as being mediated by the episodic memory system (Tulving, 1999). He distinguished semantic memory from episodic memory, proposing that each is associated with a different level of consciousness (1972, 1985). Accordingly, semantic memory involves knowing about past events and is associated with noetic consciousness - the type of consciousness that allows for the retrieval and awareness of objective knowledge about events and facts about the world. Although semantic memory allows for recall of the details associated with a past event, it does not involve the subjective re-experiencing of this event (Wheeler, Stuss, & Tulving, 1997).

In contrast, episodic memory consists of remembering personally experienced events and is associated with autonoetic consciousness - the awareness that one's self and experiences extend across time (Tulving, 1985, 1989; Wheeler, 2000). To illustrate, semantic retrieval is the process by which a person is able to recall the name and location of the animal shelter where she adopted a rabbit. Such details can be recalled without drawing on the personal experience of adopting the rabbit. However, when this same person re-experiences the joy she felt when she brought her new rabbit home, she is doing so via the episodic memory system.

Episodic future thinking. Tulving argues that a major adaptive advantage of episodic memory is the ability to mentally construct one's personal future. Drawing on Tulving's ideas about episodic memory, Atance and O'Neill (2001) introduced the term *episodic future thinking* to describe the capacity to mentally project oneself into the future to pre-experience events and their personal relevance. For example, imagine that a young woman arrives at a dinner party without a gift for the host and subsequently feels embarrassed upon learning that all the other guests have brought gifts. The next time this young woman is invited to a dinner party, she can draw on this past event to *pre-experience* the embarrassment she will feel if she were to show up empty handed again. Based on such pre-experiencing, this woman may decide to adjust her behaviour in the present (i.e., by purchasing a gift for the host) to avoid re-experiencing embarrassment in the future. This example illustrates how foresight can facilitate *behaviour* that benefits one's future self. Atance and O'Neill (2001; 2005) distinguished this type of thinking about the future (which is flexible and allows for anticipation of events that are relatively novel and uncertain) from that which is based on scripts (memories of how a routine event typically unfolds).

Refining terminology: episodic foresight. In addition to *episodic future thinking*, the terms *mental time travel into the future* (Suddendorf & Corballis, 1997), *prospection* (Buckner & Carroll, 2007), *projection* (Okuda et al., 2003), *simulation* (Schacter, Addis, & Buckner, 2008) and - most recently - *episodic foresight* (Suddendorf, 2010) have been used to reflect the cognitive capacity to vividly envision events that might occur in one's personal future. The term *episodic foresight* was adopted in a special issue devoted entirely to children's future-oriented thinking and behaviour (*Cognitive Development*, 26, 2011) and - in the interests of simplicity and consistency - is the term adopted for use for the remainder of this dissertation. *Episodic foresight*

(EpF) is intended to capture both the imaginative component of future thinking and the capacity to organize current behaviour in anticipation of future circumstances (Suddendorf & Moore, 2011).

The Adaptive Functions of Foresight: Why Study EpF?

The capacity to think about the future is an essential part of what makes us human. It allows us to envision our future goals and anticipate possible consequences of present actions - whether these pertain to a job interview tomorrow, an exam we will write in a week's time, or retirement thirty years from now. If we could not envision ourselves in the future - however near or distant - we would lack the necessary frame of reference to guide our choices and planning in the present. The future scenarios we can imagine are unlimited, allowing us to anticipate how we might respond to each, to foresee obstacles, and to plan flexibly for alternatives (Hudson, Mayhew, & Prabhakar, 2011; Suddendorf & Redshaw, 2013).

Existing Research and Theory about EpF

Initially, most of the research on episodic foresight focused on the similarities between thinking about the future and remembering the past among human adults (e.g., Addis, Wong, & Schacter, 2007; Okuda, Fujii, Ohtake, Tsukiura, Tanji, Suzuki, et al., 2003; Schacter, Addis, & Buckner, 2007; Szpunar & McDermott, 2008). However, episodic foresight and future-oriented behaviour have since emerged as areas of interest across a range of fields including neuroscience (Botzung, Denkova, & Manning, 2008; Buckner & Carroll, 2007; Hassabis, Kumaran, Vann, & Maguire, 2007), comparative cognition (e.g., Raby & Clayton, 2009; Roberts & Feeney, 2009; Suddendorf & Corballis, 2010), and developmental psychology (e.g., Atance & Meltzoff, 2005; Busby & Suddendorf, 2005; Hudson, 2006; Lemmon & Moore, 2007). In this section, my review of previous studies begins with those supporting a relationship between remembering personal

past events and imagining future ones in adult participants, followed by an overview of other cognitive capacities theorized to be involved in, or necessary for, EpF. I then review the relevant developmental research.

Studies of the association between memory and EpF in adults. Tulving (1985) argued that remembering our personal pasts and mentally projecting ourselves into personal futures both rely on “autonoetic consciousness” - the self’s awareness of its existence across time (past, present, and future). More recently, researchers (e.g., Buckner & Carroll, 2007) have argued that episodic memory and EpF are both served by the same core brain network, and thus rely on similar neurocognitive resources. Case studies of amnesic patients have demonstrated a connection between individuals’ episodic memories and their capacity for self-projection into possible futures (EpF). A well-known case study describes the presentation of K.C. (formerly N.N.), who suffered frontal lobe damage and amnesia following a motorcycle accident (Tulving, 1985). Although he displayed relatively intact language and general knowledge, K.C.’s capacity for mental time travel was severely impaired, rendering him unable to report what he had done prior to his interview and what he would do the following day.

Similarly, Klein et al. (2002) studied patient, D.B., who presented with amnesia after suffering what was presumed to be hypoxic brain damage following cardiac arrest. Not only was D.B. unable to recall his personal past, he could not describe a personal future event either. In contrast to his impaired episodic memory and foresight, when asked about public (as opposed to personal) past and future events (e.g., “Can you tell me what you think will be the most important medical breakthroughs likely to take place in the next ten years?”), D.B. performed no differently than neurologically healthy controls.

These case studies illustrate that impairments in episodic memory often occur jointly with impairments in episodic foresight. However, a major limitation of these case studies is that patients' impairments tend not to be restricted to amnesia, meaning that their observed deficits in EpF could also be attributed to a loss of skills other than episodic memory. More recently, neuroimaging studies with healthy adult participants have addressed this issue.

In one of the first studies supporting a link between memory and foresight among healthy adults, Okuda et al. (2003) used positron emission tomography (PET) to measure participants' regional cerebral blood flow (rCBF) while they talked about past and future experiences. The researchers observed that several regions in the frontal and medial temporal lobes were activated both when participants recalled personal experiences and when they imagined future ones. Using functional magnetic resonance imaging (fMRI) techniques, Addis et al. (2007) and Szpunar, Watson, and McDermott (2007) reported findings consistent with those of Okuda et al. In addition to identifying common brain activations for both retrospection and prospection, these studies also identified separate brain regions that are uniquely activated during either recollection or self-projection. For instance, Addis et al. observed that the actual construction (as opposed to the elaboration) of future scenarios involved brain regions not activated during the construction of past events. The activation of these additional regions may be explained by the need to flexibly recombine memories from one's personal past when envisioning possible future scenarios (Schacter, Addis, & Buckner, 2007).

Cognitive factors implicated in EpF. In addition to revealing an overlap in brain regions involved in both episodic memory and episodic foresight, the neuroimaging studies discussed in the previous section suggest that EpF also involves additional neurocognitive processes. As it pertains to this dissertation - for which I explored saving as a behavioural

manifestation of EpF from a developmental perspective - this raises the question: what cognitive factors may contribute to the development of EpF? Suddendorf and colleagues (e.g., Suddendorf & Corballis, 1997; Suddendorf & Corballis, 2007) argue that a flexible anticipation system likely involves a number of cognitive components including imagination, a representational space (i.e., working memory), semantic memory (i.e., knowledge of scripts), offline processing (via which newly acquired information is combined with long-term memories), metarepresentation (i.e., theory of mind), language, recursion [“a computation procedure that calls itself”, as exemplified in sentences such as, “I think that you think...” (Suddendorf & Corballis, 2007, p. 16)], an understanding of the time dimension itself, self-awareness, metacognition (i.e., thinking about thinking), inhibitory control, and prospective memory (remembering to perform a future action at a specified time). Rather than cover all of these factors in depth, I will limit the scope of my review to those that have received the most theoretical and empirical attention: theory of mind (ToM), inhibitory control (IC), and working memory (WM).

EpF and ToM. Theory of mind is the cognitive process that allows us to understand our own and others' behaviour in terms of such mental states as desires, thoughts, and beliefs (Taylor, 1996; Wellman & Liu, 2004). A number of authors have posited a link between future thinking and ToM (e.g., Atance & Meltzoff, 2005; Buckner & Carroll, 2007; Moore, Barresi, & Thompson, 1998; Spreng, Mar, & Kim, 2009; Suddendorf & Corballis, 1997; 2007; Suddendorf & Redshaw, 2013). Buckner and Carroll (2007) argued that prospection, retrospection, and adopting others' perspectives (i.e., ToM) all involve the same core brain network: the frontal and temporal-parietal lobe and systems. The unifying feature of these processes is that each of them involves calling to mind noncurrent events or perspectives. Case studies of patients with frontal lobe damage who display impaired prospective and retrospective abilities (Klein et al., 2002;

Tulving, 1985) lend some support to the idea of a common neural network. In addition, Spreng, Mar, and Kim (2008) observed overlap in the brain areas activated when participants recalled their personal pasts, imagined their personal futures, and engaged in ToM reasoning.

Representational ToM is often referred to as “metarepresentation”, that is, mental representations of external representations (Dennett, 1998). Beliefs are propositional representations of the world that can be true or false (Goldman, 2012), for example, one’s belief that there is milk in the fridge. Three-year-old children do not yet understand that beliefs can be false. Perner (1991) refers to this lack of awareness as a “conceptual deficit”. It is this deficit that renders 3-year-olds unable to pass false-belief tests. False-belief tests were developed to assess metarepresentation/ToM in children. In one classic false-belief task (e.g., Baron-Cohen, Leslie, & Frith, 1985; Wimmer & Perner, 1983), a story character places an object in a hiding place and leaves the scene. In her absence, a second character moves the object from the initial hiding place to another hiding place. Thus, the child observer and second character know where the object is now, but the first character does not. Children are asked where they think the first character will look for the object. This is argued to be a test of children’s representational ToM because they must predict the first character’s belief by appealing to that character’s representation of reality, which is different from reality and from what they themselves know (Perner, 1991).

Although some key components of ToM develop in infancy [e.g., joint attention, sensitivity to others’ intentions (e.g., Brooks & Meltzoff, 2005; Woodward & Sommerville, 2000)], studies have consistently shown that children only begin to pass false-belief tasks (i.e., by predicting that the first character will look for the object in the first location) at around 4 years of age (see Wellman, Cross, & Watson, 2001 and Wellman & Liu, 2004, for a review).

The kind of metarepresentational reasoning tapped by false-belief tasks has been argued to be the specific aspect of ToM necessary for EpF. Suddendorf and colleagues (Suddendorf & Corballis, 2007; Suddendorf & Redshaw, 2013) have argued that the ability to project oneself forward in time to anticipate future states and needs necessitates the understanding that one's own mental states can change across time. When children pass false-belief tasks, they are demonstrating an understanding that others may not know what they know, that appearances do not always correspond to reality (Gopnik & Astington, 1988), and that they have not always known what they know now (Gopnik & Graf, 1988).

Perner, Kloo and Gornik (2007) found that, after controlling for age, 3- to 6-year-old children's recall for directly experienced events (episodic memory, the retrospective counterpart to EpF) improved with increased ToM competence. No published studies have explicitly tested whether children's performance on the type of EpF task developed for this dissertation (i.e., tasks measuring children's ability to organize current behaviour in anticipation of future circumstances) correlates with their performance on measures of false-belief understanding. However, there is evidence suggesting that certain other future-oriented processes are associated with ToM capacity in young children: [JM1] Moore et al. (1998) reported that 4-year-old children who performed well on tasks requiring them to reason about beliefs and desires tended to be those children who made prosocial future-oriented choices on a sticker task (e.g., choosing to have one sticker for both self and another person later, as opposed to one sticker for self now). More recently, Ford, Driscoll, Shum, and Macaulay (2012) found a positive association between 4- to 6-year-olds' performance on a false-belief task and a measure of prospective memory [the ability to remember to engage in a particular activity at the appropriate time in the future (Kvavilashvili, 1992)].

EpF and working memory. Working memory (WM) belongs to the set of cognitive abilities collectively referred to as *executive functions*, higher order processes associated with the frontal lobe that allow us to monitor our thoughts and actions (Carlson, 2005). WM is the mental space in which information is temporally combined and manipulated, keeping task relevant information in a readily accessible state (Baddeley, 1992; Kane et al., 2004). It has been conceived as the representational space in which episodic details are recombined into imagined future events (Schacter & Addis, 2007; Suddendorf & Corballis, 2007). Hill and Emery (2013) administered WM tasks to college students who were also asked to recall autobiographical memories and imagine future personal events of varying levels of specificity (i.e., ranging from general to increasingly detailed). After controlling for autobiographical memory, WM predicted the “episodic specificity” of participants’ imagined future scenarios, leading the authors to conclude that WM contributes to the construction of future events. Although no studies of which I am aware have explored whether WM is associated with EpF in children, WM storage capacity has been shown to increase in a linear fashion from ages 4 to 11 (Alloway, Gathercole, & Pickering, 2006). Some authors suggest that working memory consists of a domain-general faculty that organises information in two independent, domain-specific storage components for verbal and visuospatial information (Baddeley, 1986; Engle, Kane, & Tuholski, 1999, cited in Alloway et al., 2006). Alternatively, other researchers have argued that working memory resources are separated into verbal and visuospatial constructs (Shah & Miyake, 1996, cited in Alloway et al., 2006). As such, the two WM tasks selected for use in the second study of this dissertation involved verbal information only (Backward Digit Span) and verbal information paired with visuospatial information (Counting and Labelling), respectively.

EpF and inhibitory control. Inhibitory control (IC) is the ability to inhibit impulsive responses that interfere with a cognitively represented goal (Carlson, Moses, & Breton, 2002; Rothbart & Posner, 1985). Like WM, IC is one of the executive functions. Suddendorf and Corballis (2007) argue that future-oriented behaviour is not possible without a certain amount of IC. In their view, future-oriented behaviour necessarily draws on inhibitory control because automatic, present-oriented impulses must be inhibited in favour of behaviours adapted for anticipated events or needs. For example, in order to save for a trip I would like to take at the end of the month, I must inhibit impulses to spend money in the meantime on other immediately available commodities. Neuropsychological evidence provides some support for this view: Frontal-lobe damage in adults (which often leads to impairments in executive functioning), has been found to be associated with impaired mental time travel abilities (Levine, 2004). Among young children, Moore et al. (1998) reported that future-oriented prosocial behavior was related to IC as well as ToM. In the section that follows, other developmental studies of future-oriented thought and behaviour are reviewed. I discuss the limitations inherent in existing methods designed to assess children's capacity for episodic foresight. I also explain how some previous studies informed the development of the new paradigm that is the focus of this dissertation.

Developmental studies of EpF.

Verbal Measures of Episodic Foresight. The first attempts to examine the development of episodic foresight used methodologies that assessed whether children's language reflects an understanding of the future. For example, Atance and O'Neill (2005) asked 3-year-olds to pretend they were going on a trip and to select three items (from a set of eight) to bring with them. Only 37% of children's responses referenced possible future needs or situations when asked to verbally explain their choice of items. In a similar vein, Atance and Meltzoff (2005)

assessed children's ability to anticipate the physiological needs that could arise in hypothetical future scenarios. They presented 3-, 4-, and 5-year-olds with photographs of outdoor locations (e.g., a winter scene) intended to elicit thoughts about future states (e.g., cold). Children were asked to imagine themselves in these environments, to choose one item (from among a set of three) that they would need in each environment (e.g., a winter coat), and to explain their choice (e.g., "I might get cold"). While all three age groups chose the correct items significantly more often than chance, 4- and 5-year-olds referenced a possible future state significantly more often (62% and 71% of the time, respectively) than did 3-year-olds (35%) when explaining their choice. Similar age-related differences were reported by Busby and Suddendorf (2005), who examined young children's ability to talk about *real* (as opposed to hypothetical) events (both past and future ones).

In what constituted the first study requiring children to project themselves into the future and re-experience the past, Busby and Suddendorf (2005) asked children to report an event that occurred "yesterday" as well as something they would do "tomorrow" (the correctness of these responses was assessed via parental reports). In an initial experiment involving 3- and 4-year-olds, children's performance on the past and future questions did not differ. Similarly, in a second experiment that also included 5-year-olds, children's performance on the past and future questions did not differ within each age group. In terms of age differences, while most 4- and 5-year-olds were able to report an event that would actually occur the next day, significantly fewer 3-year-olds did so.

More recently, Hayne, Gross, McNamee, Fitzgibbon, and Tustin (2011) reasoned that Busby and Suddendorf's (2005) task may have been unnecessarily difficult because it required children to generate future personal events themselves. Hayne et al. argued that because young

children tend to have little personal control over future events - which are usually determined by their parents - they may have had difficulty when asked to generate them. In light of this issue, Hayne et al. adapted Suddendorf and Busby's task using a personalized, parent-informed, visual timeline for each child and administered the task to 3- and 5-year-old children. The individual timelines were constructed on large pieces of paper and consisted of photos provided by parents to depict children's lives to date in a linear fashion. In addition, parents were asked to list events their children had experienced in the past and would experience in the near future. The task began with an activity designed to reinforce the notion of linear time sequencing in children's minds as well as to provide them with cues (i.e., photos of themselves from every year of life since birth) to generate memories from different periods in their lives. Following this timeline activity, children were interviewed about parent-reported, personal events from target periods (e.g., yesterday, earlier today, later today, tomorrow). All 3- and 5-year-olds were able to report at least one clause of accurate information about an event for each period, and all participants but one 3-year-old reported at least one clause of accurate information about an event that would happen tomorrow. Five-year olds reported more information overall compared to 3-year-olds, as well as a greater proportion of past tense clauses. Three- and 5-year-olds did not differ with respect to the proportion of future tense clauses uttered, nor with respect to the proportion of future-oriented information provided. The authors reported that children in their study were more successful at reporting both past and future events than those participating in Busby and Suddendorf's (2005) experiment. Hayne et al. interpret this difference as resulting from the more child-friendly nature of their own study and, more specifically, the addition of two forms of prompting: (1) the personalized timeline which cued children to the target periods of their lives and (2) real, parent-generated past and future events unique to each child.

Findings from these initial language-based studies suggest that children's capacity for future thought undergoes substantial improvement between ages 3 and 5. However, because language itself also develops considerably between these ages, children's performance on verbal measures of episodic foresight may be bound up with their linguistic proficiency. Relying on verbal markers of children's future thinking can either over- or under-estimate their capacity for foresight (Suddendorf & Busby, 2005). With respect to the former, Atance and O'Neill (2001) argue that although children as young as 2 years can talk about the future, this talk likely reflects learned "scripts" of routine, predictable activities rather than true mental self-projection into the future. And, in terms of the latter, children do not yet have a mature understanding of temporal terms such as "yesterday" and "tomorrow" (Harner, 1975) and thus asking them about these timeframes is somewhat problematic.

Behavioural Measures of EpF. In light of such arguments, researchers have advocated for the use of methods that examine future-oriented *behaviours* (e.g., Atance & O'Neill, 2005; Suddendorf & Busby, 2005). Such approaches have mostly assessed whether children select items in the present that will fulfill a future need. For example, Suddendorf and Busby (2005) designed a "two-rooms" paradigm in which 3-, 4-, and 5-year-olds were guided into a room containing nothing but an empty puzzle board (i.e., no puzzle pieces). After a brief delay, children were brought into a different room where they engaged in unrelated activities for 5 minutes. They were then shown four items, including the "target" puzzle pieces that were missing from the puzzle board in the first room. Children were told that they were going to return to the first room and were asked to select an item to bring with them from among the set of four. Four- and 5-year-olds, but not 3-year-olds, were more likely to choose the puzzle pieces compared to a control group of children who had not been presented with the empty puzzle board

in the first room. One limitation of this experiment is that some children may have succeeded merely by “matching” the puzzle pieces to the puzzle board.

Nevertheless, Suddendorf, Nielsen, and von Gehlen (2011) reported comparable findings across a broader range of contexts in which the “matching” features of target items and their corresponding future scenarios were somewhat less salient. In three experiments, 3- and 4-year-olds were presented with novel problems to which they would return after a delay. For example, children were shown how to use a key to open a locked box to access stickers. Next, the experimenter pretended to have broken the key by surreptitiously replacing it with a broken one. Children were then told that they were going to play games in a different room but would be returning to the first room later. After a fifteen minute delay, children were presented with four objects (three distracter items and a target key of the same shape but of a different colour as the original) and asked to choose one to take back to the first room. The majority of 4-year-olds (65%) correctly selected the target key, while significantly fewer 3-year-olds (29%) did so. However, when children were asked to select from among the same four items immediately after they had encountered the problem (i.e., with no delay), the majority of 3- and 4-year-olds (over 85%) correctly chose the target item required to solve two novel problems (to access desirable items and feed a character). These findings suggest that it is only by age 4 that children begin drawing on their memory of past problems to secure future solutions.

Using a different approach to examine children's future-oriented choices, Russell, Alexis, and Clayton (2010) engaged 3-, 4-, and 5-year old children in a game of ‘blow football’ (a game in which a toy football is moved by blowing on it with a straw). While materials included non-essential football paraphernalia (e.g., a cardboard referee, a team badge) the only item children actually needed to play the game from their (red) side of the table was a straw to blow the

football. Children were shown that in order to play the game from the experimenter's (blue) side of the table, a box for them to stand on (so that they could reach the table) would also be required. After playing the game with the experimenter from the red side, children were told that they would be returning to play the game from the blue side the next day. They were told that some of the materials would be taken away but that they could save two items (from a set of six) to play the game from the blue side the next day. Results revealed that no 3- or 4-year olds saved the correct item pair (i.e., straw and box), while 5-year-olds did so more often than expected by chance. However, when children were asked to select the items required to play the game on the other side "right now" (as opposed to the next day), all three age groups selected the straw and box significantly more often than expected by chance.

Another future-oriented process that has been studied behaviourally from a developmental perspective is delay of gratification (DoG). Moore and colleagues (e.g., Lemmon & Moore, 2007; Moore et al., 1998; Thompson, Barresi, & Moore, 1997) modified the traditional DoG paradigm (e.g., Mischel & Mischel, 1983) to assess whether children would wait to receive more stickers in the future versus fewer stickers in the present (thus displaying "future-oriented prudence" - behavior aimed at benefiting one's future self). Overall, these studies have found that while younger children typically do not delay gratification, older children (i.e., 4- and 5-year-olds) will delay if the delayed reward is sufficiently larger than the immediate reward.

Other investigators have developed methods to assess children's ability to anticipate needs or desires that will arise amid future circumstances that differ from current ones. Atance and Meltzoff (2006) examined children's ability to anticipate future desires that contrast with their current ones by manipulating children's physiological states in the laboratory. Their experiment was based on the expectation that, when offered a choice between a more desirable

item (i.e., pretzels) and a less desirable item (i.e., water), children would choose the former. However, Atance and Meltzoff reasoned that the desirability of pretzels relative to water should vary according to children's current states. For example, while children in a neutral state may prefer pretzels, children in a state of thirst should have a stronger desire for water. Based on these premises, Atance and Meltzoff assigned 3-, 4-, and 5-year-olds to one of four conditions. In two of these conditions, children received pretzels to eat while the experimenter read them a story for 12 minutes. Children in the remaining two conditions also heard the stories for 12 minutes, but did not receive pretzels. Following story time, all children were offered a choice of pretzels or water, with the temporal dimension of the choice varying across conditions. In one "pretzel" condition and one "no pretzel" condition, children were asked whether they wanted pretzels or water "right now". In the remaining pretzel and no pretzel conditions, children were asked to make a choice for "tomorrow."

Children's choices differed significantly as a function of condition. Eighty-three percent of children who had not eaten pretzels during the stories chose pretzels in both the *right now* and *tomorrow* conditions. In contrast, only 25% of children who had eaten pretzels and were asked to choose for *right now* chose pretzels, confirming that the desirability of pretzels relative to water had shifted as a result of children's current state (i.e., thirst). Of particular interest was whether children who had eaten pretzels and were asked to choose for *tomorrow* would be able to anticipate that, despite their current state of thirst, their preference for pretzels over water would return the next day. Only 8% of children in this condition chose pretzels, suggesting that they were unable to anticipate a future physiological state that would differ from their current state. In contrast with previous studies examining children's capacity for foresight, no age differences were detected in this study. In interpreting this finding, Atance and Meltzoff referred to contexts

in which even adults have difficulty overriding current states that are at odds with future ones (e.g., Gilbert, Gill, & Wilson, 2002; Nisbett & Kanouse, 1969; Read & van Leeuwen, 1998); a notable example being grocery-shopping while hungry. This highlights the salience of physiological states and their powerful influence on humans' reasoning about the future.

More recently, Russell, Cheke, Clayton and Meltzoff (2011) examined whether a paradigm adapted from Clayton and Dickinson's (1998) work with scrub jays would produce the same developmental trajectory in episodic foresight reported in earlier studies with children (i.e., failure at age 3, transitional performance at age 4, and success at age 5). To succeed on Clayton and Dickinson's What-Where-When (WWW) binding task, scrub jays had to bind "what" information (type of food), to "where" information (location of food) to "when" information (temporal duration from present) when storing and retrieving food. Following this approach, Russell et al. familiarized 3- to 5-year old children with the effects of different amounts of time on causal transformations such as heat melting chocolate (rendering it messy and inedible) or baking a cake (rendering it edible). Children were asked to make a choice in the present, or predict what their choice would be in the future, based on what they expected would happen to their preferred food over shorter (approximately 3 minutes) and longer (approximately 30 minutes) periods of time. For example, the correct future choice in one long-delay condition was a less preferred biscuit that would remain intact and edible over time, rather than preferred chocolate that would melt and become inedible over time. As expected, failure among 3-year-olds was observed, but 4- and 5-year-olds also performed poorly (no better than expected by chance) when asked to make a choice for the future. This finding contrasts with the significantly better-than-chance performance of 5-year-olds on Russell et al.'s (2010) blow-football task at age 5. Similar to Atance and Meltzoff (2006), the authors concluded that the poor performance

of 4- and 5-year-olds on their WWW task could be accounted for by their difficulty inhibiting reference to the currently preferred/edible food. In other words, asking children to select an object that is currently less desirable (but will be more desirable in the future) might pose a challenge that hinges on their executive skills as well as their prospective skills (Atance & Meltzoff, 2006). Russell et al.'s (2011) study calls attention to the need to delineate the role of executive skills (and specifically inhibitory control) in children's ability to make present choices that will benefit them in the future.

The findings from these studies suggest that asking younger children to make a choice with their future self in mind renders the same decision more difficult than if they were asked to make a choice for the present. The age-related differences yielded by the behavioural investigations of Suddendorf and Busby (2005), Suddendorf et al. (2010), Russell et al. (2010), and Moore and colleagues (Lemmon & Moore, 2007; Moore et al., 1998; Thompson et al., 1997) are quite consistent with the age differences obtained in language-based studies. However, just as verbal approaches have been criticized for potentially over- or under-estimating children's capacity for episodic foresight, the existing behavioural methods are not without their limitations.

Limitations of Existing Behavioural Paradigms

In reviewing the literature, I observed that all of the available behavioural paradigms relied on forced-choice response formats to elicit children's future-oriented behaviour. In other words, in each of the previous studies, the actual variable of interest was whether children correctly selected a future-oriented option from among present-oriented and/or distracter options. Although forced-choice approaches may possess the sensitivity to capture young children's emerging capacity for foresight, they do not tell us whether or when young children engage in

anticipatory behaviour *spontaneously*. It has been argued that the supreme adaptive advantage of mental time travel is the ability to plan flexibly for future needs in *novel* situations (Suddendorf & Corballis, 2007). With this view in mind, I reasoned that the prompting inherent in forced-choice paradigms renders their assessments of children's capacity for flexible, novel foresight less accurate than the insight that might be afforded by more open-ended measures.

Assessing Children's Spontaneous Anticipatory Behaviour

To address this gap in the literature, I drew on existing methods to develop a paradigm designed to measure children's spontaneous future-oriented behaviour in the laboratory.

I chose children's saving as the specific behaviour of interest because: 1) a strictly present-oriented individual would not engage in saving, and 2) saving behaviour can be assessed non-verbally.

The goals of study 1 of this dissertation (Metcalf & Atance, 2011) were to examine children's sensitivity to the relative value of future rewards, determine whether children will save more when they can draw on a recent past experience, and explore whether children's saving is associated with their ToM ability. Three-to-5-year-olds visited one room containing a small (less rewarding) marble run followed by another room containing a larger (more desirable) marble run. In the "more-rewarding-future" (MRF) condition, we measured how many marbles (0 to 3) children saved for the second room when they accessed the small marble game *first* and the large marble game *second*. In the "more-rewarding-present" (MRP) condition, we measured how many marbles (0 to 3) children saved when they accessed the marble games in the reverse order. Children in both conditions were presented with a second trial identical to the first and with two false-belief tasks.

In study 2, I refined the marble paradigm used in study 1 and explored whether 3-to-5-year-olds' saving would be facilitated by a verbal prompt alerting them to their choices (i.e., saving or spending marbles). I also assessed whether children's saving was related to their inhibitory control, theory of mind, working memory, and receptive language abilities (the second trial of the saving task was dropped from the protocol in study 2 to allow for the addition of these additional measures, which rendered the protocol quite long). Age-related differences for all variables of interest were explored and discussed in both studies.

Do Preschoolers Save to Benefit their Future Selves?

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Abstract

We developed a new paradigm for measuring children's saving behaviors. Two marble games that differed in desirability assessed whether 3-, 4-, and 5-year-olds saved marbles for future use; saved increasingly on a second trial; saved increasingly with age; and, were sensitive to the relative value of future rewards. We also assessed whether performance on the saving paradigm was related to theory of mind performance. Results indicated that children saved significantly more marbles on the second trial than the first and saved significantly more when a future reward was more desirable than a present reward, than when this relationship was reversed. However, older children did not save significantly more than younger children. Finally, children's performance on the "unexpected contents" false belief task was marginally correlated with the number of marbles saved on trial 2. Implications for children's future thinking and comparative research are discussed.

Keywords: saving behaviors; episodic foresight; episodic memory; theory of mind

Do Preschoolers Save to Benefit Their Future Selves?

There has been a surge of research in the last five years on humans' capacity to think about the future. Most of this research has focused on the adult population and on the similarities between thinking about the future and thinking about the past (e.g., Addis, Wong, & Schacter, 2007; Schacter, Addis, & Buckner, 2007; Szpunar & McDermott, 2008). Although developmentalists have begun to study future thinking, one future-oriented process that remains relatively unexplored is children's saving behavior, which we examine in the study reported here.

Studying children's saving behaviors is important for several reasons. First, an organism who has no concept of the future would not engage in flexible saving strategies. By "flexible," we mean in a novel context and in a domain that is not linked with survival (e.g., future enjoyment of a non-essential resource). Second, saving is a highly adaptive aspect of humans' future-oriented behavior. Humans regularly engage in saving behaviors in anticipation of future needs across a variety of contexts. We save money for retirement and save room for dessert. As such, these behaviors arguably reflect what Tulving (1985; 1999) and Suddendorf and Corballis (1997; 2007) have coined *mental time travel*.

Mental time travel (MTT) describes the cognitive process that allows humans to mentally project themselves backwards or forwards in time, and is believed to be mediated by the episodic memory system (Tulving, 1999). Tulving argues that a major adaptive advantage of episodic memory is the ability to mentally construct one's personal future. Indeed, recent data suggest that adults draw on their subjective memories of past experiences when envisioning personal future scenarios (e.g., Szpunar & McDermott, 2008). Drawing on Tulving's notion of episodic memory, Atance and O'Neill (2001) introduced the term *episodic future thinking* or, what is referred to in

this special issue (and the term we will use hereafter) as *episodic foresight*, to describe the capacity to mentally project oneself into the future to pre-experience events and their personal relevance.

For example, imagine that a young woman arrives at a dinner party without a gift for the host and subsequently feels embarrassed upon learning that all the other guests have brought one. The next time this young woman is invited to a dinner party, she may draw on this past event to *pre-experience* the embarrassment she will feel were she to show up empty handed again. Based on such pre-experiencing, this woman may decide to adjust her behavior in the present (i.e., by purchasing a gift for the host) to avoid re-experiencing embarrassment in the future. This example illustrates how episodic foresight can facilitate *behavior* that benefits one's future self. Atance and O'Neill (2001; 2005) distinguished this type of thinking about the future (which is flexible and allows for anticipation of events that are relatively novel and uncertain) from that which is based on scripts (memories of how routine events typically unfold).

Researchers initially relied on language-based measures to examine the emergence of episodic foresight (e.g., Atance & Meltzoff, 2005; Atance & O'Neill, 2005; Busby & Suddendorf, 2005). More recently, however, they have advocated for the use of methodologies that assess future-oriented behaviors (e.g., Atance & Meltzoff, 2005; Atance & O'Neill, 2005; Busby & Suddendorf, 2005; Suddendorf & Busby, 2005). These paradigms have mostly assessed whether children will select items in the present that will fulfill a future need. For example, Suddendorf and Busby (2005) developed a "two-rooms" methodology in which 3-, 4-, and 5-year-olds were led into an empty room, which contained a puzzle board, but no puzzle pieces. After a brief delay, children were taken into a neighboring room to play unrelated games for 5 minutes. They were then shown four items, including the "target" puzzle pieces. Children were

told that they would now return to the first room and were asked which one of the items they wanted to bring with them. Four- and 5-year-olds, but not 3-year-olds, were more likely to select the puzzle pieces compared to a control group of children (who were not presented with the puzzle board in the empty room). One possible limitation of this study is the high association between the puzzle board and the puzzle pieces; some children may have succeeded simply by “matching” the puzzle pieces to the puzzle board.

Nonetheless, in a more recent study, Suddendorf, Nielsen, and von Gehlen (2011) reported similar findings across a broader range of scenarios (also using a “two-rooms” methodology) to which the “matching” argument does not as readily apply. In three experiments, 3- and 4-year-olds were presented with novel problems to which they would return after a delay. For example, children learned how to use a key to open a locked box and retrieve stickers. Next, the experimenter pretended to have broken the key by switching it with a broken one when children were not looking. After a brief delay, children were presented with the correct object (i.e., a key of the same shape, but of a different color, as the original) among a set of distracters, and asked to select one to take back to the first room. The majority of 4-year-olds (65%) chose correctly, while significantly fewer 3-year-olds (29%) did so. Interestingly, when children were presented with the choices immediately after they had encountered the problem (i.e., with no delay), the majority of 3- and 4-year-olds (over 85%) were able to select the correct solutions to two novel problems (to access desirable items and feed a character). These findings suggest that it is only by age 4 that children begin to draw on their memory of a past problem to secure a future solution.

Using a different type of methodology to study children’s future-oriented choices, Russell, Alexis, and Clayton (2010) engaged 3-, 4-, and 5-year old children in a game of blow

football. Although materials included non-essential items (e.g., a cardboard referee, a team badge) the only item that children needed to play the game from their side of the table (red) was a straw with which to blow the football. However, children were shown that to play the game from the experimenter's side of the table (blue) a box for them to stand on (so that they could reach the table) would also be needed. After playing the game with the experimenter from the red side, children were told that they would be returning the next day to play the game from the blue side. They were told that some of the materials would be taken away but that they could save two items (from an array of six) so that they could play the game from the blue side the next day. Whereas no 3- or 4-year olds saved the correct item pair (i.e., straw and box), 5-year-olds did so more often than would be expected by chance. However, in a "present-self" version of the task, in which children were asked to select the items required to play the game on the other side "right now", all three age groups selected the correct item pair significantly more often than chance.

One common methodological element of the existing behavioral studies is the use of forced-choice response formats. That is, in all of these studies, the variable of interest was whether children selected the correct future-oriented option among a present-oriented option and/or distracter options. Although such forced-choice approaches may provide sensitive measures of young children's emerging capacity to act with the future in mind, they do not tell us whether/when young children engage in anticipatory thinking *spontaneously*. Suddendorf and Corballis (2007) argue that the crucial adaptive advantage of mental time travel is the ability to plan for future needs in novel situations. As such, the prompting inherent in forced-choice approaches may be less likely to yield accurate reflections of children's capacity for flexible,

novel foresight than would more open-ended approaches. To our knowledge, no developmental studies have examined children's spontaneous anticipatory behavior.

To do so, we drew on Suddendorf and colleagues' (Suddendorf & Busby, 2005; Suddendorf et al., 2011) "two-rooms" set-up, in which children move from one room to another across time, creating temporal contexts within the laboratory. Like Suddendorf et al., we were interested in whether children would draw on their memory of a recent past experience and exert future-oriented behavior accordingly. Our approach differed, however, in that we used a method that would allow us to assess whether children would do this spontaneously, in the absence of prompting. We were also inspired by Moore and colleagues' (Moore, Barresi, & Thompson, 1998; Thompson, Barresi, & Moore, 1997) modified delay of gratification paradigm (Mischel & Mischel, 1983) that assessed whether children would wait to receive two stickers in the future versus one sticker in the present (thus showing "future-oriented prudence"). Thompson et al. reported that across several trials, 4- and 5-year-olds, but not 3-year-olds, preferred larger delayed rewards over smaller, albeit immediate, rewards.

Finally, it is important to note that although Russell et al. (2010) examined whether children would correctly select items needed to play blow football from the opposite side of a table, thereby "saving" them for the next day, this behavior does not constitute the type of "saving" we were interested in assessing in the current study. In economic terms, saving is defined by the postponement of some consumption to the future (e.g., Wärneryd, 1999). Similarly, in the present study, we define saving as reserving resources for future enjoyment. Accordingly, in our paradigm, children were told that they would play in two rooms consecutively, for equal amounts of time. Children received three marbles and were shown that each room contained a marble game and nothing else for them to play with. We were interested

in whether children would save marbles for the second room by refraining from using all three marbles in the first room. We provided children with only three marbles because we wanted them to experience some degree of waiting—a feature that is inherent to saving—during the three minutes (either because they were saving marbles or had none left). We intentionally provided children with an uneven number of marbles to assess how they divide rewards among their present and future selves when an equal split is impossible.

In trial 1 of our paradigm, 3-, 4-, and 5-year-olds were introduced to two rooms and shown that the first room contained a small marble game (consisting of one run into which marbles could be dropped), while the second room contained a larger, more desirable, marble game (consisting of three runs) (see Figure 1). In each room, children were shown that once they put a marble down a run, the marble could not be used again. Children were then given three marbles and told that there were no others available. Next, children were told that they would stay in the first room for three minutes, and then in the second room for another three minutes. The main dependent variable of interest was the number of marbles that children saved for use with the larger marble game in the second room.

In trial 2 of our paradigm, the experimenter revealed that she had found three additional marbles for children to play with. The procedure and dependent variable were identical to those in trial 1. The goal of this trial was to determine whether, after experiencing the consequences of not saving (in those cases in which children did indeed use, or “spend”, all their marbles in the first room), children learned to save when given a second opportunity to do so. As such, in addition to the number of marbles saved within each trial, we were interested in whether children saved more in trial 2 compared to trial 1, reflecting an ability to draw on a recent past experience (episodic memory) when making present decisions that will affect their future selves.

We also ran a second “reverse” condition (hereafter referred to as the “more-rewarding-present” condition) in which children visited the room with the large marble game *first*, and the room with the small marble game *second*. This condition was important for several reasons. First, it would allow us to determine whether younger children might save less than older children because they prefer the small marble game to the large marble game, and not because they are less able to think about their future selves. Were this the case, then younger children should save more marbles in the more-rewarding-present condition as compared to the more-rewarding-future condition (described earlier). Second, if children in the more-rewarding-future condition (older and younger alike) save their marbles because they deem a future event (i.e., playing with the large marble game) more rewarding than a present event (i.e., playing with the small marble game), then they should save more marbles in this condition than children in the more-rewarding-present condition.

One final reason for including the more-rewarding-present condition was more theoretical in nature. We reasoned that if children can indeed think about their future selves, then the optimum strategy in the more-rewarding-present (reverse) condition would be to save at least one marble for the small marble game. Although the larger marble game is presumably more desirable, using up all of one’s marbles in this game would then lead to several minutes with nothing to do in the second room. However, saving one marble indicates some thought about one’s future self. Thus, we reasoned that children might also save when known future opportunities for enjoyment will yield relatively *less* enjoyment compared to present ones. Although putting marbles in the second (small) marble game is less desirable than putting them in the first (large) one, it is *more* desirable than the only other future alternative, which is having nothing to do for 3 minutes.

Finally, we administered two theory of mind (ToM) tasks (“unexpected contents” and “change-in-location”) to all children to determine whether their performance on these was related to their saving behavior. ToM— a cognitive process that has been studied intensely in the last two decades (see Wellman & Liu, 2004, for a review)— allows us to understand our own and others’ behavior in terms of such mental states as desires, thoughts, and beliefs (Taylor, 1996; Wellman & Liu, 2004). Beliefs are propositional representations of the world that can be true or false (Goldman, 2012). Three-year-old children do not yet understand that beliefs can be false because they lack representational ToM or “metarepresentation”. False-belief tests were developed to assess metarepresentation/ToM in children. An abundance of research suggests that representational ToM begins to emerge at around age 4 (e.g., Flavell, Flavell, Green, & Moses, 1990; Gopnik & Astington, 1988; Gopnik & Slaughter, 1991; Wellman, Cross, & Watson, 2001; Wellman & Liu, 2004). Indeed, several researchers have argued that episodic foresight and ToM are related (Atance & Meltzoff, 2005; Buckner & Carroll, 2006; Moore et al., 1998; Suddendorf & Busby, 2003; Suddendorf & Corballis, 1997). More specifically, the particular kind of metarepresentational reasoning tapped by false-belief tasks has been argued to be the aspect of ToM necessary for EpF. Suddendorf and colleagues (Suddendorf & Corballis, 2007; Suddendorf & Redshaw, 2013) have argued that the ability to project oneself forward in time to anticipate future states and needs necessitates the understanding that one's own mental states can change across time.

In sum, our saving paradigm allowed us to: a) determine whether 3-to-5-year-old children spontaneously save in the present to secure future enjoyment, b) explore children’s ability to draw on a recent past experience (i.e., past consequences of failing to save) and adjust their behavior when faced with the same temporal decision again, and c) examine whether children

save in contexts in which known future opportunities yield relatively lesser rewards than present ones.

We hypothesized that: (a) children will save more marbles on trial 2 compared to trial 1, reflecting improved episodic foresight when the memory of a recent past experience is available to facilitate future-oriented behavior; (b) children will save more marbles in the more-rewarding-future condition than in the more-rewarding-present condition, reflecting sensitivity to the relative value of future rewards; (c) the number of marbles saved in both trials and conditions will increase with age; and (d) children's scores on the saving paradigm will be positively correlated with their scores on the ToM tasks.

Method

Participants

Seventy-four children were recruited in a large city using advertisements in newspapers, daycares, and local retailers. The majority of participants were from middle-class backgrounds and were predominantly White, but the sample also included some children of Asian and African descent. All children were fluent in English. Children received a small gift for their participation. Twenty-four 3-year-olds (11 boys; *M*_{age} = 42.2 months, range = 37-47 months), 26 4-year-olds (13 boys; *M*_{age} = 53.0 months, range = 48 to 58 months), and 24 5-year-olds (12 boys; mean age = 67.6 months, range = 61 to 71 months), participated in this study. Three additional children were tested but not included because they were fussy.

Materials, Design and Procedure

Children were assigned to one of two saving conditions and were administered two ToM tasks in counterbalanced order. Participants were randomly assigned to each cell of the design (2 conditions x 3 age groups = 6 cells) until the required number of children per cell was met. There

were 12 children in each cell, with the exception of the cell ($n = 14$) for the 4-year-olds in the more-rewarding-present condition.

Due to experimenter oversight, one child in the more-rewarding-future condition and four children in the more-rewarding-present condition were not administered the ToM tasks. Children were also administered a series of unrelated tasks not discussed here. Participants were tested individually in two adjacent laboratory playrooms by a female experimenter. All sessions were video-recorded.

Saving paradigm: more-rewarding-future condition. A sign on the door of the first testing room (on the left) displayed a photo of the small marble game against a red background (hereafter referred to as the “red room”), while a sign on the second door (on the right) displayed a photo of the large marble game against a blue background (hereafter referred to as the “blue room”). The experimenter guided children into the hallway and showed them the two rooms (i.e., “you are going to get to play in two rooms”). The experimenter pointed to the sign on the door of the red room and told children that the red room contained a “little marble game”. The experimenter and child then entered this room and the experimenter demonstrated how the small marble game worked (the small marble game consisted of only one “run”). The experimenter put one marble down the run, and explained that once the marble is dropped down the hole, it goes into a box at the end of the run and cannot be used again. Next, children and the experimenter returned to the hallway. The experimenter pointed to the sign on the door of the blue room and explained that the blue room contained a “big marble game”. Children and the experimenter entered the blue room and the experimenter demonstrated how the large marble game worked by dropping one marble down a run (the big marble game consisted of 3 different “runs”). As with the small marble game, the experimenter explained that once a marble is dropped down a run, it

goes into a box and cannot be used again. The experimenter once again guided children back into the hallway and explained what they would be doing during trial 1.

Trial 1. The experimenter pointed to the sign on the door of the red room and stated, "First, you are going to stay in the red room for three minutes. The red room has the *little* marble game." The experimenter then pointed to the sign on the door of the blue room and said, "Next, you are going to stay in the blue room for three minutes. The blue room has the *big* marble game." The experimenter handed the child a transparent bag containing three marbles and explained, "You only get three marbles today. Remember, once you put a marble down the hole, you can't use it again." Immediately after giving children these instructions, the experimenter asked children what they were going to do "right now." If children did not refer to both the red room and the little marble game, the instructions were repeated.

Upon entering the red room, the experimenter sat at a desk located in the back of the room, put on headphones, and said to children, "I'm going to do my work over here until this timer rings". The experimenter started a timer (which had been set to ring after three minutes) and placed it on the desk. During the three minutes, the experimenter pretended to work and kept her interactions with children to a minimum. We did this so that children would not have anything to do in either room other than play with the marble game (should they have marbles remaining). When children attempted to interact with the experimenter, she made neutral statements such as, "I have some work to do". The experimenter noted the number of marbles children used in the small marble game. Immediately after the timer rang, the experimenter asked children what they were going to do next. Irrespective of their responses, the experimenter said, "We're going to go in the blue room for 3 minutes. The blue room has the *big* marble game. Bring your marble bag!"

Children and the experimenter entered the blue room, at which point the procedure was identical to that in the red room: The experimenter pretended to work until the timer rang, and noted the number of marbles children used in the large marble game. Some children, who had used all of their marbles in the first room, asked the experimenter questions such as, "But I don't have any more marbles left, what can I do?" As in the first room, the experimenter responded to children's inquiries with neutral statements such as, "I have some work to finish." Immediately after the timer rang, the experimenter opened a small box on the desk, removed three more marbles, and said, "Guess what? I found three more marbles for you to play with! Let's go see the signs again so you can remember what you are going to do."

Trial 2. The procedure for trial 2 was identical to that of trial 1.

Saving paradigm: more-rewarding-present condition. The more-rewarding-present condition was structurally similar to the more-rewarding-future condition (i.e., the instructions were followed by trial 1 and trial 2). However, procedures in this condition diverged from the more-rewarding-future condition in one important way: The order in which children gained access to the small and large marbles games was reversed. That is, in this condition, the first, red room contained the *large* marble game, and the second, blue room contained the *small* marble game. The instructions and signage in the more-rewarding-present condition reflected these changes.

ToM tasks. In the *Unexpected Contents* task (e.g., Perner, Leekam, & Wimmer, 1987) children were shown a Band-Aid box and were asked to state what they believed was inside. After stating "Band-Aids," children were shown that the box actually contained a toy pig. The box was then closed and children were asked to state its true contents (i.e., "pig"). Children who were unable to correctly state the box's true contents were shown that the box contained a pig a

second time. Children were then asked the target question, “When you first saw this box, before we opened it, what did you think was inside?” Children received a score of 1 if they correctly stated “Band-Aids” to this target question; otherwise, they received a score of 0. In the *change-in-location* task (e.g., Wimmer & Perner, 1983), hand puppets - “Ernie” and “Bert” from Sesame Street - were used to act out a scene in which Ernie moves a ball from location A to location B, unbeknownst to Bert, who had initially put the ball in location A. Children were then asked to state where Bert believes the ball is (location A), and where the ball really is (location B). Children received a score of 1 if they correctly stated Bert’s belief about the location of the ball and the true location of the ball. Otherwise, children received a score of 0.

Interrater Reliability

The number of marbles each child saved/used in each room was recorded by the experimenter. For reliability purposes, a trained research assistant independently coded 75% of the testing sessions from the DVD recordings. Mean Cohen’s kappa was 1.00 for both dependent variables (i.e., the number of marbles saved on trials 1 and 2).

Results

Unexpectedly, 14 children (7 in each condition; 6 boys, 8 girls; 4 3-year-olds, 6 4-year-olds, 4 5-year-olds) did not use all of their saved marbles in the second room on trial 1 and/or trial 2 (see Tables 1 and 2 for details regarding how these children used and/or saved their marbles in each condition). It is quite possible that these children were engaging in saving behavior— for example, they may have been trying to save their marbles for a future use beyond the context of the laboratory (e.g., home) or they may have saved marbles for the marble game in the second room and then simply lost interest when it came time to use them. Nonetheless,

because it is also possible that children's behavior did not reflect saving for the future, we decided to run the analyses first including, and then excluding, these children.

In the more-rewarding-future condition, 39% of children saved one or more marbles for the second room on trial 1, while 72% saved at least one marble on trial 2. A similar pattern emerged in the more-rewarding-present condition: 29% of children saved at least one marble on trial 1 and 63% did so on trial 2. For both conditions, some children who had not saved at all on trial 1 became "savers" in trial 2 (39% in the more-rewarding-future condition and 45% in the more-rewarding-present condition).

In order to be able to test for interaction effects, a parametric test ($2 \times 2 \times 3$ mixed analysis of variance) was initially selected to determine whether children saved more marbles in trial 2 compared to trial 1, saved more marbles in the more-rewarding-future condition compared to the more-rewarding-present condition, and whether these varied as a function of age. However, examination of the z-scores for skewness revealed that data in 2 of the 12 cells of the saving task were skewed. In trial 1 of the more-rewarding-future condition, Z_{skewness} scores exceeded 1.96 for 4- and 5-year-olds (Z_{skewness} scores of 4.18 and 1.98, respectively). Square root transformations to all cells resulted in an acceptable Z_{skewness} score for the latter cell and an unchanged Z_{skewness} score to the former cell. Because normality was not achieved in all cells following the square root transformations, logarithmic transformations were applied to the original data. These resulted in an acceptable Z_{skewness} score for the first trial of the saving task for 5-year-olds in the more-rewarding-future condition. However, the Z_{skewness} score for 4-year-olds in the first trial of the more-rewarding-future condition remained unchanged. Because these simple transformations did not result in normality in all cells, non-parametric tests were conducted to assess the main effects of Trial, Condition, and Age.

A Wilcoxon Signed-ranks test indicated that children saved more in Trial 2 than in Trial 1, $z = -4.26$, $p < .001$. A Mann-Whitney test indicated that children in the more-rewarding-future condition saved more marbles than children in the more-rewarding-present-condition, $U = 311.5$, $p = .034$. The distributions of the number of marbles saved were not significantly different between 3-, 4-, and 5-year-olds using Kruskal-Wallis, $\chi^2 = 5.04$, $p < .08$ [CA2].

Levene's test of Equality of Error Variances indicated that variances were not equal between groups on trial 1 of the saving task. This is not surprising given that 3-year-olds were at floor in the more-rewarding-future condition on the first trial of the saving task. All other assumptions underlying the ANOVA were met.

In order to test for interaction effects, we entered the number of marbles saved in each trial into a $2 \times 2 \times 3$ mixed analysis of variance (ANOVA) with Trial (trial 1, trial 2) as a within-subjects factor and Condition (more-rewarding-future, more-rewarding-present), and Age (3, 4, 5) as between-subjects factors. The results yielded by this parametric test were similar to those produced by the non-parametric tests described above. The main effect of Trial was significant, $F(1, 68) = 26.95$, $p < .001$, $\eta_p^2 = .28$. Children saved more marbles in Trial 2 ($M = 1.22$, $SD = .12$), than in Trial 1 ($M = .63$, $SD = .11$). The main effect of Condition was also significant, $F(1, 68) = 4.27$, $p = .043$, $\eta_p^2 = .06$. Children saved more marbles in the more-rewarding-future condition ($M = 1.13$, $SD = .14$) than in the more-rewarding-present condition ($M = .72$, $SD = .14$). Interestingly, there was no main effect of Age, $p = .87$, nor any significant interactions (see Figure 2).

Performance on the change-in-location and unexpected contents ToM tasks were both significantly correlated with age, $r(65) = .42$, $p < .001$, and $r(65) = .43$, $p < .001$, respectively, and with each other, $r(65) = .39$, $p = .001$. Separate 1-tailed partial correlations (controlling for

age in months) were conducted between children's scores on each ToM task and the number of marbles saved on trial 1 and on trial 2. Change-in-location performance was not significantly related to the number of marbles saved on either trial. Performance on the unexpected contents task was marginally related to the number of marbles saved on trial 2 $r(61) = .18, p = .083$. Because of the main effect of Condition that we obtained, we also ran these correlations separately within each condition; these were, however, non-significant.

We re-ran the above analyses excluding those children who did not use all of their marbles in the second room on either trial 1 or trial 2. The only difference that emerged in this sample was a stronger correlation between children's saving on trial 2 and their performance on the unexpected contents task, $r(51) = .25, p = .035$ (1-tailed). Because of the condition main effect, correlations were run separately within each condition. A marginal association emerged between children's performance on the unexpected contents task and the number of marbles saved on trial 2 within the more-rewarding-present condition only, $r(23) = .29, p = .083$.

A child could engage in saving on trials 1 and 2 in a number of ways. That is, in the first room on each trial, a child could save 1, 2, or all 3 marbles for use in the second room. To conduct a more brute investigation of children's age-related saving, we conducted a Pearson χ^2 test within each trial using children's dichotomous saving scores (0 = no marbles saved, 1 = 1 or more marbles saved). These scores did not differ significantly with age on trial 1, $\chi^2(2, N = 36) = 0.10, p < 0.951$, or trial 2, $\chi^2(2, N = 36) = 2.42, p < 0.298$.)

Although older children did not save more marbles than younger children, we wondered whether they may have waited longer than younger children to use their marbles. If so, this might reflect older children's greater capacity to at least attempt to inhibit an immediate reward in favour of a delayed one. To address this question, we divided the three minutes in the first room

(in both trials 1 and 2) into six 30-second blocks. A value was assigned to each block, with values increasing with time. Marbles used in the first, second, third, fourth, fifth, and sixth time blocks were assigned 0, 1, 2, 3, 4, and 5 points, respectively. Marbles saved for the second room were assigned 6 points. Using this scoring system, children received a “waiting” score ranging from 0 to 18 points for each trial, with higher scores representing greater degrees of waiting to use marbles (see Table 3). These scores were entered into a $2 \times 2 \times 3$ mixed ANOVA with Trial (trial 1, trial 2) as a within-subjects factor and Condition (more-rewarding-future, more-rewarding-present), and Age (3, 4, 5) as between-subjects factors. The main effect of Trial was significant, $F(1, 66) = 19.44, p < .001, \eta_p^2 = .23$. Children waited longer to use their marbles in Trial 2 ($M = 8.70, SD = .59$), than in Trial 1 ($M = .582, SD = .58$) (this finding is not surprising given the main effect of Trial on the number of marbles saved, reported above). There were no main effects of Condition, or Age ($p = .94$), nor any significant interactions.

Discussion

The main goal of this study was to determine whether preschoolers spontaneously save in the present to benefit their future selves. Our newly developed behavioral paradigm allowed us to address this issue by examining the number of marbles children saved on the first trial of each condition. A secondary goal was to determine whether children would exert more future-oriented prudence (i.e., save more marbles to reduce anticipated boredom or disappointment) when they could draw on a recent past experience (i.e., the consequences of failing to save marbles for the second room) to guide their future behavior. The inclusion of a second trial in each condition allowed us to address this issue. We reasoned that all children would save more on the second trial, reflecting learning from a recent past experience, and an ability to draw on an episodic memory in a way that facilitates future-oriented behavior.

Our results indicate that children did not engage in a great deal of saving spontaneously (i.e., on trial 1) in either condition (39% in the more-rewarding-future condition and 29% in more-rewarding-present condition). In fact, collapsing across age, the mean number of marbles saved was greater than one only on trial 2 in the more-rewarding-future condition (on which children saved an average of 1.44 marbles to use in the second, big marble game).

It may be that the majority of children were unable to anticipate novel future events that they had been told about, but had not yet experienced. Alternatively, it is possible that they were unable to inhibit the impulse to put their marbles into the game that was immediately available. This would be especially true of younger children who have less well-developed inhibitory control skills than older children (e.g., Carlson & Moses, 2001). Yet, our analysis on the amount of time that children waited to use their marbles indicated that older children did not wait longer to use their marbles than younger children. Nonetheless, assessing whether individual differences on actual measures of inhibitory control predict performance on our saving paradigm could provide further insight into possible relationships between children's saving and impulse control. Indeed, in the economic literature on adults' saving behavior, it was once assumed that as long as an individual intended to save, then the necessary behavior would occur (Rabinovich & Webley, 2007). However, it is now recognized that saving is a complex behavior that requires the integration of planning and self-control (Rabinovich & Webley, 2007).

Results revealed that children saved significantly more on the second trial across both conditions (72% of children saved at least one marble on trial 2 in the more-rewarding-future condition, and 63% did so in the more-rewarding-present condition). This finding is important because it suggests that our saving paradigm represents a context in which children are able to learn (and adjust their behavior to benefit their future selves) based on a single trial. Indeed, the

retention of information following one occurrence of a unique event is, in addition to the ability to mentally project oneself through time (Tulving, 2001), a central feature of episodic memory (Ferbinteanu, Kennedy, & Shapiro, 2006; Tulving, 1983). Expanding the range of non-verbal methods for studying single-trial learning and future-oriented behavior is important in light of the growing body of research exploring the abilities of non-human species in both of these domains (see Schwartz, Colon, Sanchez, Rodriguez, & Evans, 2002, and Suddendorf & Corballis, 2007, for reviews in each of these areas, respectively). In fact, our saving paradigm assesses both of these processes in a single experiment and thus may lend itself to adaptation for use with non-human animals.

The design of this study allows us to rule out explanations for children's saving that are based on functional or script-like knowledge: Even if children knew a priori that marble games require marbles (or if they acquired this knowledge on the first trial), the same script applies to both the present and future contexts (i.e., the first and second room) in this study. If we assume that children who did not have any marbles (or perhaps only one marble) to play with in the second room on the first trial experienced boredom or disappointment, it seems fair to argue that children who saved more on the second trial did so to avoid re-experiencing the boredom or disappointment they anticipated (or pre-experienced) when drawing on their memory of the trial 1 "episode".

In addition, our paradigm (in the more-rewarding future condition) is structured to create a conflict between the desire to use a marble in the small game immediately and the desire to use a marble in the large game later. As such, fulfilling one's immediate desire is incompatible with saving. This same incompatibility is less pronounced in other two-rooms methodologies (e.g., Suddendorf & Busby, 2005) because the desire to play with a puzzle in the future (i.e., in the

second room), for example, does not conflict with the child's current desire. As such, it is unclear to what extent children need to think about the future, per se, to succeed in such paradigms.

Our prediction that children would save more marbles for the second room in the more-rewarding-future condition compared to the more-rewarding-present condition, reflecting sensitivity to the relative value of future rewards, was supported. Children tended to save more marbles when the future reward was relatively greater than the present one (i.e., in the more-rewarding-future condition), and less when these circumstances were reversed (i.e., in the more-rewarding-present condition).

Based on findings from previous behavioral studies of children's episodic foresight (e.g., Russell et al., 2009; Suddendorf and Busby, 2005; Suddendorf et al., 2010; Thompson et al., 1997), we predicted that, overall, the amount children saved across trials and conditions would show age-related increases. Interestingly, this hypothesis was not supported. Similarly, follow-up analyses revealed no age differences with respect to when children used their marbles after entering the first room (i.e., whether they tended to use up their marbles immediately upon entering the first room, whether they attempted to wait, or whether they saved marbles for the second room).

As discussed in the Introduction, previous behavioral studies (e.g., Suddendorf et al., 2011; Russell et al., 2010) have relied on force-choice measures in which a future-oriented choice was made explicitly available to children among present-oriented and/or distracter choices. One possible explanation for why our paradigm failed to yield a significant overall effect of age is that the absence of prompting reduced the performance of all children such that the behavior of older children was indistinguishable from that of younger children. By this view, findings from previous studies could be reinterpreted to suggest that older children are better at

selecting a future-oriented response that is made available to them as one of two or more response options, but not necessarily at acting with their future selves in mind spontaneously. This account could be tested by comparing children's performance on our measure of spontaneous saving to a condition that presents saving (future-oriented) and non-saving (presented-oriented) options to children in a forced-choice format. Testing older children (6- and 7-year-olds, for example) on the saving task might also provide insight into the emergence of spontaneous episodic foresight.

It is also possible that we did not detect age differences in our paradigm because there is substantial individual variability in children's saving behavior. Saving varies greatly among adults, even when socioeconomic characteristics are similar (Bernheim, Skinner, & Weinberg, 2001; Venti & Wise, 1998). Perhaps these individual differences already begin to emerge in the preschool years. Relatedly, the paradigm developed for this study— though intended to measure children's saving behavior— may represent a variant of a delay of gratification (DoG) paradigm and thus captured the individual variability reported in some DoG studies (Mischel, Shoda, & Rodriguez, 1989; Moore et al., 1998; Thompson, et al., 1997). This possibility could be assessed by comparing children's performance on our paradigm and on established measures of DoG.

Nonetheless, while it makes intuitive sense to assume that saving and DoG are related, or that the latter is a precursor to the former, the two processes can also be viewed as conceptually distinct. Indeed, Sonuga-Barke and Webley (1991) argue the following:

Delay of gratification and saving are not equivalent situations. Experiments on delay of gratification test children's waiting ability rather than their saving ability...sitting and waiting is the price of the delayed reward. In a saving situation...delay does not constitute the cost of the large reward...Mischel's subjects had only to make one choice

between small immediate and large delayed rewards, whereas in a saving situation a series of choices need to be integrated over time...clearly there are certain similarities between the two situations. Each “response” does require impulse control (p. 14).

By this view, the saving paradigm we developed differs from traditional ‘maintenance’ DoG measures (e.g., Mischel et al., 1989) in which the length of time children can wait for a larger reward is the measure of interest. Similarly, Lemmon and Moore (2007) argue that ‘choice’ DoG paradigms (e.g., Thompson et al., 1997)– in which children choose between small immediate rewards and larger future rewards across several cumulative trials– are a better measure of how children appraise their immediate and future desires relative to one another. Although we agree with this reasoning, we argue that saving, as measured by our paradigm, is different even from the future-oriented behavior assessed by choice DoG paradigms. That is, the argument that waiting is “the price of the reward” (Sonuga-Barke & Webley, 1991, p. 14) applies to choice paradigms as well, since children who delay do not give up the initial reward entirely, they simply have to wait to receive it along with the additional future reward.

In contrast, in our paradigm, each marble that is saved (and therefore allocated to future enjoyment) comes with a cost to present enjoyment. In the more-rewarding-future condition, “future enjoyment” corresponds to being able to put one or more marbles into the big marble game, whereas in the more-rewarding-present condition, future-oriented prudence alleviates boredom and/or allows children to enjoy the novel (albeit less interesting) small marble game. We liken the former to the adult example of refraining from spending a gift certificate for one’s favorite store today, knowing that the same store will be holding a fifty-percent-off sale next week. In other words, the adult is saving her resources for a time in the future when they will yield greater rewards than they would in the present. Saving in the more-rewarding-present

condition might be akin to an individual who is on a group vacation in Orlando, Florida, for example. The group will be visiting Disney World one day, and Sea World the next. Even if the individual much prefers Disney World to Sea World, the optimum strategy would be to save at least some spending money for the next day's attractions if the only alternative for the next day is to be alone with nothing to do.

One final explanation for the lack of age differences in our paradigm is that providing children with only three marbles did not allow for enough variability in how they chose to distribute their marbles across time (i.e., among their present and future selves). Providing children with more marbles (e.g., 5) might allow for more variability and further insight into how children choose to distribute their rewards across time and whether age-related differences underlie this process.

We hypothesized that the number of marbles children saved would be positively correlated with their performance on two ToM tasks, unexpected contents and change-in-location. Only a marginally significant association was detected between children's saving in trial 2 and their performance on the unexpected contents task (this marginal association became significant when the 14 children who did not use all of their saved marbles were excluded from the analyses). Although this marginal finding should be interpreted with caution, it suggests that specific forms of false-belief reasoning may differ with respect to whether and how they relate to episodic foresight. For example, success on the unexpected contents task requires children to reason about a divergent belief that occurred at a different time (i.e., the recent past). In the current study, the temporal dimension inherent in the unexpected contents task may be what overlapped with children's ability to learn from a personal past state (i.e., disappointment, boredom) in a way that benefited their future selves. Although a number of researchers have

argued that episodic foresight and ToM are related (Atance & Meltzoff, 2005; Moore et al., 1998; Suddendorf & Corballis, 1997), data supporting this association in preschool children are scarce. Our findings contribute to this area by highlighting a context in which children's future-oriented behavior may be related to their ability to adopt a perspective that differs from their current one.

The study presented here constitutes a first attempt to determine whether young children engage in *spontaneous* anticipatory behavior. We explored this issue using a new paradigm to measure children's saving - a future-oriented process that has received little attention in the developmental literature. Although children's rate of spontaneous saving was somewhat low in this paradigm, the design of our study allowed us to assess whether children would save more in a second trial in which they could draw on their memory of the consequences of their past behavior (i.e., failing to save on the first trial). We found that children (even 3-year-olds) exerted relatively more future-oriented prudence on the second trial compared to the first. As such, this study illustrates a context in which young children can a) draw on a recently acquired episodic memory to facilitate future-oriented decision making, and b) show evidence of learning after a single trial. Because these areas were addressed non-verbally, our saving paradigm could be modified for use with non-human species.

Future directions and possible modifications to the current paradigm include a) measuring children's performance on a forced-choice version of the saving paradigm to allow for meaningful comparisons with previous research, b) comparing children's saving with their performance on potentially related processes, such as delay of gratification and inhibitory control, and c) assessing each child's interest in playing with the small and large marble games (as well as the relative desirability of these) to shed light on the extent to which individual

differences affect saving (and, in turn, why we may not have obtained the age effects that we expected).

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Table 1

Use and/or saving of marbles by children in the MRF condition who retained unused marbles at the end of trial 1 and/or trial 2

Participant	Age	Marbles used trial 1 room 1	Marbles used trial 1 room 2	Marbles used trial 2 room 1	Marbles used trial 2 room 2 _[CA3]
44	4	1 (2)	1 (1)	1 (2)	1 (1)
46	4	1 (2)	1 (1)	1 (2)	1 (1)
57	3	0 (3)	0 (3)	0 (3)	0 (3)
59	5	1 (2)	1 (1)	2 (1)	1 (0)
62	4	1 (2)	1 (1)	1 (2)	1 (1)
78	5	1 (2)	1 (1)	1 (2)	1 (1)
79	3	0 (3)	0 (3)	0 (3)	0 (3)

Note. Numbers of saved/unused marbles are in parentheses.

Table 2

Use and/or saving of marbles by children in the MRP condition who retained unused marbles at the end of trial 1 and/or trial 2

Participant	Age	Marbles used trial 1 room 1	Marbles used trial 1 room 2	Marbles used trial 2 room 1	Marbles used trial 2 room 2
992 _[CA4]	3	0 (3)	0 (3)	0 (3)	0 (3)
994	5	1 (2)	1 (1)	1 (2)	1 (1)
998	5	3 (0)	0 (0)	1 (2)	1 (1)
9915	4	3 (0)	0 (0)	1 (2)	1 (1)
9918	4	1 (2)	1 (1)	1 (2)	1 (1)
9927	4	1 (2)	1 (1)	1 (2)	1 (1)
9936	3	1 (2)	1 (1)	1 (2)	1 (1)

Note. Numbers of saved/unused marbles are in parentheses.

Table 3

Children's Mean "Waiting" Scores in Trials 1 and 2

Age group	<i>n</i>	Mean "waiting" score	
		Trial 1	Trial 2
		<i>M (SD)</i>	<i>M (SD)</i>
3 years	22 ^a	6.78 (5.68)	7.91 (6.45)
4 years	26	5.54 (4.32)	9.08 (3.68)
5 years	24	5.00 (4.25)	9.04 (4.59)

Note. For each trial, children received a "waiting" score ranging from 0 to 18 points, with higher scores representing greater degrees of waiting to use marbles. Standard deviations of mean "waiting" scores are in parentheses.

^aDue to technical errors resulting in missing video data, "waiting" scores could not be computed for 2 of the 24 3-year-olds in the sample.

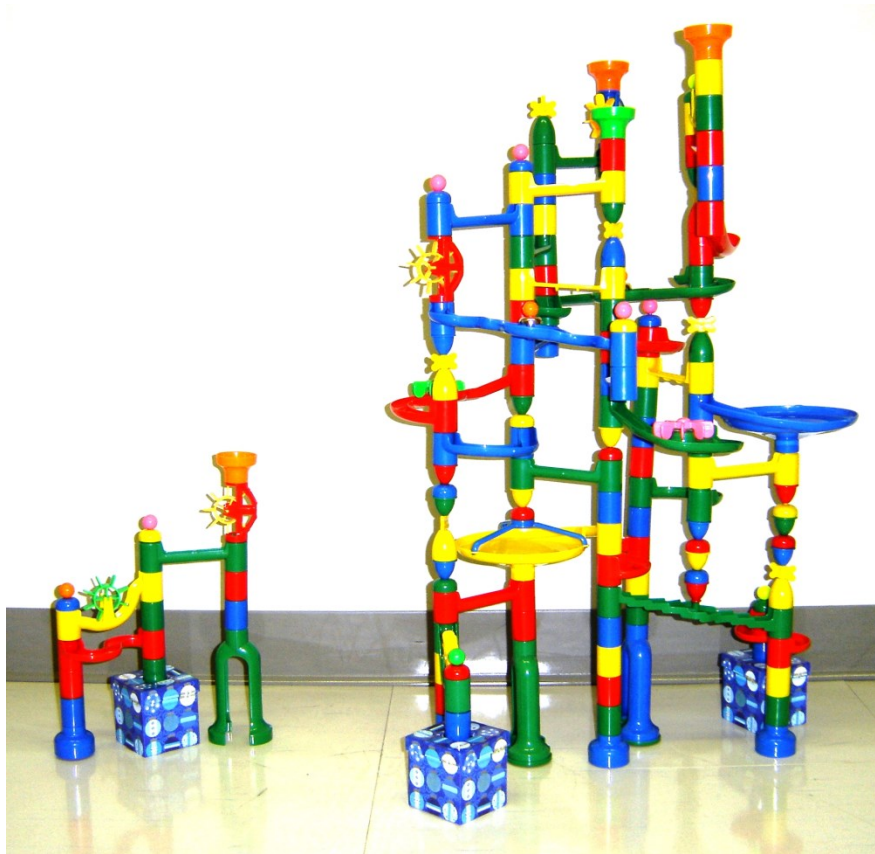


Figure 1. Small (left) and big (right) marble games placed adjacently for comparison.

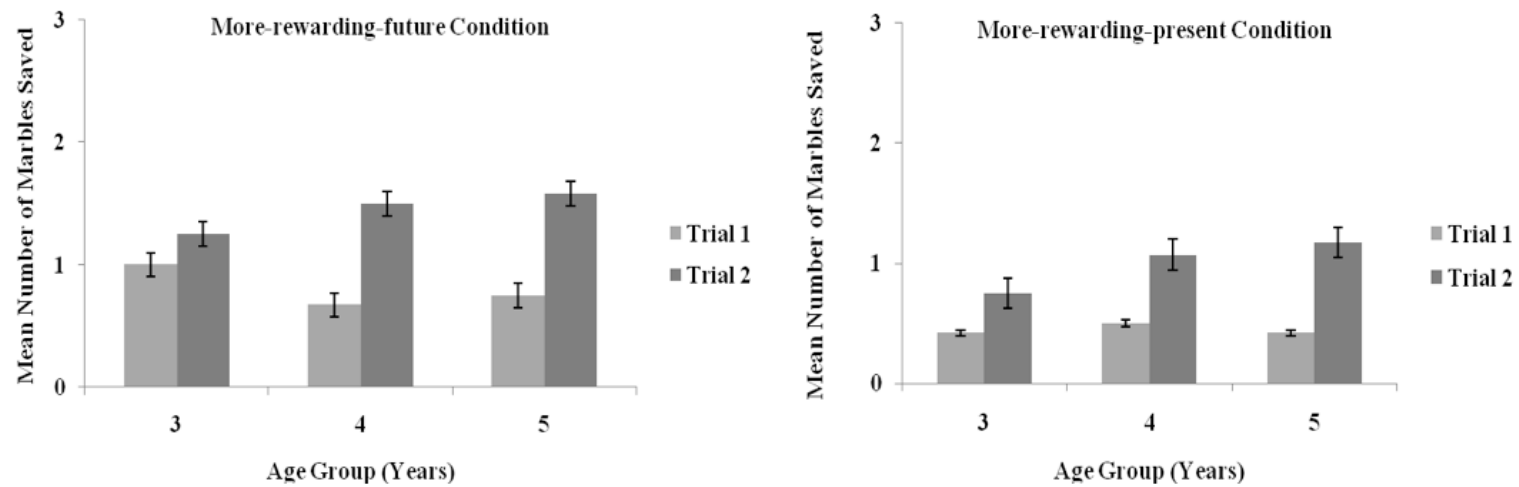


Figure 2. Mean number of marbles saved in the more-rewarding-future and more-rewarding-present conditions. Standard errors are represented in the figure by the error bars attached to each column.

Helping Children Save: Tell Them They Can (if They Want to)

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Abstract

Using a marble game paradigm, we explored whether 3-, 4-, and 5-year-olds' saving was facilitated by a verbal prompt alerting them to their choices (i.e., saving or spending marbles). Two marble games differing in desirability assessed whether children in a "prompted" condition saved more than those who did not receive a prompt ("spontaneous" condition) and whether saving increased with age. We also assessed whether children's saving was related to their inhibitory control (IC), theory of mind (ToM), working memory (WM), and receptive language abilities. Children in the prompted condition saved significantly more marbles than children in the spontaneous condition and 5-year-olds saved significantly more than 3-year-olds. IC, ToM, and WM were not positively associated with saving. After controlling for age, children's saving was not associated with receptive language, validating the marble paradigm as a nonverbal measure of children's future orientation. Implications for children's saving, episodic foresight, and future research are discussed.

Keywords: children's saving; episodic foresight; anticipation; future-oriented behaviour; prompted behaviour; verbal cue

How can we get children to save? Simply tell them they can (if they want to)

Saving for the future is a highly adaptive human behaviour. While the term “saving” tends to elicit thoughts of piggy banks, retirement accounts, and college funds, the advantages afforded by our capacity to save extend beyond the realm of finance to many life domains. For example, saving underlies such behaviours as rationing food in the context of poverty or war, storing an infant’s outgrown clothing for future offspring, and refraining from enjoying a bottle of wine before its designated date of maturity. Even time can be saved, as with an employee who avoids taking single vacation days throughout the winter to enjoy a long holiday during the summer.

Despite the domain-general nature of saving, most research on this topic has focused on the economic behaviour of adults (e.g., Anderson & Nevitte, 2006; Cryder, Lerner, Gross, & Dahl, 2008; Esner-Hershfield, Garton, Ballard, Samanez-Larkin, & Knutson, 2009; Otto, Davies, & Chater, 2007). Saving is not only observed in adults, however, but also in young children. For example, children save artwork created at school to show their parents, gather rocks and seashells for their personal collections, and (some!) save Halloween candy so that they can enjoy it beyond the evening of October 31st. Anecdotally, in our own laboratory, young children have expressed a desire to save one or more stickers and/or treats they received during an experimental session to later give to a parent or sibling.

More than ever, saving is a particularly relevant topic in light of current economic trends. In the United States, for example, the percentage of workers projected to have adequate funds to maintain their lifestyle through retirement has decreased from 53% in 1983 to 31% in 2010 (Munnell, Webb, Delorme, & Golub-Sass, 2012). Similarly, saving rates continue to decline in a number of countries including Canada, Australia, the United Kingdom, and Japan (Pasquali &

Aridas, 2013). These trends suggest that today's children will need to exercise greater thrift in young and middle-adulthood to avoid the pitfalls currently faced by today's adults. However, to adequately prepare today's children for lives characterized by increased thrift, we need to gain better insight about how saving develops; and, perhaps even more importantly, the particular contexts and/or aids that may improve children's capacity to save.

Relative to research on adults' saving behaviour, data about children's saving behaviours are scarce. In the first of just two studies exploring children's saving from an economic psychology perspective, Sonuga-Barke and Webley (1993) developed a "play economy" board used with a small sample of 4-, 6-, 9-, and 12-year-old children. The goal of the game was to save (i.e., avoid spending or losing) enough tokens to buy a toy from the toyshop at the end of the circuit. The number of times children saved their tokens (i.e., placed them in a "bank") prior to passing the "robber" and a "sweet shop" (where tokens could be stolen and spent, respectively) increased significantly with age. The largest age difference occurred between 6 and 9.

More recently, Otto, Schots, Westerman, and Webley (2006) extended this approach to examine the saving behaviours of a larger sample of school children. Interestingly, they did not find differences in saving between the ages of 6 and 11. However, the authors did report significant differences in the saving strategies used by younger and older children. Specifically, older children tended to maintain a reserve of tokens they could draw on if they encountered losses, while younger children tended to adopt the precautionary strategy of spending little or no tokens during the board game. Although these studies offer clever paradigms for assessing children's saving behaviour, they do not provide insight into whether, when, or how saving emerges among younger children. With the exception of one study that we describe in detail later

in the Introduction, the topic of saving remains largely absent from the developmental psychology literature.

However, the developmental literature has focused on two capacities that are arguably related to saving: episodic foresight and delay of gratification (DoG). Episodic foresight is defined as the capacity to mentally project oneself forward in time to anticipate future events (Suddendorf & Moore, 2011) and has started to become a topic of interest among developmental psychologists. Most research in this area has shown that children's capacity to talk about the future (e.g., Busby & Suddendorf, 2005; Quon & Atance, 2010; Suddendorf, 2010), make simple plans for the future (e.g., Atance & Meltzoff, 2005; Hudson, Shapiro, & Sosa, 1995), and select items for future use (e.g., Russell, Alexis, & Clayton, 2010; Suddendorf, Nielsen, & von Gehlen, 2011; Scarf, Gross, Colombo, & Hayne, 2013) all undergo substantial development between ages 3 and 5. This same developmental pattern also appears to characterize children's capacity to delay gratification. For example, Moore and colleagues (e.g., Lemmon & Moore, 2007; Moore, Barresi, & Thompson, 1998; Thompson, Barresi, & Moore, 1997) modified the traditional DoG paradigm (e.g., Mischel & Mischel, 1983) to assess whether children would wait to receive more stickers in the future versus fewer stickers in the present (thus displaying "future-oriented prudence"). They found that older children (i.e., 4- and 5-year-olds) will delay gratification in favour of a larger reward more often than younger children (i.e., 3-year-olds). However, it is important to note that individual variability in children's performance on this type of task has also been reported (e.g., Beck, Schaefer, Pang, & Carlson, 2011; Garon & Moore, 2007; Lemmon & Moore, 2001).

Nonetheless, there are some important conceptual distinctions between saving and both episodic foresight and DoG. With respect to the former distinction, individuals may have the

capacity to think about and envision themselves in the future (e.g., lying on the beach in Hawaii next winter), yet not necessarily to *save* for the future (e.g., setting aside funds to pay for the trip). As such, episodic foresight may be necessary but not sufficient for saving to develop. With respect to the latter distinction, whereas saving entails giving up a present reward in favour of a future reward or goal, delayed gratification (as measured by choice paradigms like the one described above) is best described as “postponement of consumption” (Stammerjohan & Webster, 2002). That is, children who delay on such tasks do not forego the initial reward (e.g., Mickey Mouse sticker) entirely, they simply have to wait to receive it along with the future reward (e.g., Mickey Mouse sticker and Donald Duck sticker) (Metcalf & Atance, 2011). In contrast, saving involves foregoing activities we desire in the present (e.g., eating a meal at an expensive restaurant) in favour of a longer-term goal (e.g., saving for a trip to Hawaii). As such, studying the emergence of saving in its own right is warranted.

To our knowledge, the only study that has measured saving in preschoolers was conducted by Metcalf and Atance (2011). They developed a paradigm in which 3-, 4-, and 5-year-olds were given three marbles and then told that they were going to spend 3 minutes in each of two rooms. The first room contained a little marble game and the second room contained a bigger, presumably more desirable, marble game. The games were “rigged” such that the marbles dropped into them could not be retrieved (i.e., each marble could only be used once). Of interest was whether children saved any marbles for use in the bigger game in the second room. Results revealed that the rate of saving was quite low (only 39% of children saved one or more marbles for the second room) and that older children did not save more marbles than younger children. However, children were also given a second trial (with an additional three marbles) that immediately followed the first. Here, children saved significantly more marbles than in the

first trial ($M = 1.22$ vs. $M = .63$, respectively), with 72% of children saving at least one marble for the second room. However, again, no age differences were detected.

The fact that an age difference was not detected suggests that saving may not follow the same developmental trajectory as either episodic foresight or DoG, where researchers have found significant differences between ages 3 and 5. However, Metcalf and Atance (2011) caution against such an interpretation for several reasons. First, from a purely methodological standpoint, giving children only three marbles may have made it difficult to detect significant variability in saving, thus leading to low sensitivity and hence a failure to detect age-related differences. Second, an aspect that was unique about Metcalf and Atance's paradigm, as compared to paradigms used to measure episodic foresight and/or DoG, was that it assessed whether children could *spontaneously* generate a future-oriented solution (i.e., whether they would, on their own volition, decide to save for the near future in the absence of any prompt to do so). In contrast, in most episodic foresight and DoG paradigms, children are provided with a future-oriented option among a set of present-oriented/distractor options. For example, a child may need a key to open a box in another room in the near future and thus is presented with the key along with several incorrect item choices and asked to select amongst them. As such, children's future-oriented behavior is not generated spontaneously/independently but, rather, in response to a question/prompt from the experimenter about which option should be selected.

In the context of Metcalf and Atance's (2011) paradigm, it is quite possible that the notion of "saving something" did not occur to children. If so, this raises the interesting possibility that even 5-year-olds (who are generally successful on episodic foresight and/or DoG tasks) have difficulty generating future-oriented solutions (such as the decision to save) spontaneously in a novel context (e.g., the marble paradigm). This would explain Metcalf and

Atance's failure to detect age-related differences. In contrast, when future-oriented choices are made explicit to children via prompts inherent in forced-choice questions, age-related increases may be detected. If so, comparing children's performance on what might be termed "prompted" vs. "spontaneous" measures of saving would allow for a more comprehensive understanding of children's capacity for saving specifically and episodic foresight more broadly.

Why might children benefit from a prompt that highlights "saving" as an alternative to "spending"? To our knowledge, no previous studies have systematically evaluated the effect of cues on children's future-oriented behaviour. However, a study by Hayne, Gross, McNamee, Fitzgibbon, and Tustin (2011) found that prompts (i.e., photos depicting children's lives chronologically along with the provision of parent-reported past and future events) improved children's ability to talk accurately about past and future events. In addition, other studies report that repeated prompts in the form of labels and symbols (e.g., decks of cards labelled "good" and "bad" on a gambling task) improve preschoolers' performance on executive function tasks (Carlson, 2005; Garon & Moore, 2007; Kirkham, Cruess, & Diamond, 2003; Muller, Zelazo, Hood, Leone, & Rohrer, 2004).

Relatedly, strategies involving verbal prompts instructing children to "stop and think" before acting have been shown to promote prosocial decision-making among students from preschool through high school (Knoff, 2000, 2001, 2005). As such, it is reasonable to hypothesize that, in the context of saving, providing children with a simple verbal prompt alerting them to the fact that saving marbles for the second room is an option may facilitate future-oriented prudence among children who would otherwise be unable to generate such a solution on their own. If so, this finding would have important implications for the development

of children's saving and, more importantly, how best to promote/increase saving behaviours in young children.

The Current Study

We developed a modified version of Metcalf and Atance's (2011) saving paradigm. Our main goal was to investigate whether children's saving is facilitated by a cue that renders two general courses of action (i.e., "saving" or "spending" marbles) explicit without attributing a positive or negative valence to either choice. Doing so addresses the issue of whether children will be better savers when the option to save is made explicit to them. Accordingly, we compared children's saving in a context in which such a cue was introduced (i.e., "prompted" condition) to one in which it was not (i.e., "spontaneous" condition) with the prediction that children would perform better in the prompted condition than in the spontaneous condition. We also expected an interaction between age and condition such that age-related improvements would be detected in the prompted condition but not in the spontaneous condition. This prediction is based on Metcalf and Atance's (2011) failure to find significant age differences in their study - which assessed what could be termed "spontaneous" saving - and on the fact that our prompted condition should conceivably show the age-related changes typically seen in studies of episodic foresight and delay of gratification.

A secondary goal of our study was to explore the extent to which saving is related to other cognitive abilities that develop during the preschool years including inhibitory control (IC), theory of mind (ToM), and working memory (WM). IC, or the ability to inhibit prepotent responses that interfere with a cognitively represented goal (Carlson, Moses, & Breton, 2002; Rothbart & Posner, 1985), seems especially relevant in light of the central role self-control is purported to play in adults' saving behavior (e.g., Otto, Davies, & Chater, 2007; Rabinovich &

Webley, 2007). Moreover, according to Suddendorf and Corballis (2007), future-oriented behaviour is impossible without a certain amount of IC because automatic, present-oriented impulses must be inhibited in favour of behaviours that adapt to anticipated events or need.

As for ToM, or the ability to understand our own and others' behaviour in terms of mental states such as desires, thoughts, and beliefs (Taylor, 1996; Wellman & Liu, 2004), researchers have suggested that the ability to project oneself forward in time to anticipate the desires and needs of one's future self is related to the ability to think about others' mental states (Atance & Meltzoff, 2005; Buckner & Carroll, 2007; Moore et al., 1998; Suddendorf & Busby, 2003; Suddendorf & Corballis, 1997; 2007). False-belief understanding, specifically, allows us to appreciate that others' mental states may differ from our own and emerges in the fourth year of life (Wellman, Cross, & Watson, 2001). Suddendorf and Corballis (1997; 2007) reasoned that this type of understanding may be necessary in order to identify with our future selves and appreciate that our mental states may differ from those of our current selves.

Finally, with respect to WM, Suddendorf and Corballis (2007) theorized that in order to imagine a future event, the mind requires some kind of representational space in which to do so. As the authors discuss, working memory is conceived as such a space (i.e., where information is temporally combined and manipulated) (Baddeley, 1992). Accordingly, we administered a battery of IC, ToM, and WM tasks alongside our saving task.¹

Method

Participants

One hundred children between the ages of 36 and 71 months were recruited in a large city using advertisements in newspapers, daycares, and local retailers. Fifteen of these children were excluded: Two due to their inability to complete the testing session, one due to experimental

error, eight because they responded to the “desirability check” question by stating that they preferred the little marble game over the big one, and four for not having used any of their marbles in the second room. The final sample thus consisted of 85 children, 27 3-year-olds (15 boys; $Mage = 41.7$ months, range = 36 to 47 months), 31 4-year-olds (15 boys; $Mage = 53.9$ months, range = 48 to 59 months), and 27 5-year-olds (14 boys; $Mage = 65.8$ months, range = 60 to 71 months). The majority of participants were from middle-class backgrounds and were predominantly White, but the sample also included some children of Asian and African descent. All children were fluent in English. Children received a small gift for their participation.

Materials, Design and Procedure

Children were randomly assigned to one of three conditions of the saving paradigm: spontaneous ($n = 34$), prompted ($n = 27$), or baseline ($n = 24$). There were no significant differences in age between the three conditions (all $ps > .75$). The goal of the baseline condition was to confirm that when both marble runs were available to children simultaneously (i.e., no delay between accessing the little marble game and the big marble game), children would put significantly more marbles in the big marble run as compared to the little marble run (thus confirming their preference for the big marble game). Thus, in this condition (as described in detail below), children were given their marbles and presented with both marble games (i.e., the big one and the little one) simultaneously. Participants were randomly assigned to each cell of the design (3 conditions x 3 age groups) until the required number of children per cell was met. All children in the spontaneous and prompted conditions were administered two ToM tasks, two IC tasks, and two WM tasks. We also gave children the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-IV) to allow us to control for the effects of language when conducting inter-task

correlations, and to assess whether children's saving ability was related to their receptive language skills.

Counterbalancing of tasks for children in the spontaneous and prompted conditions (i.e., the experimental sample) was as follows: Half of the experimental sample was administered the saving paradigm followed by the "table" tasks (collectively referred to as such because, unlike the saving paradigm, the ToM, IC, WM, and PPVT-IV tasks were all administered with the child and experimenter seated at a table). The remaining half of the experimental sample received the table tasks first followed by the saving paradigm (the saving paradigm was always administered first or last because it required that all non-essential materials be removed from the testing rooms). The order of administration of the table tasks was also counterbalanced.

Counterbalancing for the baseline condition of the saving paradigm was as follows: half of the sample received the saving paradigm followed by the PPVT-IV, while the other half was administered the PPVT-IV first, followed by the saving paradigm. Participants were tested individually in two adjacent laboratory playrooms by a female experimenter. All sessions were video-recorded.

Measures.

Saving paradigm: spontaneous condition: A sign on the door of the first testing room displayed a photo of the little marble game against a red cardboard background (hereafter referred to as the "red room"), while a sign on the door to the second testing room (adjacent to the first room) displayed a photo of the big marble game against a blue cardboard background (hereafter referred to as the "blue room"). The experimenter guided the child into the testing area to introduce him/her to the two rooms (i.e., "You are going to get to play in two rooms"). The experimenter pointed to the sign on the door of the red room and explained to the child that the

red room contained a “little marble game” (the little marble game consisted of only one short “run” into which children could drop their marbles, see Figure 1). Experimenter and child then entered the red room and the experimenter demonstrated how the little marble game worked. The experimenter put one marble down the run, and explained that once a marble is dropped down the hole, it goes into a box at the end of the run and cannot be used again. Next, child and experimenter exited the first room and proceeded to the entrance of the second room. The experimenter pointed to the sign on the door of the blue room and explained that the blue room contained “a big marble game” (the big marble game consisted of 3 different “runs”). Child and experimenter entered the blue room and the experimenter demonstrated how the big marble game worked by dropping one marble down a run. As with the little marble game, the experimenter explained that once a marble is dropped down a run, it goes into a box and cannot be used again. The color (red/blue) and the rooms in which the little/big marble games were placed were counterbalanced.

Next, the experimenter guided the child back into the laboratory and asked the “desirability check question”. The purpose of this question was to confirm children’s preference for the big marble game over the little one. The experimenter presented the child with a rectangular card to which photos of the little marble game and the big marble game were affixed. The experimenter pointed to the photo on the left of the card (“This is a picture of the little/big marble game”) and then to the photo on the right of the card (“This is a picture of the little/big marble game”). The experimenter then asked the child, “Which marble game do you like best?”

After recording children’s responses to the desirability check question, the experimenter pointed to the sign on the door of the red room and stated, “First, you are going to stay in the red room for three minutes. The red room has the *little* marble game.” The experimenter then pointed

to the sign on the door of the blue room and said, "After, you are going to stay in the blue room for three minutes. The blue room has the *big* marble game." Next, the experimenter handed the child a transparent bag containing five marbles and explained, "You only get five marbles today. Remember, once you put a marble down the hole, you can't use it again." Immediately after giving children these instructions, the experimenter asked them what they were going to do "right now." If children did not refer to both the red room and the little marble game, the instructions were repeated. We refrained from asking children what they were going to do "next" (i.e., in the second room) at this point in order to avoid inadvertently cuing them to save.

Upon entering the red room, the experimenter sat at a desk located in the back of the room, put on headphones, and said to children, "I'm going to do my work over here for three minutes until this timer rings". The experimenter started the timer (which had been set to ring after three minutes) and placed it on the desk. During the three minutes, the experimenter pretended to work and kept her interactions with the child to a minimum. We did this so that children would not have anything to do in either room other than play with the marble game (should they have marbles remaining). If children attempted to interact with the experimenter, she made neutral statements such as, "I have some work to do". The experimenter noted the number of marbles children used in the little marble game. Immediately after the timer rang, the experimenter asked children what they were going to do next. All but 2 of the 61 children correctly reported that they were going to play with the big marble game. Irrespective of their responses, the experimenter said, "We're going to go in the blue room for three minutes. The blue room has the *big* marble game. Bring your marble bag!" Child and experimenter entered the blue room, at which point the procedure was identical to that in the red room: The experimenter

pretended to work until the timer rang and noted the number of marbles the child used in the big marble game.

Saving paradigm: prompted condition. Materials and procedures for this condition were identical to the spontaneous condition with one crucial difference: In this condition, the options to save or not save marbles were made explicit to children in the form of a verbal explanation provided by the experimenter: After the child received the initial instructions (and responded to the desirability check question) and before he/she entered the red room for three minutes, the experimenter stated, “If you want to, you can use all of your marbles in the red (blue) room, or you can save some marbles for the blue (red) room.”

Saving control: baseline condition. The purpose of this condition was to confirm that children would use more marbles in the big marble game than in the little marble game when they had access to both at the same time. Materials and procedures for this condition were similar to the spontaneous and prompted conditions with the following differences: Children entered only one room that contained both the little and big marble games (the left/right placement of the games in the room, as well as the pictures on the door to the room was counterbalanced). After the experimenter demonstrated how each marble game worked, she guided the child out of the testing room and into the laboratory to administer the “desirability check question,” just as it was administered in the spontaneous and prompted conditions. After explaining to the child that he/she would be returning to the room with both marble games for 6 minutes, the experimenter handed him/her a bag containing five marbles and said, “You only get five marbles today. Remember, once you put a marble down the hole, you can’t use it again.”

As in the spontaneous and prompted conditions, the experimenter pretended to work and kept her interactions with the child to a minimum. The experimenter noted the number of marbles children used in each marble game until the timer rang.

Reliability Coding

A trained undergraduate psychology student who was blind to the goals of the study conducted reliability coding on 50% of the data. Only those tasks for which children's responses were considered to be subjective underwent reliability coding. Disagreements were resolved through discussion.

Inhibitory Control Task 1: Whisper Game (Carlson, 2005). The experimenter asked children if they could whisper their names. Children were then told that they would be shown some pictures of cartoon characters and asked to whisper their names. Children were also told that it was alright if they did not know all of the names. The experimenter then presented a series of 10 cards depicting the cartoon characters, six of which were intended to be familiar to the child (i.e., Shrek, SpongeBob, Dora The Explorer, Buzz Lightyear, Spiderman, and Diego) and four unfamiliar (i.e., Darkwing Duck, Elmer Fudd, Bullwinkle, and Tasmanian Devil). On each familiar character trial children received a score of 2 if they whispered the name, 1 if they spoke in a normal or mixed voice (i.e., if they started in one mode of voice and changed to another as in shouting to whispering or whispering to shouting), and a score of 0 if they shouted out the name. Unfamiliar characters were included in the series so that children would become more excited (and therefore more likely to shout out the name) when presented with a familiar character. Total possible scores on this task ranged from 0 to 12 (2 x 6 familiar characters). Because some children did not recognize all of the "familiar" characters, mean scores were used in the final analyses (i.e., children who only recognized 5 of the "familiar" characters but whispered all of

their names received a mean score of $10/5 = 2$). Possible mean scores ranged from 0 to 2.

Reliability for this task was satisfactory, with Cohen's kappa = .86.

Inhibitory Control Task 2: Grass/Snow (Carlson & Moses, 2001). Children were asked to place their hands on top of two child-sized felt hand shapes located beneath a white card and a green card on the table. The experimenter asked children to state the color of grass (green) and the color of snow (white). The experimenter then explained that they were going to play a silly game in which children had to point to the white card when the experimenter said "grass" and to the green card when she said "snow". There were two practice trials and 16 test trials administered consecutively. Children's first responses to each test trial were scored, even if they self-corrected. Children received a score of 1 on a test trial if they said "grass" in response to a white card or "snow" in response to a green card, and a score of 0 if they said "grass" in response to a green card or "snow" in response to a white card. Total possible scores on this task ranged from 0-16. Reliability for this task was satisfactory, with Cohen's kappa = .76.

Theory of mind task 1: Unexpected Contents (Perner, Leekam, & Wimmer, 1987).

Children were shown a Band-Aid box and asked what they thought was inside. After stating "Band-Aids," children were shown that the box actually contained a toy pig. The box was then closed and children were asked to state its true contents (i.e., "pig"). Children who were unable to correctly state the box's true contents were again shown that the box contained a pig. Next children were asked the target question, "When you first saw this box, before we opened it, what did you think was inside?" Children received a score of 1 if they correctly stated "Band-Aids" to this target question; otherwise, they received a score of 0.

Theory of mind task 2: Change-in-location (Wimmer & Perner, 1983). In this task, "Ernie" and "Bert" hand puppets (from Sesame Street) were used to act out a scene in which

Ernie moves a ball from location A to location B, unbeknownst to Bert, who had initially put the ball in location A. Children were asked to state where Bert believes the ball is (location A), and where the ball really is (location B). Children received a score of 1 if they correctly stated Bert's belief about the location of the ball and the true location of the ball. Otherwise, children received a score of 0.

Working Memory Task 1: Counting and Labeling. In this task designed to measure dual-task performance (Carlson, Moses, & Breton, 2002; Gordon & Olson, 1998), the experimenter presented children with three toys (a horse, a plastic donut, and Play-doh), and named and pointed to each toy in turn. Next, the experimenter counted while pointing to each toy, "1, 2, 3." Finally, she enumerated and stated the name for each of the three toys, "one is a horse, two is a donut, and three is Play-doh." Children were then given three toys of their own (a turtle, a plastic banana, and a dinosaur) and instructed to repeat the steps the experimenter had performed (i.e., enumerate, label, and then enumerate and label the toys). They were corrected, if necessary, after steps one and two but not after step three. Children then received a second trial of the task with a new set of items (a plastic orange, a toy car, and a crayon). Children received one point for each correct response to step 3. Possible scores on this task ranged from 0-2. Reliability for this task was satisfactory, with Cohen's kappa = .85.

Working Memory Task 2: Backward Digit Span. This task was adapted from one used by Davis and Pratt (1996) and described more recently by Carlson, Moses, and Breton (2002). Children were asked to repeat a list of single-digit numbers in reverse order. The experimenter used a puppet to demonstrate saying digits backward ("This is my friend Johnny. Whenever I say numbers, Johnny says them backwards. Listen: '5-8'." Johnny then said, "8-5"). Children were asked to do as Johnny had done. They were given a pair of two-digit practice trials and corrected

up to two times per practice trial if necessary. The experimenter then proceeded to administer the pairs of test trials. The number of digits on the list increased with each successful performance on both trials in a pair (2, 3, 4, 5, and 6 digits). Children received one point per correct trial and the task was discontinued when they failed both trials in the same pair. Possible scores on this task ranged from 0 to 10. Reliability for this task was satisfactory, with Cohen's kappa = .92.

Receptive Language: Children's receptive language ability was assessed using the *Peabody Picture Vocabulary Test-IV* (PPVT-IV; Dunn & Dunn, 2007). The PPVT-IV is an individually administered, norm-referenced, 204-item test designed to assess the receptive language level of individuals aged 2.5 to 90 years. Examinees are shown four pictures and asked to point to the one that best represents the word spoken aloud by the experimenter. Test administration continues until the examinee (in this case, the child) errs on eight words in a set of 12. The PPVT-IV takes approximately 10 to 15 minutes to administer (Dunn & Dunn, 2007).

Results

Saving Paradigm

Baseline condition. Recall that this condition served to confirm that children would use significantly more marbles in the big marble game compared to the little marble game. A paired-samples t-test confirmed that this was indeed the case with children in this condition showing an overwhelming preference for the big marble game ($M = 4.08$, $SD = 1.21$) compared to the little marble game ($M = .79$, $SD = 1.14$), $p < .001$. Examination of the z scores for skewness indicated that the distribution of the number of marbles children used was positively skewed for the little marble game and negatively skewed for the big marble game. This skewness is to be expected given the nature of children's performance in the baseline condition, in which they used very few marbles in the little marble game and most of their marbles in the big marble game.

Effects of Condition and Age

In order to be able to test for interaction effects, a parametric test (2 x 3 analysis of variance) was selected to determine whether children saved significantly more marbles in the prompted condition compared to the spontaneous condition, and whether saving varied as a function of age. However, examination of the z-scores for skewness revealed that data in 2 of the 6 cells of the saving task were skewed. In the spontaneous condition, z_{skewness} scores exceeded 1.96 for 3- and 4-year-olds (z_{skewness} scores of 4.60 and 3.54, respectively). In order to retain the ability to compare children's rates of saving across studies 1 and 2 (see Study 2 Addendum), no transformations were applied to the data. However, because the assumption of normality was violated in 2 cells, the ANOVA was followed up with non-parametric tests to assess the main effects. Levene's test of Equality of Error Variances indicated that variances were not equal between groups on the saving task. This is not surprising given that 3- and 4-year-olds' saving was close to floor in the spontaneous condition ($M = .20$ and $.31$, respectively). In contrast, 5-year-olds saved at least one marble in the spontaneous condition, on average ($M = 1.36$). All other assumptions underlying the ANOVA were met.

The results of the 2 x 3 ANOVA were as follows: The main effect of Condition was significant, $F(1, 55) = 14.67, p < .001, \eta_p^2 = .211$. Children saved more marbles in the prompted condition ($M = 1.92, SD = .25$) than in the spontaneous condition ($M = .62, SD = .22$). The main effect of age was also significant, $F(2, 55) = 3.30, p = .044, \eta_p^2 = .107$. Follow-up Tukey's HSD tests revealed that 5-year-olds ($M = 1.87, SD = .302$) saved significantly more than 3-year-olds ($M = .788, SD = .308$), $p = .040$. Although 4-year-olds ($M = 1.15, SD = .266$) saved more than 3-year-olds and less than 5-year-olds, these differences were not significant. There was no significant Condition x Age interaction (see Figure 2).

The results of the non-parametric tests were similar to those yielded by the ANOVA. A Mann-Whitney test indicated that 5-year-olds saved more marbles than 3-year-olds, $U = 106.5$, $p = .049$. A second Mann-Whitney test indicated that children saved more marbles in the prompted condition than in the spontaneous condition, $U = 234.5$, $p < .001$ [CA5].

Performance on IC, ToM, WM, and the PPVT-IV

In order to ensure that children in the spontaneous and prompted conditions did not differ with respect to their performance on the other tasks administered, condition (Spontaneous, Prompted) was entered into a Multiple Analysis of Variance (MANOVA) as the independent variable with the two IC tasks, ToM aggregate, WM aggregate, and raw PPVT-IV scores entered as dependent variables. No significant multivariate effect was detected, $F(5, 47) = .923$, $p = .474$. As can be seen in Table 1, no significant univariate effects were detected. This parametric analysis was followed-up with non-parametric tests (Kruskal-Wallis), which were also non-significant (see Table 1).

We ran a series of one-way ANOVAs to determine whether children's performance on these tasks varied as a function of age. Examination of the z-scores for skewness revealed that the distribution of scores were skewed in several cells. As such, the ANOVAs were followed-up with non-parametric tests. As can be seen in Table 2, both the ANOVAs and a series of Kruskal Wallis (non-parametric) tests revealed that all tasks except for Whisper Game varied as a function of age.

Relation between saving, IC, ToM, WM, and Receptive Language (PPVT-IV)

A series of first-order correlations (two-tailed) revealed that children's performance on the whisper game and grass/snow IC tasks were not significantly related. Performance on the two ToM Tasks (unexpected contents and change-in-location) and the two WM tasks (backwards

digit span and counting and labelling) were significantly positively correlated with each other, $r(56) = .48, p < .001$, and $r(58) = .45, p < .001$, respectively, leading us to create composite ToM and WM scores. The ToM composite was created by adding scores from the two ToM tasks together. The WM composite was created by first dividing Backward Digit Span scores by 5 (so that they fell on the same scale as Counting and Labeling scores) and then adding scores from the two tasks together. Finally, we considered the relations between saving and each IC task, the ToM and WM composites, and receptive language (PPVT-IV raw scores). As can be seen in Table 3, only PPVT-IV scores and WM were correlated with saving before controlling for the effects of age. These correlations were non-significant after controlling for age.

Additionally, because of the main effect of condition that we obtained, we also ran the two-tailed bivariate correlations between each IC task, the ToM and WM composites, receptive language, and saving separately within each condition. PPVT-IV scores and WM were correlated with saving before controlling for age in the spontaneous condition only. These correlations were non-significant after controlling for age.

Discussion

The main goal of this study was to determine whether children would save more when a prompt highlighting two general courses of action (i.e., saving or spending) was presented. Accordingly, we adapted Metcalf and Atance's (2011) marble saving paradigm to compare the saving behaviour of 3- to 5-year-old children who either did, or did not, receive this cue. We were also interested in whether any effects of such a cue would vary as a function of children's age. A second goal was to determine whether children's performance on other cognitive skills developing over the preschool period was related to the amount that children saved.

As predicted, children in the prompted condition saved significantly more marbles than children in the spontaneous condition. This finding suggests that in saving contexts, simply alerting children to their choices (i.e., saving or not saving) leads to more future-oriented decision making. Recall that the verbal prompt children received was as follows: “If you want to, you can use all of your marbles in the red room, or you can save some for the blue room”. There are several ways to explain why this simple prompt facilitated children’s saving to the extent that it did. First, as mentioned in the Introduction, the verbal prompt may have cued children in the prompted condition to ‘stop and think’ before acting, while children in the spontaneous condition might have acted more impulsively, using up marbles in the little marble game. The *Stop & Think Social Skills Program* (Knoff, 2000, 2001, 2005) has been shown to effectively teach prosocial behaviour to diverse groups of students from preschool through high school (CASEL, 2002; Kilian, Fish, & Maniago, 2006). The program uses five sequential steps to teach, reinforce, and implement prosocial behaviour. The first step, “stop and think” is “a self-control, impulse-control, and/or self-management step designed to condition students to take the time necessary to calm down and think about how they want to handle a situation” (Knoff, 2009, p.20). The prompt children received in the current study may have served a similar function, albeit in a saving context rather than a social context.

Another way to explain the superior performance in the prompted condition as compared to the spontaneous condition lies in Gollwitzer’s work (Gollwitzer, 1993, 1999) on different types of intentions and how these lead to goal attainment among adults. Gollwitzer distinguishes between *goal intentions*, which merely identify a certain desired outcome in the form of ‘I intend to achieve X’, and *implementation intentions*, a highly effective form of planning that specifies the why, how and where of a course of action that will lead to goal attainment: ‘If situation Y is

encountered, then I will perform behavior Z' (Gawrilow, Gollwitzer, & Oettingen, 2011). This specific situational cue automates the initiation of the intended behavior (Gawrilow et al., 2011). It is possible that in the current study, the verbal prompt facilitated saving by inducing children to formulate the implementation intention: 'When I am in the first room with the little marble game, I will save marbles to use in the big marble game' necessary to achieve the goal intention: 'I want to play with the big marble game'. Indeed, the relevance of Gollwitzer's work on implementation intentions to children was recently established by Gawrilow et al., who found that the delay of gratification performance of children with and without Attention Deficit Hyperactivity Disorder was superior when they formed implementation intentions specifying when, where, and what they intended to do in order to facilitate unpleasant waiting. More broadly, it is possible that the function of our prompt was two- or threefold: alerting children to their choices, *and/or* urging them to form implementation intentions, *and/or* serving as a self-control mechanism.

Consistent with our prediction and with the findings of earlier behavioural studies of children's episodic foresight (all of which involved presenting children with forced-choice response formats), older children saved significantly more than younger children in the prompted condition. However, in contrast to Metcalf and Atance's (2011) findings and to our prediction, older children also saved more than younger children in the spontaneous condition. Indeed, in both conditions, 5-year-olds saved more than 3-year-olds (while 4-year-olds saved less than 5-year-olds and more than 3-year-olds, these differences were not significant). This may be due to the fact that Metcalf and Atance gave children three marbles to use, whereas we gave them five. This may have allowed us to detect finer-grained age-related differences. However, it is also possible that our desirability check question (which asked children whether they preferred the

big marble game or the little one), which was not used by Metcalf and Atance, may in fact have served as a goal/intention implementing cue and/or a self-control mechanism in and of itself. In this view, children in the spontaneous condition received one 'cue' (the desirability check) whereas children in the prompted condition received two (the desirability check plus the verbal prompt alerting them to the options to use all of their marbles in the first room or save some). Whether the desirability check actually functioned to facilitate saving could be explored experimentally by comparing the saving behaviour of children in three conditions: the prompted and spontaneous conditions as presented in the current study, and a third condition in which children receive neither the verbal prompt alerting them to their choices nor the desirability check (i.e., the more-rewarding-future condition presented in study 1).

Our findings revealed that children's saving was not significantly related to their IC, WM, or ToM. With respect to IC, in particular, we think it is unlikely that children's saving on the marble paradigm - which involves refraining from using at least one marble in the little marble game in the present in order to enjoy the big marble game in the near future - is truly independent of their self-control. In our view, a more likely explanation for the lack of association between children's saving and their performance on the grass/snow and whisper tasks is that these measures may not actually tap the specific form of self-control required for saving marbles in our saving paradigm. Grass/snow and whisper are both conflict tasks requiring children to inhibit a dominant response that conflicts with the response called for by the task (Carlson, Moses, & Claxton, 2004). For example, on the Grass/Snow task, children must inhibit a prepotent response and initiate a conflicting one in an alternating pattern (i.e., by pointing to the green card when they hear "snow" and pointing to the white card when they hear "grass"). Carlson et al. contrast the demand characteristics of conflict tasks with those that require children

to postpone - rather than completely inhibit - a prepotent response and simply “remain in idle” (Carlson et al., 2004, p. 315) until the time they must wait to access the desired reward has elapsed. As such, future studies should include pure “delay” tasks that measure children’s ability to wait. In this sense, Mischel’s classic delay of gratification task would be a good choice.

The lack of association between saving and ToM observed in this study is in need of replication, but one possible way to explain this finding is that saving for the future - at least in some cases - would seem to reflect a strong focus on the self and the self’s future needs. In contrast, the change-in-location and unexpected contents tasks are concerned with children’s ability to identify *another’s* mental state and their own *past* mental state, respectively. Nonetheless, recent arguments for links between ToM and future thinking/prospection, at least, have been made and suggest that we might expect a positive relation between saving and ToM. As noted, however, this issue will need to be addressed in follow-up studies that include additional and more varied tasks of both saving and theory of mind. Similarly, the lack of association between saving and WM reported in the current study warrants further investigation and replication. The working memory demands of our saving task may differ qualitatively and/or quantitatively from those of the working memory tasks administered in this study.

Finally, children’s saving was not associated with their receptive language ability. We believe that this is an important finding because it suggests that the marble paradigm can be used to assess a critical aspect of children’s future orientation without confounding it with their receptive language functioning. The fact that some previous tasks of episodic foresight have relied heavily on language has been pointed out (e.g., Hudson, Mayhew, & Prabhakar 2011; Suddendorf & Busby, 2005) thus resulting in the call for methods that are more “non-verbal.” Yet, even so, children’s performance on such non-verbal tasks has not, to our knowledge, been

assessed alongside any measure of their language abilities. As such, the current study is the first to actually measure how children's performance on a more non-verbal test of future orientation is related to their language (receptive skills, in particular) ability. Nonetheless, although we have shown that children's performance on a non-verbal measure of saving was independent of their *receptive* language abilities, our study has not shed any light on how children's saving (or episodic foresight, more broadly) might be related to their *expressive* language skills. Children often talk themselves through tasks, producing speech that is often internalized as private, inner speech (Lidstone, Meins, & Fernyhough, 2010). Even if children's receptive language skills are not associated with their propensity to save, their expressive language may be involved in their formulation of plans or intentions related to saving[CA6].

Directions for Future Research

Saving is an important and under-studied aspect of young children's future-oriented behavior and so an important goal is to develop a broader variety of tasks to assess this skill. With respect to the types of prompts or cues that may lead to an increase in children's saving, one possibility is to develop "visual" tasks that would allow children to "see the future." For example, children could be presented with a rectangular sheet of paper featuring uncoloured line drawings (much like one would find in a colouring book) of an orange, an apple, and a strawberry in linear fashion from left to right. Children would then be presented with three crayons (one orange, one red, and one green) and instructed to colour in the fruits using an appropriately coloured crayon, each of which can be used only once. Of interest is whether children would 'save' the red crayon to colour in the strawberry by selecting the green crayon to colour in the apple. In fact, this type of task could easily be implemented in a classroom setting as an exercise to encourage young children to think ahead and to effectively plan their activities.

Indeed, getting to the strawberry only to discover that the red crayon is no longer available may be an especially effective learning experience that, in turn, could foster children's future orientation in subsequent activities.

Although we did not detect the expected relationships between saving and IC, WM, or ToM, it is possible that using a broader range of saving tasks may yield a different picture. It will also be important to determine the extent to which saving is related to other future-oriented processes including delay of gratification, planning, and episodic foresight, as well as other aspects of language (e.g., expressive language skills). Alternately, factors that may be more "social" or "environmental" in nature may be especially relevant for the development of saving. For example, the extent to which children save may be a function of how much importance parents and/or the school setting place on saving. In this respect, even a child who has strong cognitive abilities (e.g., ToM, IC, etc.) but for whom saving is simply not valued in his environment may have difficulty saving. Saving may in fact be very "experience-dependent" such that the opportunities that children are given by their parents to save influences their level of saving. Saving would still be expected to increase with age, as we found in our study, because as children get older they have more opportunities to capitalize on their parents' prompts/advice to save. This line of reasoning could be tested by administering a parental "saving practices" questionnaire alongside lab-based measures of saving to determine whether individual differences in saving practices predict children's performance on the lab-based tasks.

Conclusion

This study investigated the factors that lead to an increase in prudent future-oriented behaviour among young children in saving contexts. Specifically, we found that simply alerting children to their choices of action without urging a particular choice led to greater saving

behaviour. This finding has important implications for strategies aimed at fostering children's problem-solving and decision-making skills across a number of contexts including those at home, daycare, and school.

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Footnote

¹We also administered an adapted version of Lemmon and Moore's (2007) delay of gratification choice paradigm. Children received two trials in which they chose between receiving one sticker now and receiving four/five stickers now ("practice" trials). "Test" trials consisted of two different choices, each presented three times: 1 sticker now or 4 stickers later and 1 sticker now or 5 stickers later. However, the results of this task were difficult to interpret due to the fact that children did not show an overwhelming baseline preference for the larger number of stickers on the practice trials (only 57% of children preferred the larger reward on the 4 stickers now vs. 1 sticker now practice trial and only 54% of children preferred the larger reward on the 5 stickers now vs. 1 sticker now practice trial). These results rendered subsequent interpretation of the data difficult.

Table 1

Mean scores on all variables as a function of condition

Task	Spontaneous Condition	Prompted Condition	Condition effects	
			(univariate F)	Kruskal Wallis Test
PPVT-4 raw scores	97.59 (28.64)	99.24 (30.064)	$F(1, 51) = .327$	$\chi^2 = .001$
ToM Aggregate (range = 0-2)	1.34 (.79)	1.12 (.90)	$F(1, 51) = 1.079$	$\chi^2 = .780$ [CA7]
WM Aggregate (range = 0-4)	1.77 (1.03)	1.77 (1.09)	$F(1, 51) = .002$	$\chi^2 = .057$
Grass/snow (range = 0-16)	12.91 (5.19)	11.56 (5.71)	$F(1, 51) = .683$	$\chi^2 = .336$
Whisper game (range = 0-2)	1.87 (.33)	1.85 (.454)	$F(1, 51) = .135$	$\chi^2 = .035$

Note. Standard deviations are in parentheses. No significant parametric or nonparametric effects were detected between conditions for any variable.

Table 2

Mean scores on all tasks as a function of age

Task	3-year-olds	4-year-olds	5-year-olds	Age effects	
				(univariate <i>F</i>)	Kruskal Wallis Test
<i>Receptive Vocabulary</i>					
PPVT-4 raw scores	66.56 ^a (14.70)	102.91 ^b (19.25)	124.11 ^c (19.35)	F(2, 56) = 47.14**	$\chi^2 = 35.82^{**}$
<i>ToM tasks</i>					
Unexpected contents (range = 0-1)	.24 ^a (.44)	.71 ^b (.46)	.78 ^b (.43)	F(2, 56) = 7.82**	$\chi^2 = 12.67^{**}$
Change-in-location (range= 0-1)	.19 ^a (.40)	.75 ^b (.44)	.94 ^b (.24)	F(2, 55) = 18.22**	$\chi^2 = 22.71^{**}$
<i>IC tasks</i>					
Whisper game (range = 0-2)	1.69 ^a (.62)	1.91 ^a (.23)	1.96 ^a (.17)	F(2, 58) = 2.73	$\chi^2 = 4.82$
Grass/snow (range = 0-16)	9.72 ^a (6.00)	12.04 ^{a,b} (5.71)	15.11 ^b (2.73)	F(2, 58) = 5.25**	$\chi^2 = 11.99^{**}$
<i>WM tasks</i>					
Backwards digit span (range = 0-10)	.56 ^a (.98)	1.30 ^a (1.26)	2.89 ^b (1.66)	F(2, 57) = 15.08**	$\chi^2 = 19.55^{**}$
Counting & labelling (range = 0-2)	.47 ^a (.80)	1.78 ^b (.60)	1.94 ^b (.23)	F(2, 56) = 34.53**	$\chi^2 = 37.72^{**}$

Note. Standard deviations are in parentheses. The ns for individual tasks ranged from 55 to 61. Means in the same row that do not share superscripts differ at $p < .05$ using the Tukey HSD test [CA8].

* $p < .05$

** $p < .01$.

Table 3

Inter-task bivariate correlations

Variable	2	3	4	5	6	7
1. Age	.81**	.31*	.64**	.32*	.39**	.74**
2. PPVT-IV (raw scores)	—	.29* ^a	.58**	.21	.51**	.67**
3. Saving		—	-.029	.13	.06	.27* ^b
4. ToM (aggregate)			—	.14	.35**	.63**
5. IC: Whisper Game				—	-.012	.33*
6. IC: Grass/Snow					—	.42**
7. WM (aggregate)						—

Note. The *ns* ranged from 58 to 61.

^aSaving is no longer correlated with PPVT-IV scores when controlling for age.

^bSaving is no longer correlated with WM when controlling for age.

**p* < .05.

***p* < .01.

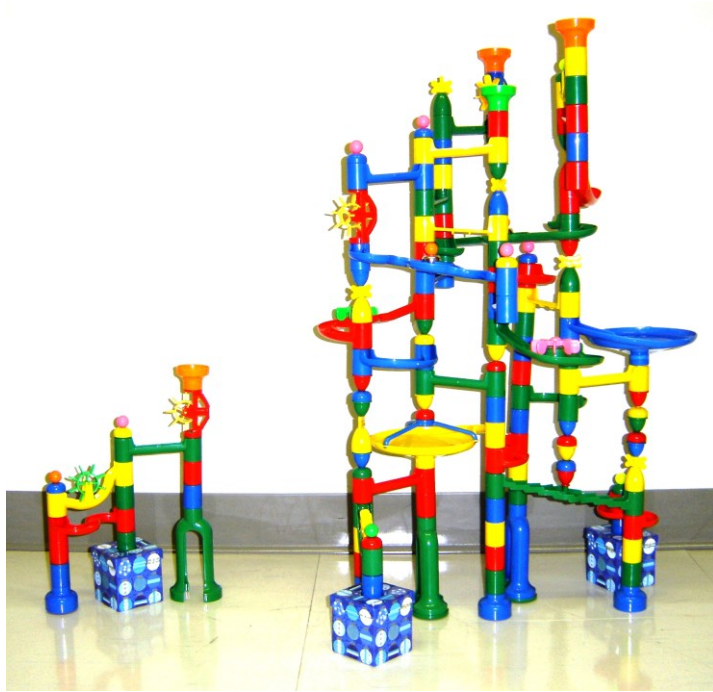


Figure 1. Small (left) and big (right) marble games placed adjacently for comparison

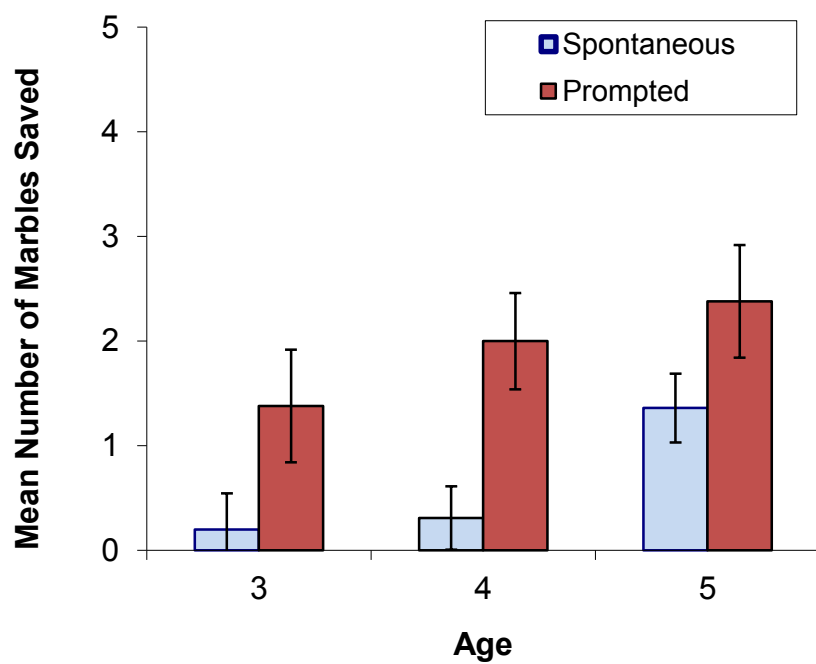


Figure 2. Mean number of marbles saved in the spontaneous and prompted conditions. Standard errors are represented in the figure by the error bars attached to each column.

Study 2 Addendum

The manuscripts for studies 1 and 2 were drafted as separate articles for publication purposes. In his evaluation of my dissertation, Dr. Chris Moore (external examiner) suggested that I compare the data from studies 1 and 2. Specifically, he suggested that I compare children's saving under similar conditions across the two experiments by comparing (1) the proportion of marbles saved in trial 1 of study 1 to the proportion of marbles saved in the spontaneous condition of study 2 and (2) the proportion of marbles saved in trial 2 of study 1 to the proportion of marbles saved in the prompted condition of study 2. The results of these analyses are presented here.

A univariate ANOVA was run to determine whether the proportion of marbles saved on the second trial of the more-rewarding-future condition in study 1 differed from the proportion of marbles saved by children in the prompted condition of study 2. Results revealed no significant difference between studies, $F(1, 54) = .205, p < .653$. A non-parametric test (Mann-Whitney) also produced a non-significant result, $U = 342.00, p = .405$.

A second univariate ANOVA was run to determine whether the proportion of marbles saved on the first trial of the more-rewarding-future condition in study 1 differed from the proportion of marbles saved by children in the spontaneous condition of study 2. Results revealed no significant difference between studies, $F(1, 61) = .161, p = .689$. A non-parametric test (Mann-Whitney) also produced a non-significant result, $U = 476, p = .753$.

General Discussion

My doctoral research has contributed to the developmental psychology literature in several important ways. Using a new marble game paradigm designed to capture behavioural evidence of episodic foresight among young children, the experiments conducted for this dissertation constitute the first empirical studies of saving behaviour among preschoolers. I observed that all previous studies of children's future-oriented behaviour relied exclusively on forced-choice response formats and yet, the effect of the prompting inherent in such methods on children's performance remained unexamined. The first study carried out for this dissertation constituted the first attempt to study children's capacity for *spontaneous* anticipatory behaviour; that is, unprompted future-oriented behaviour that occurs in a novel context. In my second study, the performance of children presented with this prompt-free saving context was compared to that of children who received a verbal prompt alerting them to their choices (i.e., to save or spend marbles).

Whether children will demonstrate better EpF (i.e., by saving more) in a familiar context in which they can draw on a recent past experience is also one that had not been investigated previously. Similarly, although a number of authors have hypothesized relationships between other cognitive processes (i.e., ToM, WM, IC) and EpF, the second study conducted for this dissertation was the first to actually examine these relationships empirically using a behavioural measure of EpF. Finally, although a number of authors have developed behavioural methods to assess children's emerging capacity for EpF, my second study was the first to include a measure of language proficiency (a receptive language test) in order to systematically evaluate whether children's performance on a supposedly nonverbal measure of EpF might be independent of their language skills.

In the sections that follow, I address the research questions outlined in the General Introduction by discussing the findings associated with each of them, any limitations inherent in the methods used to test my hypotheses, and directions for future research. Age-related findings are discussed within each section as they pertain to each phenomenon of interest.

Did Preschoolers Save Spontaneously in a Novel Context?

The primary goal of study 1 was to investigate whether 3-, 4-, and 5-year-old children would spontaneously save (by refraining from using up all of their marbles in the first room) to benefit their future selves (i.e., to have marbles to use in the second room). As explained in the Discussion section of the manuscript for study 1, the rate of spontaneous saving (i.e., on trial 1) was relatively low: only 39% and 23% of children saved one or more marbles in the more-rewarding-future and more-rewarding-present conditions, respectively. Furthermore, contrary to my prediction, no age differences in saving were detected. These findings suggested that, in the absence of the kinds of prompts provided by forced-choice response formats, preschool children may be unable to anticipate future circumstances that they have been told about but have yet to experience. The lack of age differences contrasted with previous behavioural studies which, using forced-choice methods that rendered a future-oriented choice salient to children, report that older children demonstrate greater EpF than younger children. I postulated that the absence of prompting in my first study may have reduced the performance of all children to the extent that older children's capacity for EpF in this novel context was no better than younger children's. Put another way, previous studies could be conceived as having bolstered children's ability to behave in a way that benefits their future selves by rendering future-oriented courses of action explicit to them in the form of forced-choice response options. The question of whether prompting

facilitates children's capacity for EpF/saving was addressed in study 2 and is discussed in an upcoming section.

Although the lack of age differences observed in study 1 are at odds with most prior studies of EpF in young children, there are two previous studies that - despite using forced-choice response formats - also failed to detect age differences. As discussed in the General Introduction, Atance and Meltzoff (2006) designed a task that pits children's general preference for pretzels (over water) against their present desire for water after consuming several salty, thirst-inducing pretzels. Despite having stated a general preference for pretzels at the outset, while in a current state of thirst (after eating pretzels), an overwhelming majority of 3- to 5-year-olds claimed that they would prefer water tomorrow, suggesting that they failed to dissociate themselves from their current state of thirst when projecting themselves into the future. No age differences were observed on this task. In interpreting this finding, the authors cited contexts in which even adults struggle to override current states that differ from future ones, such as when shopping for groceries while hungry. These contexts highlight the salience of physiological states and their influence on our reasoning about the future.

Also reviewed in the General Introduction was a study by Russell et al. (2011), who introduced children to the effects of different amounts of time on causal transformations like heat melting chocolate (rendering it messy and inedible) and baking a cake (rendering it edible). Children were asked to state what their choice would be in the future based on what they anticipated would happen to their preferred food over shorter (3 minute) and longer (30 minute) time periods. The correct future choice in one long-delay condition, for example, was a less preferred biscuit that would remain intact and edible over time over preferred chocolate that would melt, becoming inedible. In addition to the expected failure of 3-year-olds when asked to

make a choice for the future, the performance of 4- and 5-year-olds was also surprisingly poor (no better than chance). Similar to Atance and Meltzoff (2006), Russell et al. (2011) postulated that 4- and 5-year-olds' poor performance on their task might be attributed to their difficulty overriding their focus on the currently preferred/edible food.

Mahy, Grass, Wagner, and Kliegel (2014) recently conceptualized tasks such as these as requiring “hot” processes, distinguishing them from those requiring “cool” processes. In making this distinction, Mahy et al. drew on the hot/cool framework that has previously been applied to other domains of cognitive development, most notably executive functioning (e.g., Carlson, Davis, & Leach, 2005; Hongwanishkul, Happaney, Lee & Zelazo, 2005). Within this framework, tasks that draw more on cognitive processes are considered “cool”, while those that draw more heavily on emotional or motivational processes are deemed “hot”. Examples of tasks deemed to tap cool EF processes in children include the Pencil Tap (Smith-Donald, Raver, Hayes, & Richardson, 2007) in which children must tap a pencil once if the researcher taps twice and twice if the researcher taps once and Bear & Dragon (Kochanska et al., 2000) in which children must follow directions given by the bear, but not the dragon. Hot EF tasks for use with children include Treat Delay (Mischel, Shoda, & Rodriguez, 1989) in which children must choose between receiving a small portion of a treat (e.g., marshmallows) immediately or waiting to receive a larger portion and Gift Delay, in which children are asked not to peek while an experimenter wraps a gift noisily (Kochanska, Murray, & Harlan, 2000).

In a recent developmental study of hot and cool executive function (EF), Prencipe et al. (2011) observed that while performance on EF tasks tapping cool processes developed quickly in early childhood, tasks drawing on hot processes were more difficult, displaying an extended developmental trajectory into later childhood. Mahy et al. proposed that the hot/cool framework

may also explain the different developmental trajectories observed between EpF tasks that rely more on hot processes (i.e., self-projection while a current motivational state conflicts with a future one, e.g., Atance & Meltzoff, 2006; Russell et al., 2011) and those that rely more on cool processes (i.e., self-projection that draws on semantic scripts and/or cognitive reasoning in the absence of salient affective components, e.g., Suddendorf & Busby, 2005).

Mahy et al. (2014) compared 3- and 7-year-olds' performance on an EpF task deemed to tap cool reasoning processes about the need for items in hypothetical future situations (i.e., Picture-Book task, Atance & Meltzoff, 2005, see the General Introduction of this dissertation for a review) to one that relies on hot processes to override a current motivational state when reasoning about the future (Pretzel task; Atance & Meltzoff, 2006). Seven-year-olds performed significantly better than 3-year-olds on the "cool" Picture-Book task, but no age differences were observed on the "hot" Pretzel task, with 3- and 7-year-olds performing equally poorly in the condition requiring them to predict a future state (i.e., desire for preferred pretzels) that conflicted with their current state (i.e., thirst for water). Mahy et al. noted that the extent to which tasks tap hot versus cool processes is dimensional rather than dichotomous. Thus, although the marble saving paradigm does not appeal to children's physiological/food-related desires and as such might be deemed "cooler" than the Pretzel task and Russell et al.'s (2011) task, the motivational appeal of the marble games may be strong enough to render the task "hotter" than Suddendorf and colleagues' (Suddendorf & Busby, 2005; Suddendorf, Nielsen, & von Gehlen, 2011) "two-rooms" tasks, for example. This account offers another explanation as to why the marble paradigm - like the paradigms used by Atance and Meltzoff (2006) and Russell et al. (2011) - failed to yield age differences in study 1.

Finally, I also wondered whether having provided children with only three marbles contributed to the lack of age differences observed in study 1 by failing to allow for enough variability in when/where children chose to use their marbles (i.e., in the first or second room). To address this question, children in study 2 received five marbles instead of three. Age differences were detected, with 5-year-olds saving significantly more marbles than 3-year-olds. Given that the marble paradigm has only been used in two studies (i.e., study 1 in which children received three marbles and study 2 in which they received five), the age differences detected in study 2 require replication. Should the five-marble version of the spontaneous condition yield age differences again, we could conclude with greater certainty that the lack of age differences in study 1 was simply due to limited variability in saving rates resulting from the provision of too few marbles. Alternatively, should these age differences fail to be replicated, the hot/cool framework adopted by Mahy et al. (2014) to explain the distinct developmental trajectories of other EpF tasks could be drawn upon to conceptualize the marble saving task as a relatively “hot” one. The saving task might be deemed “hot” in light of the motivational component associated with children’s desire to play with the marble games. The two existing hot EpF tasks developed for use with children (i.e., Atance & Meltzoff, 2006; Russell et al., 2011) both involve food-related preferences and forced-choice response formats. Adding the marble saving task to these would expand the range of methods to use and domains to assess within a hot/cool EpF framework.

Did Preschoolers Save More When They Could Draw on a Recent Past Experience?

A second goal of study 1 was to determine whether children would demonstrate greater EpF (by saving more marbles) when they could draw on a recent past experience (in this case, the consequences of failing to save marbles for the second room on the first trial). This question

was addressed by administering a second trial of the marble paradigm by “surprising” children with a second set of marbles following trial 1. Across conditions (more-rewarding-future and more-rewarding-present) and age groups, children saved significantly more on trial 2 relative to trial 1, indicating that the ability to draw on a recent personal experience (episodic memory) facilitates future-oriented decision making in young children. This finding is consistent with several studies that have demonstrated that personal recollections enable adults to anticipate future events and plan for them (e.g., Klein, Loftus, Kihlstrom, 2002; Schacter, Addis, & Buckner, 2008; Szpunar & McDermott, 2008; Tulving & Lepage, 2000). Indeed, Klein and colleagues (e.g., Klein, Robertson, & Delton, 2010, 2011; Klein, Robertson, Delton, & Lax, 2012) have argued that the adaptive function of memory is prospective in that it stores information that can be used to plan for future circumstances.

An interesting goal for future research would be to increase the length of time between the two trials to determine just how recent a past experience needs to be in order for children to be able to draw on it to anticipate and plan for future circumstances.

Did Preschoolers Save Less When Spending in the Anticipated Future Context Would Yield Less Enjoyment Than Spending in the Present?

Study 1 also demonstrated young children’s sensitivity to the relative value of future rewards. That is, even in a novel context (i.e., trial 1), 3-to-5-year-old children can appreciate when using up resources (i.e., “spending”) will yield greater rewards and adjust the timing of their consumption accordingly.

There are a number of real-world contexts that illustrate why such an understanding is adaptive. For example, imagine a woman typically buys one \$2.00 litre can of apple juice for her family every Friday. Let’s assume that this woman usually purchases the same grocery items

every week, making sure not to surpass her weekly grocery budget of \$75.00. Now, imagine that on a particular Friday this woman discovers that apple juice is on sale for half price on that day only. Assuming her family consumes non-perishable, canned apple juice on a regular and ongoing basis, it would make sense for her to spend more on apple juice this week to stock up on as much of the product as possible, since every can purchased during the sale will yield more juice per dollar than cans purchased at the regular price in the future. Even if the woman spends more than her usual weekly grocery budget of \$75 to accommodate overstocking on apple juice, overall, she will be saving money on groceries for as long as her supply of apple juice (purchased at the reduced price) lasts.

Does Providing Children With A Verbal Prompt Facilitate Saving?

On trial 1 of study 1, only 39% of children (in the more-rewarding-future condition) saved one or more marbles for the second room, and no age differences were detected. What was unique about this experiment compared to previous developmental studies of episodic foresight was that it assessed whether children could generate a future-oriented solution *spontaneously*, that is, without being prompted to do so. As discussed previously, it is possible that the notion of saving marbles did not even occur to children in this context. This raised the question of whether children might benefit from a prompt that explicitly highlights the options to “save” vs. “spend” marbles. Thus, in study 2, we compared rates of saving between children who received such a prompt to those who did not. As predicted, 3-, 4-, and 5-year-olds in the prompted condition saved significantly more than those in the spontaneous condition. This finding indicates that, in saving contexts, simply alerting children to two general courses of action (saving or spending) improves their future-oriented decision making.

The bolstering effect of the prompt on children's saving is consistent with previous findings that prompts improve the performance of both children and adults on verbal measures of EpF. For example, Hayne et al. (2011) found that prompts improved children's ability to accurately report future events, and D'Archembeau and Mathy (2011) found that cuing adults with knowledge about their personal goals facilitated their ability to produce future events during a fluency task as well as their access to episodic details when imagining future events. Prompts have also been found to facilitate children's performance in other cognitive domains. For example, a number of authors have reported that children's performance on executive functioning tasks is improved by prompts such as labels and symbols (e.g., Carlson, 2005; Garon & Moore, 2007).

As discussed in the manuscript for study 2, the verbal prompt ("if you want to, you can use all of your marbles in the red room, or you can save some for the blue room") may have cued children in the prompted condition to stop and think before acting, while children in the spontaneous condition acted more impulsively. This interpretation is consistent with the results of evidence-based social skills programs that teach children to "stop and think" about how they want to handle a situation before acting (CASEL, 2002, Kilian, Fish, & Maniago, 2006; Knoff, 2000, 2001, 2005). In the Stop & Think Social Skills Program, for example, the initial "stop and think" step is intended as a self-control/self-management step (Knoff, 2009). Relatedly, it is possible that the verbal prompt incited saving by cuing children to formulate an "implementation intention" (Gollwitzer, 1993, 1999; Gawvrilow et al., 2011) to save. As discussed previously, an implementation intention, as conceived of by Gollwitzer, is a form of planning that specifies "why," "how," and "where" an action will take place to fulfill a certain goal. Thus, the verbal prompt may have induced children to formulate the implementation intention, 'when I am in the

first room with the little marble game, I will save marbles to use in the big marble game’.

Perhaps the verbal prompt facilitated children’s saving in a combination of ways: by alerting them to a choice they may not have known they had (e.g., the option to save marbles), inducing them to form an implementation intention, and/or acting as a self-control mechanism.

Recent Past Experience and Prompting Both Facilitate Saving

Together, studies 1 and 2 illustrate two different factors that facilitate saving in young children: In study 1, children saved significantly more marbles on trial 2 relative to trial 1. In study 2, children in the prompted condition saved significantly more than children in the spontaneous condition. The follow-up analyses presented in the Study 2 Addendum revealed that the proportion of marbles saved by children on the second trial in study 1 was not significantly different than the proportion of marbles saved by children in the prompted condition in study 2. This finding suggests that past experience with the saving context (explored in study 1 via the inclusion of a second trial) and informing children of their choices prior to action (explored in study 2 via the inclusion of the prompted condition) may have similar bolstering effects on children’s saving. This finding could be confirmed in a single sample in a future study by comparing the saving rate of children who receive a prompt on a single trial of the saving task to that of children to whom a second trial of the saving task would be administered without any verbal prompts^[CA9].

Was Preschoolers’ Saving Associated With Their Performance on Other Cognitive Tasks?

ToM. I predicted that children’s performance on the saving paradigm (deemed to involve EpF) would be associated with their performance on measures of false-belief. In both studies 1 and 2, children were administered two false-belief tasks (change-in-location and unexpected contents) to determine whether their performance on these would be related to the number of

marbles they saved. With the exception of a marginally significant association between children's performance on unexpected contents and their saving on the second trial in study 1, no other ToM-related analyses yielded significant results in either study. These non-significant findings were at odds with my predictions and with the theoretical association between ToM and EpF that has been put forward by others (e.g., Atance & Meltzoff, 2005; Buckner & Carroll, 2007; Moore et al., 1998; Suddendorf & Corballis, 1997, 2007).

Only one trial of the saving paradigm was administered in study 2 (the second trial of the saving task was dropped from the protocol in study 2 to allow for the addition of the IC and WM tasks as well as the PPVT-IV, which rendered the protocol quite long). As such, the marginally significant association between children's performance on the unexpected contents task and saving on trial 2 that was detected in study 1 was not investigated further in study 2. However, this association would be worth exploring further in future studies. Although marginally significant associations should be interpreted with caution, the unexpected contents task - which requires the child to recall and reason about her own past belief that differs from her current knowledge - may have overlapped with the episodic memory (EM) aspect of saving in a familiar context (i.e., on the second trial, in which a past experience could be drawn on to anticipate future circumstances). In other words, children's performance on unexpected contents may have been associated with their EM capacity rather than their EpF or saving abilities, per se. This interpretation is consistent with research indicating that children's recall for directly experienced events (episodic memory) improves with increased ToM competence (Perner et al., 2007).

Just as the marginal association between children's saving on trial 2 and their performance on unexpected contents in study 1 requires further investigation, the lack of association between children's false-belief understanding and saving in novel contexts (i.e., on

the first trial in study 1 and in the spontaneous and prompted conditions in study 2) also warrants replication. The experiments described in this dissertation were the first to include ToM tasks alongside a behavioural (i.e., nonverbal) task designed to tap EpF, so there are no other data against which to compare my null findings in this regard. One possible explanation for the lack of association between ToM and children's saving in a novel context is that while the latter requires children to identify with their future selves, the change-in-location and unexpected contents tasks require them to reason about *someone else's* belief and their own *past* belief, respectively. Another explanation is that saving may not follow the same developmental trajectory as false-belief understanding. Although 3-year-olds tend to fail false-belief tasks while 4-year-olds tend to pass them (Wellman & Liu, 2004; Wellman, Watson, & Cross, 2001), 4-year-olds did not save significantly more than 3-year-olds in study 2 (in which only the saving rates of 3- and 5-year-olds differed significantly) and no age differences were detected in study 1. In contrast, other behavioural studies of children's EpF that may tap "cooler" processes have produced developmental differences between 3- and 4-year-olds (e.g., Suddendorf, Nielsen, & von Gehlen, 2011) that may correlate with the development of false-belief understanding. Administering a battery of both ToM and EpF tasks (verbal/nonverbal, hot/cool, prompted/unprompted) to children would provide much needed insight into what components of ToM reasoning - if any - are associated with the development of specific aspects of EpF.

IC. In study 2, children's performance on two measures of inhibitory control (grass/snow and whisper) was not associated with the number of marbles they saved. In light of research suggesting an association between self-control and saving in adulthood (Laran, 2010; Moffitt et al., 2011), I believe it is unlikely that IC plays no role in children's saving. Rather, as discussed in the manuscript for study 2, a more likely explanation is that the IC tasks selected for this study

did not actually entail the particular form of self-control involved in saving. Within the framework proposed by Carlson et al. (2004), both grass/snow and whisper are considered “conflict” tasks. That is, they require children to inhibit a dominant response (i.e., associating grass with green, blurting out the names of characters they recognize) while initiating a conflicting one. The demands of conflict tasks are distinguished from tasks that involve postponing rather than inhibiting a dominant response (Carlson et al., 2004). Because saving in the context of the marble paradigm involves postponing consumption rather than inhibiting it altogether, IC tasks that involve delaying one’s access to rewards [e.g., gift delay, Kochanska et al., (1996)] would be a better choice in future studies.

WM. No significant association was detected between children’s saving in study 2 and their performance on either of the working memory tasks administered. As is the case with the other cognitive domains assessed alongside saving in study 2 (i.e., ToM, IC, and receptive language), no previous empirical studies have examined the relationship between WM and EpF in children. However, the lack of association between children’s WM and saving is consistent with the findings of Ford, Driscoll, Shum, and Macaulay (2012), who found that working memory made no unique contribution to the variance in prospective memory skills among 4- to 6-year-olds.

Language. Children’s performance on the saving paradigm was not associated with their receptive language ability. This is an important finding in light of the fact that no previous studies have assessed whether measures designed to tap children’s capacity for EpF without confounding it with their ability to express future thought verbally actually achieved this. In addition to seeking to replicate my finding that children’s rates of saving were not associated with their *receptive* language skills, it would also be important for future studies to determine

whether children's performance on the saving paradigm is independent of their *expressive* language skills. Children frequently talk themselves through tasks, producing speech that is often internalized as private, inner speech (Lidstone, Meins, & Fernyhough, 2010). Lidstone et al. found that the performance of 7- to 10-year-olds whose self-directed speech was suppressed during a planning task was poorer relative to children whose speech was not suppressed. The authors concluded that the suppression of private speech likely interfered with children's ability to create and follow a plan. Similarly, while children's receptive language may not play much of a role in their success on the saving paradigm, self-talk (i.e., expressive language) may be involved in their formulation of implementation intentions related to saving. This possibility could easily be explored by administering a measure of expressive language to children alongside the saving paradigm.

Limitations

As alluded to above, one limitation of my doctoral research program is that only a single aspect of language functioning (i.e., receptive language) was assessed alongside children's saving. Relatedly, although the dependent variable yielded by the saving task (i.e., the number of marbles children saved) was behavioural and nonverbal, essential task instructions were administered to children verbally. As such, while the saving task does not require children to *respond* orally, the demands of the task are not entirely nonverbal and, therefore, neither is the task. Although study 2 confirmed that children's performance on the saving task was not associated with their receptive language (and perhaps not confounded by their ability to understand task instructions), further studies assessing a broader range of children's linguistic skills in addition to their rate of saving are needed to delineate the role of language (or lack thereof) in children's performance on the saving task.

Just as only one aspect of children's language functioning was explored alongside children's saving in study 2, only one facet of ToM (false-belief reasoning) and two domains of executive functioning (IC and WM) were assessed alongside children's saving. The ToM and executive functioning tasks selected for my doctoral research were chosen based on the writings and theoretical work of Suddendorf and colleagues (Suddendorf & Corballis, 2007; Suddendorf & Redshaw, 2013), who proposed that false-belief understanding, IC, and WM in particular might be necessary for episodic foresight. In addition to exploring whether other aspects of children's language functioning are associated with their propensity to save, it would also be important to determine whether other aspects of ToM (e.g., understanding diverse desires) and executive functioning (e.g., switching skills) are associated with saving among young children and how/whether these associations vary across the preschool period. These further investigations will be especially important given the overall lack of association between saving and the language, ToM, and executive functioning tasks used in the studies reported here.

Although the sample sizes in both experiments were adequate and results largely replicated developmental changes reported in previous studies (i.e., age-related changes on the PPVT-IV, each of the ToM tasks, and three of the four EF tasks), the children in these studies were not adequately representative of the general population of 3- to 5-year-olds. The sample was skewed towards a middle- to high-income, English speaking, highly educated, and largely White sample of children. As such, the results of my doctoral research are not generalizable to all cultural, ethnic, and socio-economic groups. Future studies should undertake to explore the emergence of saving and associated phenomena in a more varied sample of children.

Directions for Future Research

Many of the additional questions raised by my findings and some of the limitations identified above could be addressed by administering a battery of EpF (verbal/nonverbal, prompted/unprompted, hot/cool), IC (conflict/delay), ToM, WM, and language (receptive/expressive) tasks to children. Administering the saving paradigm and other EpF tasks alongside measures of other future-oriented processes such as prospective memory, planning, and delay of gratification would help to delineate how these processes overlap, how they differ, and whether they are indeed unique processes. Expanding the age range of children assessed is also recommended in light of the relatively low saving rates reported in my studies, even among 5-year-olds.

As discussed in the manuscript for study 2, studying the social and environmental factors that may influence children's propensity to save would also be important. Cultural, parental, and demographic factors may be especially relevant for the development of saving. These could be assessed by gathering data about parents' financial attitudes, practices, and statuses and measuring whether they predict children's performance on the saving paradigm.

Conclusion

The studies carried out for this dissertation were the first to explore saving behaviour in preschool children. In addition to allowing me to investigate whether and when young children save, the paradigm I developed and refined for these studies also provided a new method to investigate children's capacity for episodic foresight more broadly. My findings provide important preliminary evidence about the development of saving and suggest that it is likely a complex process that warrants special consideration in the developmental literature. In addition, my studies highlight the importance of considering the specific attributes of paradigms designed

to tap episodic foresight. Specifically, whether children can draw on personal experience and whether future-oriented courses of action are rendered salient or not seem to be two important factors that determine whether or not children will save. These factors may also play a role in children's performance in other decision-making contexts requiring episodic foresight. Saving, defined as reserving resources for future consumption, deserves more attention in the developmental literature. In light of current economic and environmental conditions, understanding how to incite today's children to conserve resources for the future will be crucial to our species' and others' survival.

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Appendix A
Consent Form for CCLL Testing

University of Ottawa
Childhood Cognition and Learning Laboratory

Project: Preschoolers' Saving Behaviours.*

**This project is funded by the Natural Sciences and Engineering Research Council of Canada (NSERC).*

Dear parents:

We are currently conducting a study which examines children's use of saving strategies. For instance, do children understand that although they might love eating spaghetti for dinner, eating less of it will allow them to "save room" for the even yummier dessert that will follow? We're also interested in whether children save objects for future use. For instance, adults understand that the plastic bags we are left with after unpacking groceries may come in handy in the future (i.e. for packing lunches, use as garbage bags) and so we save them. Do children share this understanding? We have developed a series of short tasks that assess children's use of saving strategies and, with your permission, we would like to administer these tasks to your child.

There are several benefits to having your child participate in this study. The first is that children tend to enjoy having the opportunity to interact with a friendly adult in this type of game-like setting. The second is that this research will help us to better understand the development of saving behaviour and of foresight in general. One of our hypotheses is that young children, who are often described as being "stuck in the present" may have difficulty engaging in behaviours that would benefit their future selves. Understanding that children may have a genuine difficulty with orienting themselves to the future (as opposed to simply not 'caring' or 'thinking' about the future) will allow us to better understand their behaviour.

Your child's participation will consist of attending one session lasting approximately 60 minutes. Your child's session has been scheduled for _____. His/her session will be recorded onto DVD. Only the study team will have access to the DVDs. The information that your child shares during the session will remain strictly confidential. This will be ensured by having the researchers assign a code to all of the study records. The link between these codes and the study information (e.g., consent forms) will be kept in a separate, secure location.

With your permission, we would like to keep the DVDs for 10 years. These DVDs will be stored in a secure location. We will keep your name, as well as your child's name linked to the study information for 10 years. If we publish the results of this study, we will not use your name or your child's name. We will also ask you whether you wish to have the researchers contact you about the opportunity to participate in future research studies in our laboratory, and whether you would agree to having the researchers use segments of your child's videotapes for educational (e.g., classroom instruction) and academic (e.g., conference presentations) purposes. We would not reveal your child's name in these presentations.

Participation in this study is strictly voluntary. Moreover, only those children who agree, themselves, to participate will take part in the study.

There are no known risks for your child in these procedures. Children typically have fun engaging in these types of “games.” The researcher will stop the session if your child does not wish to continue playing, or becomes tired or frustrated. Your child (or you) are free to withdraw from the project at any time before, or during, a session, refuse to participate, and refuse to answer questions.

We provide you with free parking during your session at the University of Ottawa. Your child will also receive a small toy for his/her participation.

Any information about your rights as a research participant may be addressed to Protocol Officer for Ethics in Research, 550 Cumberland Street, Room 159, (613) 562-5841, or ethics@uottawa.ca

If you wish to have your child participate in this research, please sign this consent form. There are two copies of this consent form, one of which you may keep.

If you have any questions about the conduct of the research project, you may contact the researcher.

Researcher's signature: _____ Date: _____

Parent's signature: _____ Date: _____

I give the researchers permission to re-contact me about future research.
YES ____ **NO** ____

I give the researchers permission to use segments from the DVDs
for educational or research presentations.
YES ____ **NO** ____

Appendix B
Assent form for CCLL Testing

**University of Ottawa
Childhood Cognition and Learning Laboratory**

Project: Preschoolers' Saving Behaviours

What will happen:

Hi my name is (experimenter's name inserted here). I have some toys I want to show you and some games to play in the room right next door. I will also be videorecording us playing together. Your Mom/Dad will be watching us the whole time through this window (show child window). She/he will be able to see everything that you do. If you would like to stop playing with me at any time, you just let me know okay? Are you ready to go see my toys? Do you have any questions?

_____ assent obtained

Appendix C
Protocol for Saving Task, Study 1, More-Rewarding-Future Condition

Marble Run – Saving Study

Materials: 2 marble runs (1 complex & 1 simple), 8 marbles (3 in bag for child, 3 in bag in closed box in blue room for trial 2, 2 in E's pocket for demos), signs to identify testing room doors (1 photo of simple marble run with red background and 1 photo of complex marble run with blue background).

Set up: *Note: Depending on experiments being administered, child may need to take break with parent during set-up.*

Two testing rooms required. Door of 1st testing room displays photo of the simple marble run (red room). The simple marble run is on the floor in the 1st room. Door of 2nd testing room displays photo of the complex marble run (blue room). The complex marble run is on the floor in 2nd room. **Be sure to test both marble runs before each participant.**

Introduction: E guides child into hallway and shows her the two rooms: ***You are going to get to play in two rooms. Look at this door with the red sign (E points). This picture tells us that the red room has a little marble game. Let's take a look inside the red room.*** E enters red room with child and demonstrates the marble run with one marble (child is not permitted to try yet). ***This is how the little marble game works, watch me*** (E places marble in run). ***See how the marble goes into this box at the end? Once you put a marble down the hole, you can't use it again. Let's go see the other room.***

E guides child back out to hallway. ***Look at this door with the blue sign (E points). This picture means that this room has a big marble game. Let's take a look inside the blue room.*** E enters blue room with child and demonstrates the big marble run (child is not permitted to try yet). ***This is how the big marble game works, watch me*** (E places marble in run). ***Once you put a marble down the hole, you can't use it again. Let's go see what you are going to do.***

E guides child back into hallway, closing both testing room doors. E points to the sign on the red (left) door. *****First you are going to stay in the red room for 3 minutes. The red room has the little marble game. After, you are going to stay in the blue room for 3 minutes*** (E points to the sign on the blue (right) door). ***The blue room has the big marble game.***

You only get 3 marbles today (E hands bag of 3 marbles to child). ***Remember, once you put a marble down a marble hole, you can't use it again.***

Memory check: (a) Okay, so which room are you going to play in first?

*(red)** _____

(b) And which marble game is in the red room?

*(little)** _____

→ ***If incorrect, repeat instructions x1 from ** & repeat (a) & (b). Note outcome:**

→ Regardless of child's response 2nd time, E says: *(Yeah...) We're going to go in the red room first. The red room has the little marble game.*

Standardization Guidelines:

- If child tries to take used marbles from bottom of run say, "Oh, we can't take marbles out of there, they're all used up".

Trial 1

-Red Room-

E guides child into red room. *"Okay, we're gonna stay in the red room for 3 minutes. I'm going to do my work over here until this timer rings."* E sets timer and places it on table, then puts headphones on to "work".

marbles used in little marble run: ____ # marbles saved ____

Observations: _____

Memory check: When timer goes off, E says: *Okay, do you remember what we're going to do now?*

If child does not spontaneously mention both the blue room and the big marble run, ask the following as necessary: *So, which room are you going to play in now? (blue)*

And which marble game is in the blue room? (big)

Regardless of child's answer(s) E says: *(Yeah...) We're going to go in the blue room for 3 minutes. The blue room has the big marble game. Bring your marble bag!*

-Blue Room-

E guides child into the blue room. *"Okay, we're going to stay in the blue room for 3 minutes. I'm going to do my work over here until this timer rings."* E sets timer and places it on table, then puts headphones on to "work".

marbles used in big marble run: ____ # marbles leftover ____

Observations: _____

After timer rings, E removes 3 more marbles from box (**leave box open**) & says *"Guess what? I found 3 more marbles for you to play with! Let's go see the signs again so you can remember what you are going to do."*

E guides child into hallway.

Trial 2 Signs remain on testing room doors as in trial 1.

****First, you are going to stay in the red room for 3 minutes. The red room has the little marble game. After, you are going to play in the blue room for 3 minutes. The blue room has the big marble game. These are the last 3 marbles, we don't have anymore now.** (E hands bag of 3 marbles to child).

Remember, once you put a marble down a hole, you can't use it again.

Memory check: (a) Okay, so which room are you going to play in first? (red)*

(b) And which marble game is in the red room? (little)*

→ *If incorrect, repeat instructions x1 from ** & repeat (a) & (b). Note outcome:

→ Regardless of child's response 2nd time, E says: (Yeah...) We're going to go in the red room first. The red room has the little marble game.

-Red Room-

E guides child into red room. **"Okay, we're going to stay in the red room for 3 minutes. I'm going to do my work over here until this timer rings."** E sets timer and places it on table, then puts headphones on to "work".

marbles used in little marble run: ____ # marbles saved ____

Observations: _____

Memory check: When timer goes off, E says: Okay, do you remember what we're going to do now?

If child does not spontaneously mention both the blue room and the big marble run, ask the following as necessary:

So which room are you going to play in now? (blue)

And which marble game is in the blue room? (big)

Regardless of child's answer(s) E says: (Yeah...) We're going to go in the blue room for 3 minutes. The blue room has the big marble game. Bring your marble bag!

-Blue Room-

E guides child into the blue room. **"Okay, we're going to stay in the blue room for 3 minutes. I'm going to do my work over here until this timer rings."** E sets timer and places it on table, then puts headphones on to "work".

marbles used in big marble run: ____ # marbles leftover ____ Observations: _____

Appendix D
Protocol for Saving Task, Study 1, More-Rewarding-Present Condition

Marble Run Reverse Control – Saving Study

Materials: 2 marble runs (1 complex & 1 simple), 8 marbles (3 in bag for child, 3 in bag in closed box in blue room for trial 2, 2 in E's pocket for demos), signs to identify testing room doors (1 photo of little marble run with blue background and 1 photo of big marble run with red background).

Set up: *Note: Depending on experiments being administered, child may need to take break with parent during set-up.* Two testing rooms required. Door of 1st testing room displays photo of the big marble run (red room). The big marble run is on the floor in the 1st room. Door of 2nd testing room displays photo of the little marble run (blue room). The little marble run is on the floor in 2nd room. **Be sure to test both marble runs before each participant.**

Introduction: E guides child into hallway and shows her the two rooms: ***You are going to get to play in two rooms. Look at this door with the red sign (E points). This picture tells us that the red room has a big marble game. Let's take a look inside the red room.*** E enters red room with child and demonstrates the marble run with one marble (child is not permitted to try yet). ***This is how the big marble game works, watch me*** (E places marble in run). ***See how the marble goes into this box at the end? Once you put a marble down the hole, you can't use it again. Let's go see the other room.***

E guides child back out to hallway. ***Look at this door with the blue sign (E points). This picture means that this room has a little marble game. Let's take a look inside the blue room.*** E enters blue room with child and demonstrates the little marble run (child is not permitted to try yet). ***This is how the little marble game works, watch me*** (E places marble in run). ***Once you put a marble down the hole, you can't use it again. Let's go see what you are going to do.***

E guides child back into hallway, closing both testing room doors. E points to the sign on the red (left) door. *****First you are going to stay in the red room for 3 minutes. The red room has the big marble game. After, you are going to stay in the blue room for 3 minutes*** (E points to the sign on the blue (right) door). ***The blue room has the little marble game.***

You only get 3 marbles today (E hands bag of 3 marbles to child). ***Remember, once you put a marble down a marble hole, you can't use it again.***

Memory check: (a) Okay, so which room are you going to play in first? (red)*

(b) And which marble game is in the red room? (big)*

→ ***If incorrect, repeat instructions x1 from ** & repeat (a) & (b). Note outcome:**

→ **After correct initial response or ANY response after receiving questions 2nd time, E says:**
(Yeah...) We're going to go in the red room first. The red room has the big marble game.

Standardization Guidelines:

- If child tries to take used marbles from bottom of run say, "Oh, we can't take marbles out of there, they're all used up".

Trial 1***-Red Room-***

E guides child into red room. ***"Okay, we're gonna stay in the red room for 3 minutes. I'm going to do my work over here until this timer rings."*** E sets timer and places it on table, then puts headphones on to "work".

marbles used in big marble run: ____ # marbles saved ____

Observations: _____

Memory check: When timer goes off, E says: *Okay, do you remember what we're going to do now?*

If child does not spontaneously mention both the blue room and the little marble run, ask the following as necessary:

So, which room are you going to play in now? (blue)

And which marble game is in the blue room? (little)

Regardless of child's answer(s) E says: *(Yeah...) We're going to go in the blue room for 3 minutes.*

The blue room has the little marble game. Bring your marble bag!

-Blue Room-

E guides child into the blue room. ***"Okay, we're going to stay in the blue room for 3 minutes. I'm going to do my work over here until this timer rings."*** E sets timer and places it on table, then puts headphones on to "work".

marbles used in little marble run: ____ # marbles leftover ____

Observations: _____

After timer rings, E removes 3 more marbles from box (**leave box open**) & says ***"Guess what? I found 3 more marbles for you to play with! Let's go see the signs again so you can remember what you are going to do."***

E guides child into hallway.

Trial 2

Signs remain on testing room doors as in trial 1.

*****First, you are going to stay in the red room for 3 minutes. The red room has the big marble game. After, you are going to play in the blue room for 3 minutes. The blue room has the little marble game. These are the last 3 marbles, we don't have anymore now.*** (E hands bag of 3 marbles to child).

Remember, once you put a marble down a hole, you can't use it again.

Memory check: (a) *Okay, so which room are you going to play in first? (red)**

(b) *And which marble game is in the red room?(big)**

→ **If incorrect, repeat instructions x1 from ** & repeat (a) & (b). Note outcome:*

→ *After correct initial response or ANY response after receiving questions 2nd time, E says:*

(Yeah...) We're going to go in the red room first. The red room has the big marble game.

-Red Room-

E guides child into red room. ***"Okay, we're going to stay in the red room for 3 minutes. I'm going to do my work over here until this timer rings."*** E sets timer and places it on table, then puts headphones on to "work".

marbles used in big marble run: ____ # marbles saved ____

Observations: _____

Memory check: When timer goes off, E says: *Okay, do you remember what we're going to do now?*

If child does not spontaneously mention both the blue room and the little marble run, ask the following as necessary:

So which room are you going to play in now? (blue)

And which marble game is in the blue room? (little)

Regardless of child's answer(s) E says: *(Yeah...) We're going to go in the blue room for 3 minutes.*

The blue room has the little marble game. Bring your marble bag!

-Blue Room-

E guides child into the blue room. ***"Okay, we're going to stay in the blue room for 3 minutes. I'm going to do my work over here until this timer rings."*** E sets timer and places it on table, then puts headphones on to "work".

marbles used in little marble run: ____ # marbles leftover ____

Observations: _____

Appendix E
Theory of Mind Tasks, Study 1

CONTENTS FALSE BELIEFS: (Band-Aids, Pigs)

(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?” _____

If child doesn’t answer/responds incorrectly, then re-open the box and show the pig: “It’s really a pig inside”; then proceed to the next part.

“When you first saw this box, before we opened it, what did you think was inside?” (*Target question*) _____ (*Correct Answer – Band-Aids*)

If child doesn’t respond or says “I don’t know” then ask the following Forced choice question:
“When you first saw this box, before we opened it, what did you think was inside? **Band-Aids** or a **pig**?”

CHANGE IN LOCATION: (Red, Blue)

“Here’s Bert and here’s Ernie. And, here’s a **red box** and here’s a **blue 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 **red box** or does he think that it’s in the **blue box**?” _____

Reality question (all children need to be asked this question):

“Where is the ball really?” _____ (*correct answer: red*)

Appendix F

Saving Task, Study 2, Spontaneous Condition

Materials: 2 marble runs (1 complex & 1 simple), 7 marbles (5 in bag for child, 2 in E's pocket for demos), signs to identify testing room doors (1 photo of simple marble run with red background and 1 photo of complex marble run with blue background), 2 timers (1 for each room), rectangular card to which photos of little & big marble games are affixed with Velcro (desirability check).

Set up: *Note: Depending on experiments being administered, child may need to take break with parent during set-up.* Two testing rooms required. Door of 1st testing room displays photo of the simple marble run (red room). The simple marble run is on the floor in the 1st room. Door of 2nd testing room displays photo of the complex marble run (blue room). The complex marble run is on the floor in 2nd room. **Be sure to test both marble runs before each participant & put desirability check card in hall.**

Introduction: E guides child into hallway and introduces the two rooms: ***You are going to get to play in two rooms. Look at this door with the red sign (E points). This picture tells us that the red room has a little marble game. Let's take a look inside the red room.*** E enters red room with child and demonstrates the marble run with one marble (child is not permitted to try yet). ***This is how the little marble game works, watch me*** (E places marble in run). ***See how the marble goes into this box at the end? Once you put a marble down the hole, the marble goes into this box. Once a marble is in the box we can't take it out cause it's all used up. Let's go see the other room.***

E guides child back out to hallway. ***Look at this door with the blue sign (E points). This picture means that this room has a big marble game. Let's take a look inside the blue room.*** E enters blue room with child and demonstrates the big marble run (child is not permitted to try yet). ***This is how the big marble game works, watch me*** (E places marble in run). ***Once you put a marble down the hole, the marble goes into this box. Once a marble is in the box we can't take it out cause it's all used up. Ok, let's go back into the hall, I have a question for you.*** E guides child back into hallway, closing both testing room doors.

Desirability check: E presents child with card to which photos of the **little (left) & big (right)** marble games are affixed. E points to the photo on the left of the card & states, ***this is a picture of the little marble game*** (E then points to photo on right), ***this is a picture of the big marble game.***

E asks: ***Which marble game do you like best?***

E states: ***Now let's see what you are going to do.***

E points to the sign on the red (left) door. *****First you are going to stay in the red room for 3 minutes. The red room has the little marble game. After, you are going to stay in the blue room for 3 minutes (E points to the sign on the blue (right) door). The blue room has the big marble game.***

Memory check: (a) *Okay, so which room are you going to play in first?** _____

(b) *And which marble game is in the red room?*

→ **If incorrect, repeat instructions x1 from ** & repeat (a) & (b). Note outcome:*

→ Regardless of child's response 2nd time, E says: *(Yeah...) We're going to go in the red room first. The red room has the little marble game. You only get 5 marbles today (E hands bag of 5 marbles to child). Remember, once you put a marble down a marble hole, you can't take it*

Standardization Guidelines:

If child tries to take used marbles from bottom of run say, *"Oh, we can't take marbles out of there, they're all used up"*.

Test Trial

-Red Room-

E guides child into red room. ***"Okay, we're gonna stay in the red room for 3 minutes. I'm going to do my work over here until this timer rings."*** E sets timer and places it on table, then puts headphones on to "work".

Time	# Marbles used	Plays with marble on floor	Plays with marble in hands	Attempts to retrieve used marble	Verbalizes intention to save	Other Observations (Verbal / Behavioural)
3:00-2:30						
2:29-2:00						
1:59-1:30						
1:29-1:00						

0:59-0:30						
0:29-0:00						

Total # marbles used in little marble run: ____ Total # marbles saved ____

Memory check: When timer goes off, E says: *Okay, do you remember what we're going to do now?*

If child does not spontaneously mention both the blue room and the big marble run, ask the following as necessary: *So, which room are you going to play in now?*

And which marble game is in the blue room?

Regardless of child's answer(s) E says: *(Yeah...) We're going to go in the blue room for 3 minutes. The blue room has the big marble game. Bring your marble bag!*

-Blue Room-

E guides child into the blue room. *"Okay, we're going to stay in the blue room for 3 minutes. I'm going to do my work over here until this timer rings."* E sets timer and places it on table, then puts headphones on to "work".

Time	# Marbles used	Plays with marble on floor	Plays with marble in hands	Attempts to retrieve used marble	Verbalizes intention to save	Other Observations (Verbal / Behavioural)
3:00-2:30						
2:29-2:00						
1:59-1:30						
1:29-1:00						
0:59-0:30						

0:29- 0:00						
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Total # marbles used in big marble run: ____ Total # marbles saved ____

IF CHILD HAS MARBLE(S) LEFT OVER, E ASKS: *Why didn't you use all of your marbles?* _____

END OF TASK: E can let children who did not get to play with the big marble game (due to failing to save marbles) drop 1 or 2 marbles down the run ☺

Appendix G

Saving Task, Study 2, Prompted Condition

Materials: 2 marble runs (1 complex & 1 simple), 7 marbles (5 in bag for child, 2 in E's pocket for demos), signs to identify testing room doors (1 photo of simple marble run with red background and 1 photo of complex marble run with blue background), 2 timers (1 for each room), rectangular card to which photos of little & big marble games are affixed with Velcro (desirability check).

Set up: *Note: Depending on experiments being administered, child may need to take break with parent during set-up.* Two testing rooms required. Door of 1st testing room displays photo of the simple marble run (red room). The simple marble run is on the floor in the 1st room. Door of 2nd testing room displays photo of the complex marble run (blue room). The complex marble run is on the floor in 2nd room. **Be sure to test both marble runs before each participant & put desirability check card in hall.**

Introduction: E guides child into hallway and introduces the two rooms: ***You are going to get to play in two rooms. Look at this door with the red sign (E points). This picture tells us that the red room has a little marble game. Let's take a look inside the red room.*** E enters red room with child and demonstrates the marble run with one marble (child is not permitted to try yet). ***This is how the little marble game works, watch me*** (E places marble in run). ***See how the marble goes into this box at the end? Once you put a marble down the hole, the marble goes into this box. Once a marble is in the box we can't take it out cause it's all used up. Let's go see the other room.***

E guides child back out to hallway. ***Look at this door with the blue sign (E points). This picture means that this room has a big marble game. Let's take a look inside the blue room.*** E enters blue room with child and demonstrates the big marble run (child is not permitted to try yet). ***This is how the big marble game works, watch me*** (E places marble in run). ***Once you put a marble down the hole, the marble goes into this box. Once a marble is in the box we can't take it out cause it's all used up. Ok, let's go back into the hall, I have a question for you.*** E guides child back into hallway, closing both testing room doors.

Desirability check: E presents child with card to which photos of the **little (left) & big (right)** marble games are affixed. E points to the photo on the left of the card & states, ***this is a picture of the little marble game*** (E then points to photo on right), ***this is a picture of the big marble game.***

E asks: ***Which marble game do you like best?***

E states: ***Now let's see what you are going to do.***

E points to the sign on the red (left) door. *****First you are going to stay in the red room for 3 minutes. The red room has the little marble game. After, you are going to stay in the blue room for 3 minutes (E points to the sign on the blue (right) door). The blue room has the big marble game.***

Memory check: (a) *Okay, so which room are you going to play in first?** _____

(b) *And which marble game is in the red room?*

→ ****If incorrect, repeat instructions x1 from ** & repeat (a) & (b). Note outcome:***

→ Regardless of child's response 2nd time, E says: *(Yeah...) We're going to go in the red room first. The red room has the little marble game. You only get 5 marbles today (E hands bag of 5 marbles to child). Remember, once you put a marble down a marble hole, you can't take it out again.*

PROMPT: "If you want to, you can use all of your marbles in the red room, or you can save some marbles for the blue room"

Standardization Guidelines:

If child tries to take used marbles from bottom of run say, *"Oh, we can't take marbles out of there, they're all used up"*.

Test Trial

-Red Room-

E guides child into red room. ***"Okay, we're gonna stay in the red room for 3 minutes. I'm going to do my work over here until this timer rings."*** E sets timer and places it on table, then puts headphones on to "work".

Time	# Marbles used	Plays with marble on floor	Plays with marble in hands	Attempts to retrieve used marble	Verbalizes intention to save	Other Observations (Verbal / Behavioural)
3:00-2:30						
2:29-2:00						
1:59-1:30						

1:29-1:00						
0:59-0:30						
0:29-0:00						

Total # marbles used in little marble run: ____ Total # marbles saved ____

Memory check: When timer goes off, E says: *Okay, do you remember what we're going to do now?*

If child does not spontaneously mention both the blue room and the big marble run, ask the following as necessary: *So, which room are you going to play in now?*

And which marble game is in the blue room?

Regardless of child's answer(s) E says: *(Yeah...) We're going to go in the blue room for 3 minutes. The blue room has the big marble game. Bring your marble bag!*

-Blue Room-

E guides child into the blue room. *"Okay, we're going to stay in the blue room for 3 minutes. I'm going to do my work over here until this timer rings."* E sets timer and places it on table, then puts headphones on to "work".

Time	# Marbles used	Plays with marble on floor	Plays with marble in hands	Attempts to retrieve used marble	Verbalizes intention to save	Other Observations (Verbal / Behavioural)
3:00-2:30						
2:29-2:00						
1:59-1:30						
1:29-1:00						

0:59- 0:30						
0:29- 0:00						

Total # marbles used in big marble run: ____ Total # marbles saved ____

IF CHILD HAS MARBLE(S) LEFT OVER, E ASKS: *Why didn't you use all of your marbles?* _____

END OF TASK: E can let children who did not get to play with the big marble game (due to failing to save marbles) drop 1 or 2 marbles down the run ☺

Appendix H

Study 2 “Table Tasks” (the PPVT-IV protocol is copyrighted and therefore not included here)

CONTENTS FALSE BELIEF TASK

(Child sees a Smarties box, closed with crayons inside)

“Here’s a Smarties box. What do you think is inside the Smarties box?”

_____.

Open box: ***“Let’s see... it’s really crayons inside!”*** (E shows child by allowing some crayons to fall into her hand)

Close box: ***“Ok, what is in the Smarties box?”*** _____.
(Crayons)

If child doesn’t answer/responds incorrectly, then re-open the box and show the crayons: ***“It’s really crayons inside”***, then proceed.

Target question: ***“When you first saw this box, before we opened it, what did you think was inside?”*** _____ (Correct Answer – Smarties)

If child doesn’t respond or says “I don’t know” then **ask the following Forced choice question:**

“When you first saw this box, before we opened it, what did you think was inside? Smarties or Crayons?” (Circle response)

CHANGE IN LOCATION TASK

“Here’s Elmo and here’s Kermit. And, here’s a Black box and here’s a White box. Elmo is playing with this truck. Then, Elmo puts the truck in this White box and leaves to go outside.”
(Elmo is shown leaving and is then placed out of sight).

“Now Kermit wants to play with the truck, so he goes over to the White box, gets out the truck, and starts to play with it. And when he’s done playing with the truck, he goes over to the Black box, puts the truck in there, and he goes outside.” (Kermit is shown leaving and then is placed out of sight).

“Look, Elmo is back and wants to play with the truck.”

“Where does Elmo think the truck is?”
_____ (correct answer: White)

If child doesn't respond then ask the following forced-choice question: ***"Where does Elmo think the truck is? Does he think it's in the Black box or does he think that it's in the White box?"***

Reality question (**all children must be asked this question**):

"Where is the truck really?" _____

(correct answer: Black)

GRASS/SNOW

Instructions

(Place hand cut-outs on table & instruct C to place hands on top of them. Might need to remind C to do this between trials.)

Let's play a game with these cards.

Do you know what color grass is? Is it green or white? _____

Do you know what color snow is? Is it green or white? _____

(praise right answers; correct wrong answers)

Well, we're gonna play a silly game.

(place white card on table in front of child on E's left)

In this game, when I say "grass," I want you to point to this card. *(E points to white card)*

Can you point to this card?

Point(1)

no point (0)

(praise if pointed, prompt if not)

(place green card next to white card, on E's right)

When I say "snow," I want you to point to this card. *(E points to green card)*

Can you point to this card?

Point (1)

no point (0)

(praise if pointed, prompt if not)

Practice Trials

(leave cards in position with white on the left and green on the right)

OK. Now I want you to put your hands on top of these hands here, and when I say the word you point to one of the cards. Ready?

(If incorrect, repeat both rules and practice trials up to 4 times)

E: Grass

(if C hesitates) Where do you point for this one? **white(1)** **green(0)** **#tries**

(praise if correct) (number of times repeated: ____)

E: Snow

(if C hesitates) Where do you point for this one? **white(0)** **green(1)** **#tries**

(praise if correct, go on to test trials) (number of times repeated: ____)

Test Trials

(Remind C to put hands on table between trials as needed.)

(Whenever C hesitates, ask "Where do you point for this one?" but do not point; do not give feedback on test trials.)

			RT (sec)
1. Grass	white(1)	green(0)	_____
2. Snow	white(0)	green(1)	_____
3. Snow	white(0)	green(1)	_____
4. Grass	white(1)	green(0)	_____
5. Snow	white(0)	green(1)	_____
6. Grass	white(1)	green(0)	_____
7. Grass	white(1)	green(0)	_____
8. Snow	white(0)	green(1)	_____
9. Snow	white(0)	green(1)	_____
10. Grass	white(1)	green(0)	_____
11. Snow	white(0)	green(1)	_____
12. Grass	white(1)	green(0)	_____

13. Grass	white(1)	green(0)	_____
14. Snow	white(0)	green(1)	_____
15. Grass	white(1)	green(0)	_____
16. Snow	white(0)	green(1)	_____
Total # Correct: _____ Out of _____ = % correct _____			

COUNTING AND LABELLING

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

Set out Horse, Donut and Play-doh. (Point to each toy as it’s mentioned and counted)
“I’m going to name these toys: Horse, Donut, Play-doh.”

“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 Horse, Two is a Donut, Three is Play-doh.”

Set out Turtle, Banana and Dinosaur.

“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 Orange, Car and Crayon

“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) ☐

WHISPER TASKInstructions

For this game I need to see if you can whisper.

(E now starts to WHISPER THROUGHOUT TASK)

Can you whisper your name really quietly?

(Praise if whisper; If S does not whisper say **"Let's try to talk very very quietly, just like I am. Can you whisper your name to me?"** After the 6th try, continue even if child never whispers)

whisper no whisper
tries _____

Test Trials

OK. Let's play this whisper game I know. I have some pictures of some cartoon characters. Let's see if you can tell me their names. Some of them I bet you'll know and some might be kind of hard and you won't know them, and that's OK.

Remember to whisper because that's how we play the game.

For each card ask, "Do you know who this is?"

(If C simply nods and says yes, prompt with, "Can you tell me his/her name?")

(If C shakes head or says no, then say "That's OK. This is a hard one. His/her name is _____. Let's try a different one.")

(If C gives an incorrect name, say "OK" and move on; code as usual but note the answer given.)

	<u>Know?</u>	<u>Code</u>
1. Shrek	Y N Other _____	_____
2. SpongeBob	Y N Other _____	_____
3. Darkwing Duck	Y N Other _____	_____
4. Dora	Y N Other _____	_____
5. Elmer Fudd	Y N Other _____	_____

You are doing really well. Remember that this is a whisper game where we try to whisper the whole time (said regardless of performance)

6. Buzz Lightyear Y N Other _____
7. Bullwinkle Y N Other _____
8. Spiderman Y N Other _____
9. Tasmanian Devil Y N Other _____
10. Diego Y N Other _____

Coding Instructions

Carlson Method:

Score only the items that C knew (or at least gave an answer to). If C did not answer (said nothing) or said "I don't know" then do not code it.

0 = shout

1 = normal voice or mixed: C starts in one mode of voice and then changes to another mode such as in self-correction (shout to whisper) or in a loss of control (whisper to shout)

2 = whisper

Total Score: _____

C answered: _____

Mean Score: _____
(Total / # answered)

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 both items 5 and 6 are incorrect). Provide no feedback after 2 training trials.

"This is my friend, Johnny. Whenever I say numbers, Johnny says them backwards. Listen: 5 – 8. (Johnny says:) 8 – 5. Now I want you to do the same as Johnny and say my numbers backwards. Do you understand? Let's try one. Ready? Listen carefully. Remember to say the numbers backwards. 3 – 1."
(score below, correct if needed)

"Let's try another one. Remember to say the numbers backwards. 2 – 5." (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 2 times (3 including initial read-through), then proceed with test trials]

(Teaching script for incorrect training trials: **“That’s not quite right, these are tricky. I said, ‘X – Y’ so to say them backwards you would say, ‘Y – X’. Let’s try it again OR let’s another one.”*)

Digits Backwards

Child’s Response

- i. **3 – 1** (“That’s right!” or correct the mistake) ____ – ____ * ; ____ – ____ *
- ii. **2 – 5** (“That’s right!” or correct the mistake) ____ – ____ * ; ____ – ____ *

DO NOT CORRECT THE FOLLOWING TEST TRIALS

Item Score

Set Score

1.	9 – 6	____ – ____ (6-9)	____
2.	3 – 8	____ – ____ (8-3)	____
3.	1 – 8 – 4	____ – ____ – ____ (4-8-1)	____
4.	7 – 2 – 5	____ – ____ – ____ (5-2-7)	____
5.	8 – 4 – 1 – 5	____ – ____ – ____ – ____ (5-1-4-8)	____
6.	5 – 3 – 6 – 8	____ – ____ – ____ – ____ (8-6-3-5)	____
7.	7 – 2 – 4 – 8 – 9	____ – ____ – ____ – ____ – ____ (9-8-4-2-7)	____
8.	5 – 3 – 6 – 1 – 2	____ – ____ – ____ – ____ – ____ (2-1-6-3-5)	____
9.	8 – 2 – 4 – 1 – 7 – 3	____ – ____ – ____ – ____ – ____ – ____ (3-7-1-4-2-8)	____
10.	7 – 4 – 9 – 3 – 1 – 8	____ – ____ – ____ – ____ – ____ – ____ (8-1-3-9-4-7)	____