SPOON-TANEOUS THOUGHTS: A NEW PERSPECTIVE ON CHILDREN'S EPISODIC FUTURE THINKING AS MEASURED THROUGH SPONTANEOUS BEHAVIOUR

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Content of Dissertation and Contribution of Authors

This dissertation is comprised of three studies, all approved by the University of Ottawa Office of Research Ethics and Integrity (file number: H-02-21-6649). The first article (Study 1) "Let's be Spontaneous: Older, but not Younger, Preschoolers Independently Prepare for a Future Problem" has been submitted to the peer-reviewed journal, *Cognition*. The author of this dissertation, Gladys Ayson, is the first author, with former Honours student, Jane Archibald, and dissertation supervisor, Cristina M. Atance, as co-authors. Jane contributed to the methodological design, data collection, and coding. The second article (Study 2), "Children's Mental Time Travel into the Future: A Functional Perspective" is published in the peer-reviewed journal *Philosophical Transactions B*. Gladys Ayson is the first author with Cristina M. Atance as co-author. The third study, "'Can We Please Go to the Zoo Tomorrow, Mommy?': A Naturalistic Investigation of Children's Spontaneous Future-Oriented Expressions" is unpublished work led by Gladys Ayson with fellow graduate student, Setenay Evsen, and Cristina M. Atance as co-authors. Setenay contributed to the coding, literature review, data preparation, and will be involved in manuscript preparation and revision.

In all studies, Gladys Ayson's contributions included theoretical and methodological formulations, literature review, experimental research design, applying for ethical approval, data collection, data preparation, data analysis, transcription, coding, manuscript preparation, and manuscript revision. Dr. Atance provided guidance, support and expertise at every stage of the development of the experimental research design, theoretical conceptualization, ethics application, data analysis, interpretation of findings, manuscript preparation and manuscript revision.

Abstract

Episodic future thinking (EFT) allows us to mentally project ourselves forward in time, guiding present actions based on future goals and desired outcomes. While adults regularly engage in such future-oriented behaviour of their own volition, it is less clear to what extent children do the same. This uncertainty stems from a reliance on experimenter-prompted tasks in developmental research, which limits our understanding of children's independent, self-initiated EFT. This dissertation addresses that gap by investigating how children spontaneously engage in future thinking through unprompted, volitional behaviours.

Study 1 introduced a novel experimental paradigm to examine spontaneous preparation for a future event among 4- to 9-year-olds. Findings showed that most children aged five and older prepared spontaneously, while most four-year-olds did not (74%). Notably, executive functioning was not correlated with spontaneous performance, but was correlated with prompted performance, suggesting these behaviours may be supported by distinct cognitive processes.

Study 2 used a naturalistic, parent-report approach to examine the functionality of children's spontaneous future-oriented statements and actions in everyday life. A thematic analysis revealed four key functions: *Future-oriented information seeking, Expressing future desires or intentions, Connecting present actions to future outcomes,* and *Predicting future mental or physiological states.* These findings suggest future-oriented information seeking may be a function of future thinking that is unique to childhood.

Study 3 adapted the methodology from Study 2 to a larger sample size and identified five overlapping themes: *Future-oriented information seeking, Expressing future desires or intentions, Preparing for the future, Predicting the future*, and *Optimizing the future*. Study 3

also explored what triggered children's spontaneous future-oriented behaviour, with findings suggesting that most instances were internally cued and had been previously observed.

Together, these studies highlight an important and underexplored area of children's cognitive development. They also provide novel, replicable methodologies for investigating spontaneous EFT, opening avenues for future research about how young children use their future thinking in self-directed and everyday contexts.

Keywords: cognitive development, episodic future thinking, naturalistic, autonomy

Chapter 1: General Introduction

"The future depends on what we do in the present." – Mahatma Gandhi

Throughout the course of a day, we dedicate a considerable amount of time to thinking about the future (D'Argembeau et al., 2011; Smallwood & Schooler, 2015). This includes thinking about specific events that might occur, which reflects episodic future thinking (EFT) – or, mentally projecting oneself into a specific future time and space (Atance & O'Neill, 2001). For example, I can use my EFT to imagine or *simulate* my upcoming dinner party, which involves 10 people sitting in my living room, enjoying R&B music and sushi. Using specific episodic details (e.g., my living room, R&B music), I can vividly "pre-experience" this event. EFT is considered an adaptive and uniquely human trait (Suddendorf, 2017). Indeed, simulating the future can help regulate emotions, build a sense of self, and strengthen social bonds (Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022).

Perhaps the most adaptive function of EFT is to inform our behaviours in the present moment (Atance et al., 2023). Research in adults has evidenced EFT to serve a "directive" function where it can guide action planning (Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022; Szpunar et al., 2014). Importantly, EFT allows us to evaluate multiple possible future scenarios and choose a course of action that avoids negative outcomes (Suddendorf et al., 2018). For example, when simulating my dinner party, I might imagine the "best" case scenario (all 10 guests arriving and enjoying the night) and "worst" case scenario (only one guest comes) which might lead me to create and send out invitations asking for RSVPs. Adults often act for a future-related purpose (hereafter referred to as "future-oriented" behaviours). Engaging in future-oriented behaviours such as marinating

chicken, packing sunscreen for a hike, and bringing reusable bags to the grocery store benefit our future selves: an easy dinner prep, no sunburns, and saving money at the grocery store.

Mounting evidence shows that EFT emerges between 3 and 5 years of age, with preschoolers demonstrating future-oriented behaviours related to specific events. For example, 4-year-olds choose to bring puzzle pieces (over crayons) to a room with an empty puzzle board (Busby & Suddendorf, 2005). However, evidence of children's future-oriented behaviours comes from lab-based tasks where children are instructed or "prompted" to act (e.g., "You can only bring one. Which one would you bring to the room with you?"). As such, there is limited understanding of when children *spontaneously* use their own future thoughts to drive their behaviour. Given that adults act for the future based on their EFT, an important question to ask is when this capacity emerges in development. Moreover, naturalistic evidence on the development of EFT is limited. There is a notable knowledge gap about children's everyday future thoughts, what motivates their future thinking, and under what circumstances these thoughts might lead to future-oriented behaviour.

Dissertation Overview

The research in this dissertation provides preliminary evidence about the development of children's "spontaneous" EFT and its translation into future-oriented behaviour. My dissertation comprises three studies that examine children's spontaneous EFT, using a standardized paradigm in Study 1 and naturalistic observation in Studies 2 and 3.

In the General Introduction (i.e., Chapter 1), I begin with an overview of how humans think about the future, highlighting two different forms of future thinking. I then discuss the developmental evidence of EFT in children and how it is measured, describing a popular behavioural paradigm, the Spoon task, used to measure EFT through future-oriented behaviour. I

then highlight some criticisms of Spoon tasks which suggest children's future-oriented behaviours could be driven by visual cuing or experimenter prompting, rather than EFT. I propose that measuring "spontaneous" EFT through unprompted behaviour can address these criticisms. I then describe cognitive, neuroimaging, and developmental evidence for when spontaneous EFT might emerge in childhood. Finally, I conclude with the objectives for this dissertation.

In Chapter 2, I describe Study 1 (Ayson, Archibald, & Atance, under review) in manuscript format. Study 1 is a novel task I developed to measure children's spontaneous EFT through unprompted behaviour. Drawing on Tulving's seminal Spoon test (2005; see also Suddendorf, 1994) and its laboratory renditions (e.g., Busby & Suddendorf, 2005), I designed a paradigm to investigate whether 4- to 9-year-olds spontaneously prepare for a future event by retrieving a necessary item without explicit instruction to do so. I investigated whether age effects, executive functioning, and parent-reported future thinking in the home influenced whether children retrieved the item in question.

In Chapter 3, I describe Study 2 (Ayson & Atance, 2024) in manuscript format. Study 2 observes unprompted expressions of children's future thoughts in their everyday environments. This was a proof-of-concept study run with a small sample of 3-, 4-, 6-, and 7-year-olds (N=12). I asked parents to observe their children over the course of one week, recording any instances of unprompted future-oriented behaviours and statements about the future. I conducted a reflexive thematic analysis on the instances to understand why children think about the future in daily life. I also conducted quantitative analyses to compare the frequency and type of future-oriented instances produced by younger children (aged 3 and 4) with those of older children (aged 6 and

7). These findings offer initial insights into the function of children's spontaneous future thinking in everyday contexts.

Chapter 4 describes Study 3 which is unpublished work (Ayson, Evsen, & Atance, in preparation). Study 3 builds on Study 2's findings with a larger sample of 3- to 9-year-olds (*N*=42). I made some modifications to Study 2's methodology to lessen the burden on parents (e.g., tracking period was four days instead of one week). In addition to a thematic analysis on the functionality of children's future thoughts, Study 3 also included a secondary objective to understand what may have "triggered" or cued these thoughts. To understand this, parents reported what they believed "prompted" their children's future thought and how typical these thoughts were and I examined age effects between younger (ages 3 to 5) and older (ages 6 to 9) children.

I conclude this dissertation with a General Discussion (Chapter 5), including a general overview of the collective findings, contributions to the literature, and limitations and directions for future research.

Future Thinking and its Forms

Future thinking, or "prospection," refers to the ability to anticipate future outcomes or events. There are multiple ways to conceptualize the future, ranging from simple associative learning to complex, episodic simulations of imagined future events. At the most basic level, future-oriented mechanisms can be driven by associative learning – where past experiences guide expectations about what is likely to happen next (Suddendorf et al., 2018). This form of learning may be supported by the brain's dopamine reward system, which reinforces patterns of behaviour that previously led to positive outcomes (Bromberg-Martin et al., 2010). This reward system is thought to drive future-oriented behaviours in animals (Enomoto et al., 2011; Le Heron

et al., 2020). For instance, a squirrel might return to a tree where it typically finds buried nuts, having formed an association between that location and a food reward. However, this associative learning – referred to as nondeclarative or procedural memory (Suddendorf & Corballis, 1997; Tulving, 1985) – is implicit and may not involve cognitive representation of the future, despite driving future-oriented behaviour. Indeed, the squirrel does not need to "think" outside of the present moment when looking for buried nuts.

Two forms of future thinking that involve explicit construction of future representations are "semantic" and "episodic" future thinking. Semantic thinking refers to the retrieval of general conceptual knowledge about the world (Irish & Piguet, 2013). It involves awareness of (and the cognitive ability to operate on) objects, events (and the relations between them) in their absence (Tulving, 1985). An example of a semantic future thought would be considering the environmental state of the world in 20 years. Drawing on generalized world knowledge, schemas, and cultural or societal understanding, this form of thinking enables predictions about the future. As we age and accumulate experience and understanding of the world, our semantic knowledge base expands.

A more complex form of future thinking, found specifically in the human experience, is termed episodic future thinking (EFT; Atance & O'Neill, 2001) or "foresight" (Suddendorf & Corballis, 2007). Unlike semantic prospection, which draws on generalized world knowledge, EFT involves mentally simulating specific future events in rich sensory and emotional detail – a process often described as "pre-experiencing" the future (Atance & O'Neill, 2001). EFT is a core component of *mental time travel* (Suddendorf & Corballis, 2007; Tulving, 1983), the cognitive ability to mentally revisit past experiences (episodic memory) and imagine future experiences.

The distinction between semantic and episodic thought can be exemplified through the case study of patient D.B. (Klein et al., 2002). D.B. displayed profound deficits in his recollection of personal events from his past (episodic memory) after suffering anoxic encephalopathy from cardiac arrest. He also suffered from severe anterograde amnesia and could not remember what he had thought about only moments earlier. D.B.'s general intelligence and semantic thinking were, however, largely preserved. Through interviewing, the distinction between semantic and episodic recall became clear: D.B. could remember the name of his old high school, but not recall any friends or memories he had made during this time. Notably, D.B. showed deficits in his EFT, but was able to identify semantic, non-personal future events. These findings point toward distinct temporal divisions between what Klein (2013) termed "lived time" (i.e., personal experiences), versus a "known time" (i.e., impersonal knowledge).

Findings from D.B. and other adult patients with amnesia, dementia, or Alzheimer's disease, have played a key role in the development of two hypotheses around EFT. The first is the *constructive episodic simulation hypothesis* which suggests the brain repurposes episodic memories to construct simulations of possible personal futures (Schacter & Addis, 2007). Supporting this, neuroimaging studies have shown that both episodic memory and EFT engage a common network of brain regions known as the default mode network (DMN), which includes the medial prefrontal cortex, posterior cingulate cortex, and medial temporal lobes, including the hippocampus (Addis et al., 2007; Mullally & Maguire, 2014; Spreng et al., 2009). This hypothesis explains why D.B., who had severe deficits in episodic memory, but not semantic memory, had difficulty identifying detailed, personal future events (EFT) but not general non-personal events (semantic future thinking). Indeed, it is difficult to anticipate what might happen to us without revisiting our past. Yet, our own memories and personal experiences do not hold all

the answers to our future. The *semantic scaffolding hypothesis* proposes that semantic knowledge also scaffolds the mental construction of episodic future thoughts (Irish & Paquet, 2013). This hypothesis stems from evidence of patients with semantic dementia (i.e., impaired semantic memory but preserved episodic memory) who struggle to conceptualize personal future events, similarly to those with episodic memory impairments (Irish et al., 2012). Thus, both episodic and semantic memory contribute importantly to the pre-experiencing of future events.

Functions of Episodic Future Thinking (EFT)

Better understanding EFT and its development is critical because this capacity is highly adaptive and has played a significant role in human survival and functioning (Suddendorf & Corballis, 2007). In their foundational work, Suddendorf and Corballis argue that mental time travel evolved to allow flexible anticipation of future scenarios, enabling individuals to prepare for or avoid threats and pursue long-term gains (Suddendorf & Corballis, 2007). By supporting the flexible consideration of multiple future paths, EFT fulfills several adaptive functions in daily life. For example, EFT can be used to build a sense of self-continuity and identity (Duffy & Cole, 2021). Knowing that you "continue" into the future and projecting different possible future selves can contribute to the formation and exploration of one's identity (Duffy & Cole, 2021; Suddendorf, 2017). EFT can also serve regulatory purposes by allowing one to prepare for or habituate to adverse emotional reactions to a future situation or promoting positive feelings by imagining joyous upcoming events (e.g., a vacation; Barsics et al., 2016; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022).

Most critically, EFT can also direct planned actions and goals (Barsics et al., 2016; Baumeister et al., 2020; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022). For example, in an early study, Marlatt (1978) reduced recidivism in

alcoholics by having them imagine being in tempting situations in order to formulate hypothetical solutions to avoid drinking. EFT's effect on behaviour has also been evidenced in children. Daniel and colleagues (2015) asked 9- to 14-year-old obese children to record and then listen to personal future events (e.g., "In 6 months, I will be celebrating my birthday.") while sitting in front of candies which they were allowed to eat ad libitum for 15 minutes. Children who listened to EFT recordings ate significantly less than those who listened to recordings of recent past events. Thus, EFT can adaptively influence behaviour throughout the lifespan.

Despite the importance of EFT, it is difficult to distinguish from semantic thinking without individuals self-reporting their phenomenological experience. This is an obstacle that must be overcome when studying EFT in young children, who may lack the metacognitive or verbal capability to express the nature of their thoughts.

Measuring EFT in Children

Research interest in the development of EFT has surged in the past two decades, with most studies focusing on experimental paradigms in a laboratory setting. These studies have consistently shown that EFT emerges and develops significantly during the preschool years, between ages 3 to 5 (Atance & O'Neill, 2001; Busby & Suddendorf, 2005; Tulving, 2005).

Verbal Evidence of EFT in Children

By age 3, children can talk about specific future events. For example, Quon and Atance (2010) asked 3- to 5-year-olds to describe specific events that will happen to them in the future (e.g., "What are you going to eat for breakfast tomorrow?"). They found that 3-year-olds could provide specific responses 89% of the time (e.g., "cereal" for breakfast). However, their responses were less accurate than those of 4- and 5-year-olds, suggesting further development of EFT between these ages (see also Busby & Suddendorf, 2005).

In contrast to more structured verbal paradigms, naturalistic observations suggest that the capacity for future talk may develop as early as 2.5 years (Hudson, 2006; Nelson, 1989). In her book *Narratives from the Crib* (1989), Nelson discusses recordings of 2-year-old Emily's pre-sleep monologues, which include detailed descriptions of future events. For example, Emily narrates:

> *"Tomorrow when we wake up from bed, first me and Daddy and Mommy, you . . . eat breakfast eat breakfast, like we usually do and then we're going to p-l-a-y, and then soon as Daddy comes, Carl's going to come over, and then we're going to play a little while. And then Carl and Emily are both going down the car with somebody, and we're going to ride to nursery school…" (Nelson, 1989, pp. 68–69).*

Though it cannot be determined whether Emily's soliloquy about tomorrow is accurate, her volitional talk about tomorrow reveals her rich understanding of the future. Notably, the level of detail she provides contrasts sharply with the more limited responses of 3-year-olds in Quon and Atance's (2010) experimental task. This discrepancy raises the question of whether laboratory tasks, which typically focus on specific prompts chosen by the experimenter, fully capture children's EFT capabilities. Naturalistic scenarios, where children initiate discussion about the future, might allow for more elaborate expressions of their EFT. This comparison underscores the need for both laboratory and naturalistic research to gain a comprehensive understanding of how EFT develops in early childhood.

Behavioural Evidence of EFT in Children

Limitations in language may mask young children's understanding of the future (Atance & Mahy, 2016; Suddendorf, 2017). Therefore, researchers often opt to use laboratory tasks that elicit future-oriented behaviours driven by EFT (e.g., retrieving an item for a future event). Of these tasks, the "gold standard" is arguably the Spoon test (Tulving, 2005; see also Suddendorf, 1994).

The Spoon Test

> The Spoon test is based on the following Estonian children's tale:
>
> *". . . a young girl dreams about going to a friend's birthday party where the guests are served delicious chocolate pudding, her favorite. Alas, all she can do is to watch other children eat it, because everybody has to have her own spoon, and she did not bring one. So the next evening, determined not to have the same disappointing experience again, she goes to bed clutching a spoon in her hand"* (Tulving, 2005, pp. 44).

In this story, the young girl foresees her return to the party and, more crucially, prepares for it by bringing a necessary item (i.e., the spoon). According to Tulving, this story convincingly demonstrates a behaviour that is driven by the child's EFT. First, the novelty of the future problem (i.e., needing a spoon for a birthday party) supports the interpretation that the equally novel action (i.e., taking a spoon to bed) must be in service of this specific event, and not evoked through learned stimulus-reward relationships (Suddendorf et al., 2011; Tulving, 2005). Second, the young girl's behaviour is only relevant to the future and does not satisfy an existing need (Tulving, 2005). That is, the young girl can only "use" the spoon at the birthday party, not in the kitchen where she presumably retrieved it. Third, although not specified in the story, the item is retrieved after a time delay and in a different spatial setting from the "problem", indicating that the behaviour must have been executed based on mental representations of the future event and not external cues (e.g., seeing the bed and thinking to get a spoon; Suddendorf et al., 2011; Tulving, 2005). Moreover, keeping and transporting an item to a different setting can demonstrate intention to use it in the future (as is the interpretation in animal studies; Mulcahy & Call, 2006). As a result, the presence of the young girl's EFT can be interpreted exclusively through her behaviour.

Laboratory Versions of the Spoon Test

Tulving's Spoon test has since been adapted into laboratory paradigms ("Spoon *tasks*") in which children are tested on their ability to "prepare" (i.e., procure an item) for a future event. Spoon tasks (also referred to as "item-choice" or "two-room" tasks; Atance et al., 2015; Busby & Suddendorf, 2005; Dickerson et al., 2018; Martin-Ordas, 2018) involve introducing children to a novel problem (i.e., the "problem event") where a specific item is needed to obtain a reward. Later, often in a different room/setting, children are given the opportunity to select an item to bring to the room containing the problem event. Busby and Suddendorf (2005) developed the first Spoon task where 3-, 4-, and 5-year-olds were taken into a room with either a puzzle board with no puzzle pieces (experimental condition) or nothing at all (control condition). After spending two minutes in this room, they were taken to another room where they played with unrelated games for five minutes. Following play, children were shown four items (a paintbrush, a coin, crayons, and puzzle pieces) and told "We are going back into [the first] room to play, and you can take one of these things with you...which one do you want to take with you?". Four- and 5-year-olds were more likely to select the puzzle pieces in the experimental condition than the control condition, but 3-year-olds were selecting between items at chance. Subsequent Spoon tasks have shown that by age 4, children can correctly select the required item for a problem event (e.g., Scarf et al., 2013; Suddendorf et al., 2011).

Standard Spoon Tasks: Forced-Choice Format

In standard Spoon tasks, a "forced-choice" question is used to measure children's future-oriented behaviour. In a forced-choice, children select a response from options provided by the experimenter (e.g., choosing between a paintbrush, a coin, crayons, and puzzle pieces in Busby & Suddendorf's, 2005, task). Developmental researchers generally err toward forced-choice

questions because they ensure a high response rate (i.e., children can select, rather than generate, their response) and the responses can be non-verbal (e.g., by pointing at their choice). In Spoon tasks, children are presented with a set of items and must select one to bring with them to the setting with the problem event. Children's choice of item is taken as evidence (if they choose the correct item) or lack thereof (if they choose the incorrect item) for their EFT.

Unlike the original Spoon test (Tulving, 2005), standard forced-choice Spoon tasks cannot unequivocally determine whether children's correct selection is driven by EFT (Dickerson et al., 2018; Russell et al., 2010). This is because it is possible for children's responses to be driven by associative learning. Children may select the item that they know to be associated with a reward – which is likely the correct item among irrelevant distractor items. For example, in Busby and Suddendorf's paradigm (2005), the correct item (puzzle pieces) is more salient than the distractor items (coin, crayons, paintbrush) because of the child's prior experience with the puzzle board. Therefore, presenting the correct item, even amidst distractors, could scaffold children's performance on Spoon tasks by visually cuing their associative learning. Supporting this criticism, Dickerson and colleagues (2018) developed a forced-choice Spoon task in which two items held associative value but, importantly, only one of the two held future utility. In their procedure, children were first trained to use coins to retrieve stickers from two different boxes. Each box had its own specific coin that, when put into the box, produced a sticker. After receiving a sticker reward from both boxes (therefore using two different coins), the experimenter told children that one of the boxes would no longer be available to play with. Later, children were asked to select from three coins: the coin that corresponded to the available box, the coin that corresponded to the unavailable box, and a distractor coin. Thus, although the first two coins both held previous reward value (i.e., children had used these coins to obtain a

reward in the past), only the coin that corresponded to the available box held future utility. Whereas the 4-year-olds selected at chance between all three options, the 5- to 7-year-olds selected the coin with future utility significantly more often than chance. These findings challenge standard Spoon task findings by showing that 4-year-olds may be selecting the correct item using associative strategies, not EFT. It may only be at age five or older that children can engage their EFT to select appropriately.

Generative Spoon Tasks

In response to criticisms surrounding the forced-choice, more recent Spoon tasks have asked children to "generate" an item, rather than select it (Atance et al., 2019; Moffett et al., 2018). One generative Spoon task was run by Atance and colleagues in 2019. The authors introduced 3-, 4-, and 5-year-olds to a puppet, Heather the Hippo, who loved to eat apples but did not have any to eat. In a different room, children were given the opportunity to bring an apple back to Heather. The procedure then diverged according to condition. More specifically, children were randomly assigned to one of three between-subjects conditions: 1) *forced-choice*, where children selected from an apple, a lemon, and an orange, 2) *generate-category*, where children were not presented with items but instead asked "What would be a good *fruit* to bring with you?", or 3) *generate-object*, where children were similarly not presented with items and asked "What would be a good *thing* to bring with you?". They found the highest mean performance to be in the forced-choice condition, demonstrating that children's performance was negatively affected when they were not visually cued to the solution (i.e., the apple). Interestingly, 4- and 5-year-olds performed significantly better on the generate-category condition than the generate-object condition and did not significantly differ in performance between the forced-choice condition and the generate-category condition (although 4-year-olds performed better on the

forced-choice compared to the general-category, albeit not significantly). This suggests that use of a specific question or prompt (e.g., "What would be a good *fruit* to bring with you?") can also scaffold performance.

Prompting Children's Future-Oriented Behaviours

Prompting is defined in this dissertation as any verbal statement or question directed toward the child that signals or cues the need to act. Similar to standard Spoon tasks, findings from generative Spoon tasks are based on responses that were prompted by an experimenter. That is, children were *told* to bring an item to the original setting. This point is critical because, when prompted, children no longer need to consider the future to *initiate* their future-oriented behaviour. For example, in Busby and Suddendorf's (2005) Spoon task, children were shown items and asked "Which one do you want to take with you?". In addition to asking *which* item to bring, this prompt also suggests to children that they *need* to bring an item (as opposed to bringing no items) and, importantly, that there is a particular item that is "correct". In the generative conditions of Atance et al.'s (2019) Spoon task, the experimenter asks children "What would be a good fruit/thing to bring with you?", again signalling the need to bring a particular item. In both standard and generative Spoon tasks, we cannot rule out the possibility that, without prompting, children would not think to bring anything to the room.

Tulving stressed that the first, central requirement for the behavioural demonstration of EFT is that the test subject "deliberately engages" in the behaviour (Tulving, 2005, p. 44). In the Estonian tale, the young girl was not instructed to bring a spoon (or any item) to bed with her. Instead, she brought the spoon on her own initiative, suggesting she simulated attending the same birthday party, anticipated needing a spoon, and prepared accordingly. Prompting, by its very nature, removes a child's decision *to* act and instead probes for *which* action they would choose

to do. While it is possible that children who are prompted still use their EFT to determine the appropriate action, it is also possible that they are problem-solving – searching for the correct answer to the experimenter's prompt, rather than reasoning about the future.

Surprisingly, this "prompting criticism" has not systematically been acknowledged nor addressed by developmental EFT researchers, until our publication in 2023 (Atance et al.). Thus, no paradigms have been developed specifically to measure children's "spontaneous" EFT through volitional or unprompted future-oriented behaviours.

The Development of Spontaneous EFT

When do children think about the future, without being told to do so? When can they use those thoughts to direct their behaviour? To answer these questions, children's *spontaneous* or unprompted EFT need be measured. While EFT has been well-evidenced to develop between 3 to 5 years old in "prompted" paradigms, the emergence of spontaneous EFT may develop later. In the following sections, I provide cognitive, neuroimaging, and developmental evidence for the later development of spontaneous EFT.

Cognitive Evidence From Szpunar et al.'s (2014) Taxonomy of EFT

Szpunar and colleagues (2014) proposed a taxonomy that classifies EFT into four different "modes". The first mode is "episodic simulation" which is the construction of a detailed mental representation of a specific autobiographical future event. An example of this is the detailed pre-experience of my dinner party which I described earlier. The second mode is "episodic prediction" which is the estimation of the likelihood of and/or one's reaction to a specific autobiographical event. For example, I can predict feeling sad if nobody decides to show up to my party. The third mode of EFT is "episodic intention" which is to set a goal related to a specific autobiographical event. Intentions specify "when" a behaviour will be performed,

making it a specific and implementable goal. In my dinner party example, my resolve to mail out invitations is an episodic intention. The fourth mode of EFT is "episodic planning" which is the identification and organization of steps needed to arrive at a specific autobiographical future event or outcome. To accomplish my intention of mailing invitations, I will use the weekend to create them on Canva, print them at a shop near my workplace on Monday, then drop them in a nearby mailbox. Szpunar and colleagues (2014) state that planning is often necessary when carrying out intended behaviours. This is because planning involves converting a goal into "actionable" steps (or behaviours).

I argue that moving through Szpunar et al.'s (2014) four modes (i.e., from simulation to planning) brings an individual closer to enacting a future-oriented behaviour using EFT. Episodic simulation forms the basis for prediction; prediction, in turn, supports the formation of intentions. Intentions establish future goals, and planning identifies the specific behaviours needed to achieve those goals. I also contend that moving through these modes requires increasing cognitive sophistication and effort. In this sense, planning can be considered a "higher-order" form of EFT, as it involves translating abstract future thoughts into concrete, goal-directed action. Szpunar and colleagues (2014) highlight findings showing that individuals with frontal lobe damage struggle with planning tasks. As the frontal lobe is often implicated in executive functioning and higher-order cognitive processes, this suggests that translating episodic simulations into goal-directed action likely requires executive control (Munakata et al., 2012; Suddendorf & Redshaw, 2013; Vincent et al., 2008). Indeed, working memory, a core executive function, supports planning by enabling the monitoring, evaluation, and updating of action sequences (Hanson et al., 2014; Hill, 2004). Inhibitory control may also play a crucial role by helping individuals focus on relevant goals while suppressing distracting or irrelevant

information (Hanson et al., 2014; Hasher et al., 2007). To further support this framework, I will now turn to neuroimaging evidence.

Neuroimaging Evidence

Studies using functional magnetic brain imaging (*f*MRI) and positron emission tomography (PET) have investigated brain activity related to the episodic simulation of future events. For example, Addis and colleagues (2007) asked participants to recall or imagine events related to different cue words shown in the *f*MRI scanner. Collectively, these findings assert that simulating future events recruits the brain's "core" or default mode network (DMN; Addis et al., 2007; Botzung et al., 2008; Mullally & Maguire, 2014; Okuda et al., 2003). This network is most known for its continued activity when the brain is at rest and/or engaged in low-effort cognitive processes (Andrews-Hanna et al., 2014). However, much of this evidence focused on the elaborated *simulation* of future events, and not necessarily whether such events were related to personal goals or plans.

A study by Gerlach and colleagues (2011) investigated brain activity during *goal-directed* simulation of future events and found additional recruitment of the dorsolateral prefrontal cortex (DLPFC). The DLPFC is a part of the brain's executive control network (ECN) which is typically activated during cognitive processes which require high-effort and attention, such as executive functions (e.g., working memory, planning; Beaty et al., 2016; Hertrich et al., 2021). The additional recruitment of the DLPFC during goal-directed future thinking could thus represent increased cognitive effort and attentional control, compared to non-goal-directed future thinking. Notably, the DLPFC undergoes a significant reduction in neuronal density between the ages of 2 and 7 (Diamond, 2002; Gerlach et al., 2011). By age 7, children's DLPFC approaches adult-like neuronal density, a developmental milestone that corresponds with marked

improvements in working memory and inhibitory control (Diamond, 2002). Thus, the emergence of these executive functions – which, as argued in the previous section, are essential for planning – can be anchored to the development of the DLPFC, with marked improvements occurring in middle childhood.

Developmental Evidence

While, to my knowledge, there is no direct developmental evidence for spontaneous EFT and its translation into future-oriented behaviour, some tasks have measured children's unprompted future-oriented utterances and behaviours. This limited evidence suggests that such behaviours emerge after the preschool years, around age 7. Some Spoon tasks have included peripheral measures of children's spontaneous future-oriented behaviour or utterances. Caza and Atance (2019) developed a task where children had to decide in which of two rooms (a room with toys or a room with no toys) they would like to put toys for a future visit. The authors tracked whether children made spontaneous utterances that solved the problem (e.g., "I wish I could bring this toy into the [no-toy] room") and found that, across two experiments, only 5% - 19% of 3- to 5-year-olds did so. Moreover, they did not find an age-related increase in such spontaneous utterances. Similar findings were obtained in Martin-Ordas' (2018) Spoon task, which required children to pack an item in a bag and take it to another room. The author measured whether children spontaneously remembered to grab the bag when told they were going to the other room. They found that only 14% of 3- to 5-year-olds remembered to grab the bag. Interestingly, after prompting ("Is there anything you need to bring upstairs with you?") the proportion of children grabbing the bag increased to 75%. Dickerson et al. (2018) noted whether children spontaneously "used" their selected coin to obtain the sticker reward from the box – a measure that may more explicitly reflect *intent* to use this item in the future. Whereas 64% of 5-

year-olds selected the correct coin, only 31% of 5-year-olds spontaneously used their coin on the box. In contrast, 77% of 7-year-olds selected the correct coin and 70% of 7-year-olds spontaneously used their coin. Collectively, these findings suggest that unprompted future-oriented behaviour for specific future events may develop after the preschool years. However, it is possible that other factors may have contributed to whether children chose to act spontaneously in these studies (e.g., feeling like they needed "permission" to use the coin on the box; Pham et al., 2024).

Further evidence for children's unprompted future-oriented behaviour can be found from the work of Brinums and colleagues (2018; 2021). Brinums et al. (2021) investigated spontaneous information-seeking behaviour in 4- to 7-year-olds. They define information-seeking behaviour as strategically gathering information that will be useful for a future purpose. Children were shown two sets of cards, one red and one blue. All cards had an image of an animal on one side, and an image of a toy on the other. The goal of the game was to memorize which specific toy corresponded with which specific animal. Children were told that they would be tested on only one of the sets (red or blue) later and, as such, they only needed to study one set of cards to succeed. Children were given a one-minute study phase where they were told that they could turn over any of the cards. Six- and 7-year-olds, but not 4- and 5-year-olds, turned over the cards in the target set significantly more often than the cards in the distractor set, further adding to the evidence that children's unprompted future-oriented behaviour emerges in middle childhood.

This same group of researchers also investigated when children engaged in spontaneous practicing (termed, "deliberate practicing"; Brinums et al., 2018). Researchers showed 4- to 7-year-olds how to play three simple motor skill games (e.g., a "golf game" where a ball must be

knocked into a goal) and identified one game which they would later be tested on (i.e., the "target" game). Children were then given five minutes alone in a different room with replicas of the three games and could play with any of the games at will. Seven-year-olds played the target game first significantly above chance and spent more time playing the target game than 4-year-olds. Interestingly, 6-year-olds only played the target game first above chance when they were prompted to "use this time to prepare for the test" but not when they were only told to "play with any of the games". These findings further suggest that unprompted future-oriented behaviour may emerge around the age of seven. Furthermore, the findings with 6-year-olds again highlight the impact of prompting on children's performance.

Work by Brinums and colleagues (2018; 2021) provides preliminary information on when children might act for the future without prompting, pinpointing this development to occur by age 7. However, it cannot definitively be ascertained whether children are mentally projecting into the future to inform their actions. Although such behaviours (information-seeking, practicing) are oriented toward a specific future event, the paradigms provide limited options for action and even shape children's behaviour independently of their EFT. For example, Brinums and colleagues (2018) brought children into a room with three games and no other available activities. The mere presence of the games may prompt children to engage with them, regardless of their initial intentions (Pham et al., 2024). While children were not instructed to play a specific game, they were told to "play with any of the games," which implicitly directs their behaviour. Similarly, in Brinum and colleagues' information-seeking paradigm (2021), children were told that they could look under any of the cards for one minute. Moreover, in both cases, presenting a choice of games or cards may allow children to rely on associative learning to guide their decision-making – reflecting a limitation shared with standard Spoon tasks (Dickerson et

al., 2018). It is important to recognize that Brinums and colleagues were not specifically attempting to isolate EFT in their studies, and a task designed to measure spontaneous EFT through unprompted behaviour is still needed. In developing such a task, researchers must account for the intrinsic constraints of the laboratory setting (Pham et al., 2024). Chapter 2 of this dissertation introduces a novel standardized paradigm designed to isolate spontaneous EFT-driven behaviour, addressing the methodological limitations discussed above.

Moving EFT Research Outside of the Lab

To my knowledge, there is no documentation of children's spontaneous EFT or unprompted future-oriented behaviours in their everyday environments. It is important for experimental data to be complemented by naturalistic evidence to avoid drawing conclusions about children's real-world behaviour and experiences without sufficient support (Dahl, 2017). As seen with 2.5-year-old Emily from *Narratives from the Crib* (Nelson, 1989), children may express sophisticated forms of future thought earlier when they are in their own environments compared to a laboratory setting. Indeed, a child's natural environment might support future thinking and future-oriented behaviour in ways that a laboratory setting cannot.

In their everyday lives, children develop a familiarity toward the environments, people, and activities they frequently encounter. Children may be better able to anticipate future events that are familiar to them and may require multiple exposures to an event before they learn how to anticipate and prepare for it. For example, the familiarity of a weekly-occurring swimming lesson could help a child learn what they need to bring to that lesson each week. Laboratory measurements of EFT, however, often take the opposite approach: to ensure children are simulating a specific future event, tasks should include a novel scenario that is only experienced once (Suddendorf et al., 2011; Tulving, 2005). These criteria are in place to ensure children do

not rely on associative learning to pass an EFT task. Yet, perhaps young children, who have limited experiences from which to build their episodic memory, use their "semantic" understanding of what will come next to build their episodic future projections. This interpretation is in line with the *semantic scaffolding hypothesis* (Irish & Paquet, 2013). If this is true, then lab-based tasks are measuring EFT in a way that does not reflect how children use this capacity in their day-to-day lives.

Another key reason to incorporate naturalistic research, particularly when assessing unprompted behaviours, is that children are likely to be more comfortable in familiar, real-world settings. In contrast, standardized laboratory paradigms often involve interactions with an experimenter following a scripted protocol rather than engaging in genuine, responsive interaction. This, compounded by the likely unfamiliarity of the experimenter and the setting, may make children hesitant to act without explicit instruction. This discomfort can lead to false negatives, where children refrain from acting not because they lack understanding, but because they are unsure whether they have permission to do (Pham et al., 2024). It is likely that children are more inclined to act spontaneously in an organic and unstructured environment, in which they feel at ease.

A third reason to incorporate naturalistic investigation into EFT research is to better understand the situations or scenarios in which children naturally engage in future thinking. At the beginning of this General Introduction, I presented commonplace examples of adult future-oriented behaviours (e.g., marinating chicken, bringing bags to the grocery store). However, children are rarely responsible for preparing meals or running errands, and it remains unclear which kinds of future-oriented behaviours reflect their EFT. Indeed, many existing EFT tasks probe behaviours that require a degree of autonomy – for example, in Spoon tasks, children must

bring an appropriate item to another room. But are young children typically expected to bring items to events on their own? Moreover, children may think about future events for reasons beyond action planning, and these purposes may differ from the functions identified in adults. Such child-specific functions can only be identified through naturalistic observation. Finally, understanding the kinds of future-oriented behaviours in which children typically engage can further inform the design of EFT tasks which are more ecologically valid and developmentally appropriate. Chapters 3 and 4 of this dissertation describe a new methodology and novel naturalistic evidence of children's day-to-day EFT functions, offering a fuller understanding of how and why children typically engage in EFT.

Current Dissertation Objectives

My dissertation measures children's spontaneous EFT in three studies, in both controlled (Study 1) and natural (Studies 2 and 3) environments. In Study 1, I adapted Tulving's Spoon test to measure unprompted future-oriented behaviour driven by EFT. By removing prompting and visual cuing (i.e., forced-choice), children's volitional item retrieval arguably reflects their episodic projection to the problem event. In Studies 2 and 3, I used a parent-report methodology in which parents tracked and recorded their child's everyday unprompted future-oriented actions and statements. I ran two iterations of this naturalistic study; the first was a proof-of-concept study (Study 2) that included a small sample of 12 children to assess the feasibility of my methodology. Study 3 then used a modified methodology (adapted from what I learned from Study 2) with a larger sample of 42 children.

Chapter 2: Study 1

The objective in Study 1 was to develop a novel methodology that would provide evidence of future-oriented behaviour driven by spontaneous EFT. I drew inspiration from

Tulving's Spoon test (2005) to develop my methodology because it outlines specific criteria to ensure the observed behaviour (i.e., item retrieval) reflects the child's EFT (see also Suddendorf et al., 2011). However, a shortcoming of the current laboratory interpretations of the Spoon test is that they prompt children to retrieve an item, calling in question whether item retrieval is driven by EFT or experimenter instruction. Study 1 of this dissertation makes an important contribution to the existing literature by designing the first paradigm to assess children's (aged 4 to 9) unprompted future-oriented behaviour driven by spontaneous EFT. Because this study was administered during the height of the COVID-19 pandemic, it was administered virtually with the child connecting via video call from their own home.

Chapter 3: Study 2

Given the lack of naturalistic evidence on children's future thinking, I developed a novel methodology to sample children's unprompted future-oriented behaviours and statements in everyday settings. The primary aim of Study 2 was to examine the feasibility of this methodology. Because this approach relies heavily on parental involvement, it was important to first run a proof-of-concept study with a small sample of children (N=12). This study captured a broad range of children's natural, unprompted future thoughts, to contribute novel evidence for the functions that future thinking serves in early childhood.

Chapter 4: Study 3

Study 3 drew on the findings from Study 2 to refine the methodology and re-administer it to a larger sample (N=42) of children. In addition to identifying the functions of children's everyday future thinking, Study 3 included a secondary investigation of what might "trigger" children's spontaneous future thoughts (e.g., types of cues, familiarity of the event, spatial location). Findings from this study further add to the novel evidence from Study 2 of childhood

functions of EFT. It also provides new evidence for what variables might influence the occurrence of children's spontaneous future thoughts in daily life.

Implications

Pre-experiencing a personal future event – termed, episodic future thinking (EFT; Atance & O'Neill, 2001) – is a key mechanism that drives present behaviour to optimize future outcomes. In adults, episodic representations of future events often lead to planning and other future-oriented actions (Baumeister et al., 2020). However, questions remain regarding the development of EFT: when do children begin to spontaneously use EFT to guide their behaviour and what kinds of behaviours does their EFT typically support?

This dissertation seeks to answer these questions through two pioneering methodologies. Existing developmental paradigms (e.g., Spoon tasks) prompt children to act for the future making it difficult to determine whether children are independently using EFT to guide their behaviour. To more accurately assess children's capacity to use EFT spontaneously, it is essential to observe – rather than initiate – their future-oriented behaviour. By doing so, this work offers the first direct insights into the development of spontaneous EFT. Moreover, understanding how EFT naturally emerges and functions in everyday contexts will help to clarify its developmental timeline and inform more ecologically valid research practices.

Chapter 2: Let's be Spontaneous: Older, but not Younger, Preschoolers Independently Prepare for a Future Problem

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Data accessibility. All data and accompanying information have been uploaded into OSF: https://osf.io/u3t8p/?view_only=08eec60221c04270b94d3a64d4475887

Abstract

Young children can be prompted to engage in future-oriented behaviour (e.g., bringing an item to a future event), however it is unclear when they can do so *spontaneously*. The shift from prompted to spontaneous future-oriented behaviour reflects children's ability to independently use their thoughts about the future to guide their actions. We examined spontaneous future-oriented behaviour by adapting the popular "Spoon" task (Tulving, 2005) of future thinking. Four- to 9-year-olds (N=134) were tested virtually in their homes and shown three crying babies; soothing the babies required a spoon, which the children did not have. Children were later told they would re-encounter the babies and were given the opportunity to spontaneously retrieve a spoon: our dependent variable of interest. Children who did not retrieve a spoon were given increasingly specific prompts, ending with a forced-choice selection. Fifty-three percent of children spontaneously retrieved a spoon; with age, children were more likely to be spontaneous, τ_b= .220, p = .001, r^2 = .115, and require less prompting, $r_s(61)$ = .501, p < .001. Spontaneous performance was significantly correlated to performance on an event-based prospective memory task, $r_{partial}(129)$ = .234, p = .007, while prompted performance was significantly correlated to performance on a working memory task, $r_{partial}(51)$ = .373, p = .006. These findings suggest an age-related improvement in children's capacity to spontaneously prepare for the future, and that its cognitive underpinnings differ from those involved in more prompted future-oriented behaviour.

Keywords: development, episodic future thinking, spontaneous behaviour, executive function, independence

Let's be Spontaneous: Older, but not Younger, Preschoolers Independently Prepare for a Future Problem

Adults think about the future twice as much as they think about the past (Anderson & McDaniel, 2019; Baumeister et al., 2020; Cameron, 1972; Smallwood et al., 2009), with the former serving numerous functions, including building a sense of self, regulating emotions, social bonding, and predicting what will happen next (Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022; Suddendorf, 2017). Future thoughts are often about specific personal events, reflecting what has been coined "episodic future thinking" (EFT; Atance & O'Neill, 2001) or "foresight" (Suddendorf & Corballis, 2007). Although simulating an event, in and of itself, has value, translating simulations into future-oriented behaviour is crucial to optimizing desired future outcomes (Baumeister et al., 2020; Hallford & D'Argembeau, 2022; Suddendorf, 2017). For example, imagining getting sweaty at the gym without taking the necessary action to address this (e.g., packing a towel) is clearly less beneficial.

Although there has been a growing body of research on the development of EFT in the past 15-20 years, it has not targeted children's capacity to act *spontaneously* with the future in mind. As we further elaborate below, we use the term *spontaneous* to capture a future-oriented action that occurs in the absence of external prompting. Understanding the development of children's spontaneous future-oriented behaviour holds both theoretical and applied value. With respect to the former, adults routinely autocue (i.e., independently generate) EFT to initiate future-oriented behaviours. Indeed, when adults think about the future, they often do so in relation to concrete plans, upcoming tasks, and future goals or intentions (D'Argembeau et al., 2011; Kvavilashvili & Rummel, 2020). Accordingly, an arguably pivotal transition in human

development is functionally engaging EFT to enact future-oriented behaviours. The development of spontaneous future-oriented behaviour also holds applied value as it pertains to children's daily lives. Young children often need their caregivers to remind or encourage them to engage in future-oriented behaviours at home (e.g., bringing a toy to the park or packing their schoolbag). However, with age, children develop more autonomy and independence, thus relying less on caregiver support to help them prepare for future experiences. In sum, knowing more about the transition from more "scaffolded" to autonomous future-oriented behaviour, along with its underlying cognitive correlates, can inform both theory and parental/caregiver practices.

We begin our paper by describing how paradigms – most notably, the "Spoon task" – to measure young children's preparatory behaviours do so in ways that prompt, rather than allow children to spontaneously initiate, behaviour. We then describe our novel empirical approach, along with its theoretical implications, to address this critical knowledge gap.

The Spoon Task

Young children have limited verbal and metacognitive skills and therefore their EFT is typically assessed using behavioural measures. Most notably, the "Spoon task" (also referred to as "item-choice" or "two-rooms" tasks; Atance et al., 2015; Dickerson et al., 2018; Martin-Ordas, 2018; Suddendorf & Busby, 2005) is often the measure of choice in both young children and non-human animals (Dickerson et al., 2018; Mulcahy & Call, 2006; Suddendorf et al., 2011). The Spoon task derives its name from Tulving's (2005) *Spoon test* which he proposed to non-verbally assess whether an organism can think episodically about the future (similar ideas about non-verbal assessments were also proposed by Suddendorf, 1994, and Suddendorf & Busby, 2005). Tulving's Spoon test, based on an Estonian children's tale, is as follows:

... a young girl dreams about going to a friend's birthday party where the guests are served delicious chocolate pudding, her favorite. Alas, all she can do is to watch other children eat it, because everybody has to have her own spoon, and she did not bring one. So the next evening, determined not to have the same disappointing experience again, she goes to bed clutching a spoon in her hand. (Tulving, 2005, p. 44)

The Spoon test has since been reimagined into various laboratory paradigms where children demonstrate their EFT by selecting and transporting an item. These tasks typically involve showing children a "problem event" (e.g., locked box with stickers inside) for which a specific item (i.e., a key) is needed to obtain a reward. Next, in a different setting/room, and after a delay period, children are told they will return to the first setting/room and are prompted to bring an item with them. Selecting the correct item (i.e., key) is taken as evidence of EFT; that is, children imagining themselves re-encountering the problem with the necessary item to solve it.

Criticisms of the Spoon Task

Association. In Spoon tasks, children's opportunity to prepare for the future event takes the form of an item-choice; that is, children are presented with a set of items, including the correct one and, in a forced-choice format, are asked to choose one to bring back to the original location. Most 4-year-olds pass the Spoon task, leading researchers to conclude that this is the age at which EFT emerges (e.g., Atance & Sommerville, 2014; Scarf et al., 2013; Suddendorf et al., 2011). However, the forced-choice format of the Spoon task has led to the criticism that children who succeed may be doing so through associative processes – that is, associating the correct item (e.g., "key") with the problem event (e.g., "locked box"; Dickerson et al., 2018; Russell et al., 2010). It is possible to reduce the salience of this association by, for example, using a locked box that can only be opened by a key of a particular shape (e.g., square) and then

presenting children with a set of keys of different shapes (e.g., Suddendorf et al., 2011). However, an association could nevertheless be formed between, for example, "square lock" and "square key" (Atance et al., 2023).

Researchers have addressed this criticism by moving away from a forced-choice format and, instead, asking children to *generate* (e.g., draw, verbally label) an item to bring with them (Atance et al., 2019; Moffett et al., 2018). In one such study, 3- to 5-year-olds had significantly more difficulty with the generative conditions than the standard (forced-choice) condition of a Spoon task, suggesting that presenting items in a forced-choice format allows them to fall back on associative, rather than episodic, strategies to succeed (Atance et al., 2019). In another study using the Spoon task, 5-year-olds – when asked to draw items they would like to take with them – drew more target items than 4-year-olds when asked "Is there anything you want to pack?". Together, these results suggest improvement beyond age four in generating future-oriented solutions.

Experimenter Prompting. The issue to which we turn next is more central to our paper. Specifically, we argue that irrespective of whether Spoon tasks test children's capacity for EFT, they do not test whether children *use* their EFT to act with the future in mind. In Tulving's (2005) Spoon test, the young girl's future-oriented behaviour was driven by her own thought about the future ("*determined not to have the same disappointing experience again*"; Tulving, 2005, p. 44). Her subsequent and *spontaneous* retrieval of the spoon is what convincingly reflects her EFT. Although both the "standard" and more "generative" Spoon tasks are inspired by Tulving's (2005) Spoon test, they deviate by prompting children to select/generate an item to bring with them. In standard Spoon tasks (e.g., Suddendorf & Busby, 2005, Suddendorf et al., 2011; Scarf et al., 2013), this prompting takes the form of asking, for example, "…you can take

one of these things with you … which one do you want to take with you?" (Suddendorf & Busby, 2005), whereas in the generative versions, children may be asked "Can you tell me what would be a good thing to bring back to the other room?" (Atance et al., 2019). By default, these tasks ensure children will take an item with them, regardless of whether their intention was to solve the problem (Atance et al., 2023).

Data to support this claim comes from a Spoon task developed by Martin-Ordas (2018). After children chose an item (in a forced-choice format), and after a delay period, only 14% spontaneously brought the item to the original location that housed the problem. However, after being prompted by an experimenter ("Is there anything you need to bring upstairs with you?"), this percentage rose to 75. A similar pattern was obtained in Dickerson and colleagues' (2018) Spoon task. Here, children were given 30 s to spontaneously use their selected item after returning to the original location. Whereas in their Experiment 1, 64% of 5-year-olds chose the correct item, only 31% spontaneously used it; this rate of spontaneous use increased to 70% in 7-year-olds. Although these findings suggest that younger children did not select the correct item with the intention to use it in the future, it is also possible that they felt a need for "permission" to act spontaneously within a laboratory setting (Pham et al., 2024). This possibility further underscores the need for a task that is specifically designed to measure children's spontaneous (i.e., *unprompted*) future-oriented behaviour.

The Current Study: Assessing Children's Spontaneous Future-Oriented Behaviour

We developed a novel paradigm – the *Spontaneous Action task* - to measure children's capacity to spontaneously retrieve an item for the future. Our task shares the basic structure of a Spoon task with the critical difference that children must act (i.e., retrieve an item) spontaneously. In our task (for which administration began during the COVID-19 pandemic),

children were tested from their homes and, through the online Zoom platform, were introduced to three crying babies. Children needed to perform a specific action (clap, say "shh", or wave a spoon) to stop each baby's crying but, critically, did not have a spoon to soothe the last baby (i.e., the problem event). After a delay period, children were given an opportunity to spontaneously retrieve a spoon: the experimenter received a phone call and left for one minute, leaving the child to do "whatever they want" during their absence.

We hypothesized that, by ages 6 to 7 years, children would spontaneously retrieve the necessary item (i.e., spoon). There were various reasons for this prediction. First, Dickerson et al.'s (2018) data showed that 7-year-olds were more likely than younger children to spontaneously use their chosen item, suggesting that they held a deliberate intention to solve the future problem. Second, work by Brinums and colleagues has shown that children's spontaneous information-seeking and practicing (Brinums et al., 2018, 2021) also emerge around 6 to 7 years. Third, Munakata and colleagues (2012) suggest that, with age, children transition from engaging their goal representations "reactively" (i.e., as needed; in response to a relevant cue/stimuli) to maintaining their representation "proactively" (i.e., until it is needed; in anticipation of a relevant cue/stimuli). This shift to proactive control may be supported by executive functions such as working memory and inhibition to keep attention on the goal (Munakata et al., 2012; Troller-Renfree et al., 2020; Zhai et al., 2024). In line with this, Gerlach and colleagues (2011) report that the dorsolateral prefrontal cortex, a brain region responsible for the maintenance of goal representations, reaches adult neural density around age 7.

Although our main goal was to capture children's spontaneous behaviour, we also assessed the impact of various levels of prompting on task success. Given that 4-year-olds pass standard Spoon tasks, but have difficulty with generative ones, we hypothesized that 4-year-olds

would require more prompting than older children to succeed on our task. Another secondary objective was to measure the extent to which children's "spontaneous" and "prompted" item retrieval relate to other conceptually relevant processes. We thus included tasks assessing working memory and inhibition (Forward and Backward Digit Span), the activation of abstract goal representations (Verbal Fluency task), and prospective memory (i.e., remembering to perform a future intention). To assess the extent to which performance on our task was related to parental report about their child's future-oriented cognition and actions in their daily lives, we also administered three subscales from the Children's Future Thinking Questionnaire (CFTQ; Mazachowsky & Mahy, 2020).

Methods

Participants

Our sample included 134 English-speaking children aged 4 to 9 years (69 girls; M_{age} = 83.22 months, *SD* = 20.88 months) from the Ottawa and Greater Toronto areas in Canada. Three a priori power analyses (ANOVA: Fixed effects, omnibus, one-way; Goodness-of-fit tests: Contingency tables; Correlation: Bivariate normal model) using G*Power 3.1.9.4 (Faul et al., 2009) were conducted to detect medium to large effect sizes for each of our primary analyses (see Main Analyses section below). The analysis that required the most participants (one-way fixed effects ANOVA; 1-beta = 0.8) determined that 132 participants were needed. Accordingly, our sample contained 23 4-year-olds, (11 girls; M_{age} = 53.52 months, *SD* = 3.53 months, range = 48-59 months), 23 5-year-olds (11 girls; M_{age} = 64.48 months, *SD* = 3.58 months, range = 60-71 months), 20 6-year-olds (9 girls; M_{age} = 79.40 months, *SD* = 3.07 months, range = 74-83 months), 24 7-year-olds (14 girls; M_{age} = 88.54 months, *SD* = 3.43 months, range = 84-95 months), 22 8-year-olds (13 girls; M_{age} = 101.64 months, *SD* = 3.51 months, range = 96-107

months), and 22 9-year-olds (11 girls; M_{age} = 113.14 months, *SD* = 3.24 months, range = 108-119 months). Demographics information collected via an online Qualtrics survey showed our sample to be 62.7% White, 17.2% mixed race, 6% Asian, 1.5% Hispanic, and 1.5% Middle Eastern with the remaining children's ethnicities unidentified (9%) or identified as Canadian (2.2%). Children were mostly from highly educated families, with parents' highest education levels reported as 38.8% graduate degree, 44.8% undergraduate degree, 8.2% college degree, 2.2% high school degree and 6% undisclosed. Twenty-four additional children were excluded from initial data cleaning due to experimenter error (*n*=3), a neurodiverse condition disclosed after testing (*n*=3), completing the session in, or in view of, the kitchen, or with a spoon in the room (*n*=6; see below for further details about these dimensions), and parent or sibling interference (*n*=12). Eleven parents did not complete the Children's Future Thinking Questionnaire (CFTQ) but their child's data was nevertheless retained. Verbal consent was obtained by the parents of our participants and children received a $10 gift card to a bookstore.

Procedure

Children participated in a 45-minute session on Zoom with the experimenter (E). All stimuli were presented through screensharing a Google slides presentation.

Introduction to Experimental Procedure

E began the Zoom call by telling the parent (without the child present) that an important aspect of the procedure was that they/E would pretend to "receive" phone calls and turn their camera and microphone off twice during the session. Critically, the parent was told to refrain from interacting with their child (C) during this time. The parent was told that during the second phone call, C may (or may not) retrieve (or ask their parent to retrieve) a spoon for an upcoming activity. The parent was then asked 1) whether there was a spoon in the room, 2) whether C was

comfortable getting a spoon on their own, 3) whether the kitchen was in their line of sight, and 4) the proximity of their location to the kitchen (i.e., in the kitchen, next to it, same floor, or different floor). Parents were instructed to remove all spoons from the room, relocate their session if they were unable to remove the spoons or were in the kitchen, or to change their orientation so they would not be facing the kitchen. If the session ultimately took place in the kitchen, with the kitchen in C's line of sight, or with a spoon in the room, the participant's data was subsequently removed from analyses (as noted in the "Participants" section). After this, C was called in to begin the Spontaneous Action task procedure.

Spontaneous Action Task Procedure

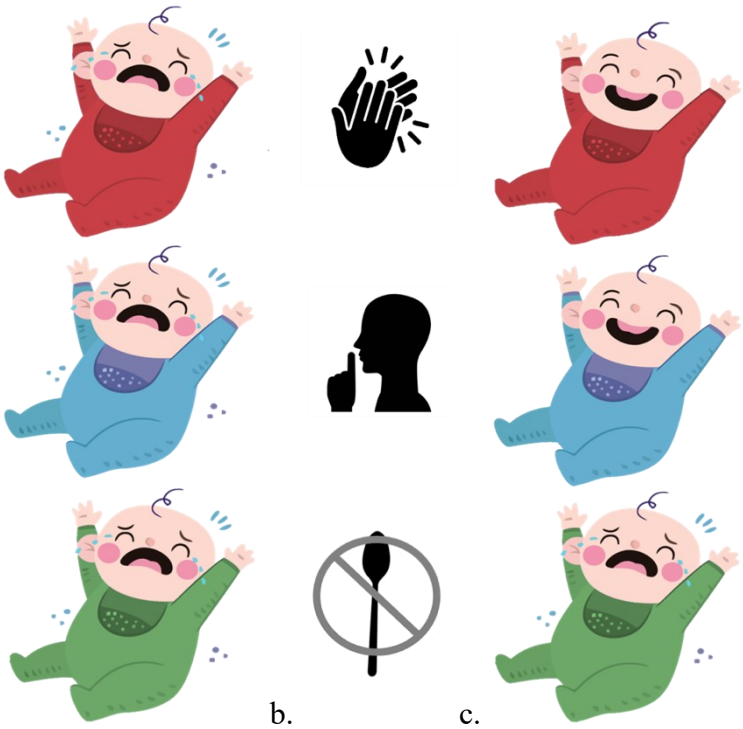
First Phone Call. E told C that they would play some games together, but that E may get some phone calls during their games. C was told that, during a phone call, E would turn their microphone and camera off for 1 minute and C could do "whatever they want" until E returned. To illustrate, E played a "ringing phone" sound and told C that they/E would be right back. Before turning off their camera, E asked C to retrieve a toothbrush while they/E was gone. This was to let C know that it was permissible to leave the computer screen, and even the room, when E received a phone call. When E returned, they asked C to show them the toothbrush. E looked at the toothbrush and thanked C for showing it to them. Eighteen children (seven 4-year-olds, four 5-year-olds, three 6-year-olds, one 7-year-old, two 8-year-olds, and one 9-year-old) did not retrieve a toothbrush during the phone call. E nonetheless moved on to the "problem" event.

Problem Event. C was told they would meet three crying babies and, critically, that they needed to stay at the computer because the babies could not be left alone. C then sequentially viewed three crying babies on-screen (see Figure 1a). Each baby was identical, save for the colour of their onesie (red, green, or blue; order counterbalanced). E told C that the first baby

"likes to hear clapping" and C was told to "clap so the baby stops crying." A crying sound played until C clapped, at which point a happy baby was displayed with an accompanying cooing sound (see Figure 1c). E then introduced the second (crying) baby and told C that this baby "likes to hear 'shh'" and to "say 'shh' so the baby stops crying." The same crying sound played until C said "shh", at which point a happy baby was displayed with the cooing sound. Finally, E introduced the third (crying) baby and told the child that this baby "likes to see spoons." Critically, E then said "Oh no, you don't have a spoon to show the baby, and it's too late to get one now! We can't leave the baby alone!" After 6 s of listening to the baby cry, E said they should play something else. Despite E's earlier instructions not to leave the babies alone, four children (three 4-year-olds and one 5-year-old) immediately left to retrieve a spoon. In these cases, E changed the presentation to a blank slide and, when C returned with a spoon, said "The poor baby just kept crying! I couldn't listen to it anymore! Let's just play something else. Before we do, why don't you go put the spoon back? I'll wait here!" All four children did so, and E continued the session.

Figure 1

Image of the Babies "Before" (a) and "After" (c) Child Completed the Required Action (b).



a. b. c.

Note. The last presented baby continued to cry because the child did not have a spoon. The colour order of the three babies was counterbalanced.

Delay Period and Opportunity to Prepare. E played videos of two Robert Munsch stories ("Good Families Don't" and "Aaron's Hair") for C, lasting approximately 8 minutes. After the delay period, E said "We're going to meet the same three babies again! Oh no, they're crying again! If all of the babies stop crying, you get a very special surprise at the end of our games!" E then received another phone call and reminded C that they could do "whatever they want" until they/E returned. Our critical dependent measure was whether, during this phone call, C spontaneously retrieved or mentioned (i.e., to their parent) a spoon. We considered a mention of the spoon as spontaneous behaviour because it was unprompted and, in addition, captured

children who may have felt uncomfortable leaving the room. Children who retrieved/mentioned a spoon during the phone call received a spontaneous score of 1. Those children who did not behave spontaneously (i.e., spontaneous score of 0) were administered increasingly specific prompts until they retrieved/mentioned a spoon. Note that our final "prompt" was an item-choice measure in which the E presented children with three items on screen (cup, apple, spoon) and asked "Which one would be good to get for the crying babies?" (see Table 1 for levels of prompting and corresponding scores). Children who mentioned a spoon at any point during prompting were asked whether they would like to get one before seeing the babies again.

Table 1

Prompts and Corresponding Prompt Score

Prompt Score	Prompt Level
3	General prompt ("What would be a good thing to get for the crying babies?")
2	Specific prompt ("What would be a good thing in your kitchen to get for the crying babies?")
1	Item-choice (E shows a spoon, cup, and apple then asks "Which one would be good to get for the crying babies?")
0	Child does not mention or retrieve spoon in response to the item-choice

Note. This score was only assigned to children who did not behave spontaneously. Prompts were administered (beginning with the general prompt) until C retrieved/mentioned a spoon, or until all prompts were administered.

Return to the Problem. After C retrieved/mentioned a spoon, or was administered all three levels of prompting, they met the crying babies again. For each baby, E asked "Can you make this baby stop crying?" For those children who did not pass the item-choice (n =14) and hence did not have a spoon for the third baby, E waved their own spoon.

Prospective Memory Intention Setting

E then congratulated C for making all the babies stop crying and said C would get their special surprise at the end of all the games. An event-based prospective memory task (Guajardo & Best, 2000) was then administered where E asked C to remind them/E to give the special surprise when they reached "the end of all their games".

Executive Function Tasks

Immediately after the Spontaneous Action task, children completed two executive function tasks in counterbalanced order:

Digit Span (Carlson, 2005). This task measured working memory (in the forward portion of the task) and working memory plus inhibition (in the backward portion). In the forward digit span, C was told to repeat the numbers that E said. E read a series of numbers beginning with two digits (e.g., "3, 4") and if C correctly recited the numbers back (i.e., "3, 4"), E then provided a new set of numbers and increased the span of numbers by one digit (e.g., "2, 5, 8"). If C did not recite the numbers back correctly, they were given a new set of numbers with the same digit span (e.g., "5, 7, 9"). This procedure was followed until C erred on three consecutive trials for the same span, or successfully completed a 7-digit span. The highest successful digit span was recorded as the final score. Eight children (four 4-year-olds, two 7-year-olds, and two 8-year-olds) did not complete this task and thus had missing data.

In the backward digit span, C was introduced to a cartoon bear on-screen named Barry. C was told that whatever E said, "Barry likes to say it backwards" and was shown an example of Barry repeating E's numbers ("1, 2") backwards ("2, 1"). C was then told to "talk like Barry" (e.g., respond "2, 1" when E said "1, 2"). E then read a series of new numbers and increased the span of numbers by one digit when C correctly recited the numbers in reverse order. This was

continued until C erred on three consecutive trials in the same span or successfully completed a 7-digit span. The highest successful digit span was recorded as the final score (a score of 1 was assigned when the child could not recite two digits backwards; Carlson, 2005). Sixteen children (eight 4-year-olds, two 5-year-olds, one 7-year-old, three 8-year-olds, and two 9-year-olds) did not correctly recite the practice trial ("2, 1") or complete the backward digit span and so had missing data for this task.

Verbal Fluency (Snyder & Munakata, 2010, 2013). This task was used to measure children's activation of abstract goal representations (Barker et al., 2014; Munakata et al., 2012). C was asked to generate as many words as possible in one minute in response to a categorical prompt (e.g., "food"). Maximal performance on this task required clustering semantically related words into subcategories (e.g., "desserts") and detecting the need to switch to another subcategory (e.g., naming "vegetables" when they cannot think of more desserts; Snyder & Munakata, 2013). This strategy is taken to reflect the activation of abstract representations (in this case, subcategories) to support performance. Because maintaining abstract representations may support internally driven goals (Munakata et al., 2012), our interest in this task was thus not the total number of items children generated but, rather, their degree of subcategory switching. C was given one practice category ("colours") and two experimental categories in counterbalanced order ("food" and "animals"). Data from the experimental trials were coded to identify semantically-related clusters of words (e.g., "cookies, cake, ice cream" when listing foods). These clusters were given a weighted score based on the number of words within the cluster, such that 1 point was given to a cluster of two words, 2 points for a cluster of three words, and so on (Barker et al., 2014). The total number of points was summed then averaged across experimental trials to yield a final "subcategory switch" score. A second, independent rater

coded clusters for 25% of the data and an intraclass correlation coefficient (ICC) was calculated using SPSS v.29 based on a mean-rating (k=2), absolute agreement, 2-way mixed-effects model. The ICC showed excellent reliability (.952) with the 95% confidence interval ranging from good to excellent (.868 to .979). We had missing data for one 4-year-old who did not complete this task.

Prospective Memory Recall

Following the EF tasks, the recall phase of the prospective memory task was administered by E telling C they were at the "end of all our games". E paused for 5 s to allow C to remind them about the "special surprise." If C did so, they received a prospective memory score of 2. If not, E prompted with "Is there anything you had to remind me of?". If C mentioned the surprise in response to this prompt, they received a score of 1; otherwise, they received a score of 0. One child was not given the prospective memory recall question due to restlessness and another child's sibling answered the recall question for the child; accordingly, these two children had missing data for this task. Regardless of performance, all children were rewarded with the special surprise (watching a funny animal video).

Data Statement

The methods and analyses for this study were preregistered on the Open Science Framework (OSF) at https://osf.io/u3t8p/?view_only=08eec60221c04270b94d3a64d4475887, where our stimuli, task protocols, and all data can also be found. Data were analyzed using SPSS, v.29.0.1.0. Our study was approved by the University of Ottawa Health Sciences and Science Research Ethics Board under the project "Do young children spontaneously think about the future?" (H-02-21-6649).

Results

Preliminary Analyses

Spontaneous Score

Recall that this score reflects whether children spontaneously retrieved (or mentioned) a spoon during E's second phone call. Chi-square tests of homogeneity (2-sided) determined that children's spontaneous score did not significantly differ by sex ($p = .375$, $V = .077$), the colour order of the babies ($p = .724$, $V = .069$), or proximity to the kitchen ($p = .645$, $V = .081$). As well, a Fisher's exact test revealed no association between spontaneous score and whether parents reported their child to be comfortable getting a spoon, $p = .279$, $OR = .350$. Of the 18 children who did not retrieve a toothbrush during the first phone call, eight of them spontaneously retrieved the spoon. This suggests no association between whether children initially got a toothbrush (and hence felt comfortable retrieving an item in their homes) and their spontaneous performance. This was confirmed by a chi-square test of association, $p = .435$, $V = .067$. Two of the four children who retrieved a spoon during the first meeting with the babies (despite being told they should not leave the babies "alone") retrieved the spoon spontaneously during the second phone call. This also suggests no association between whether children got the spoon during the first meeting with the babies and their spontaneous score, and was confirmed by a Fisher's exact test, $p = 1.00$, $OR = .884$.

Prompt Score

The prompt score (range = 0-3; see Table 1) reflects the level of prompting children required to mention or retrieve a spoon. Only children who did not behave spontaneously ($n = 63$; 47%) were assigned a prompt score. A Mann-Whitney U test determined that children's prompt score did not significantly differ by sex, $p = .357$, $\eta^2 = .01$. A Kruskal-Wallis test further

determined that children's prompt score did not significantly differ by the colour order of the babies, $p = .619$, $\eta^2_H = -.014$. Finally, a Fisher-Freeman-Halton exact test revealed no association between item-choice performance and item location on screen for children who received the item-choice, $p = .650$, $V = .429$.

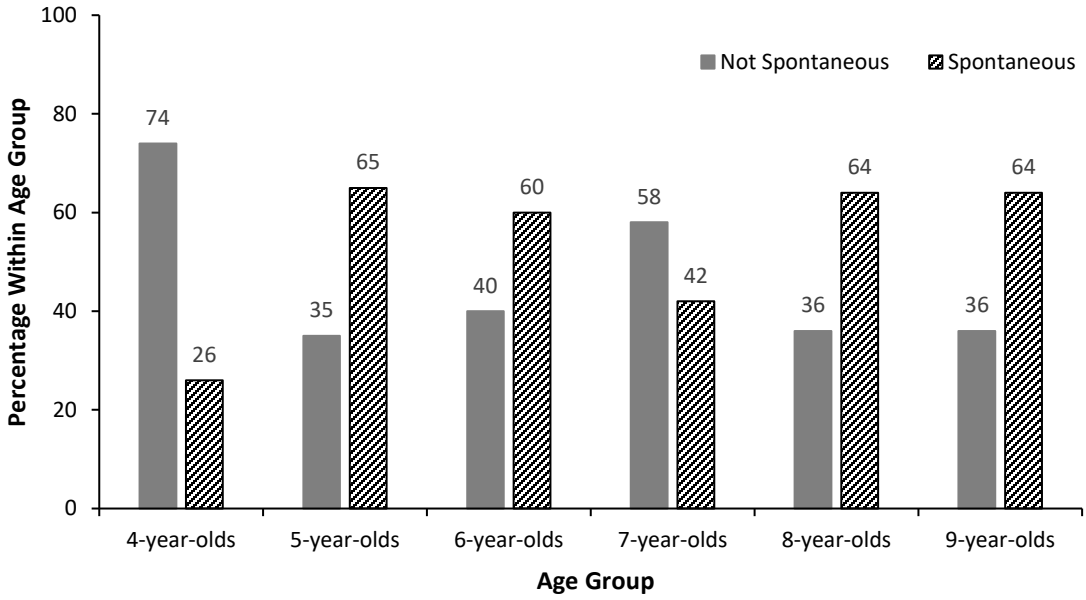
Main Analyses

Spontaneous Score

Seventy-one children (53%) behaved spontaneously. Of these, 63 retrieved a spoon and eight mentioned "spoon" but did not retrieve it. A Kendall's tau-b correlation showed that age in months and spontaneous score were positively correlated, $\tau_b = .220$, $p = .001$, $r^2 = .115$, suggesting that, with age, children were more likely to behave spontaneously. Moreover, a chi-square test of homogeneity (2-sided) indicated that spontaneous score differed significantly across age in years, $\chi^2(5) = 11.695$, $p = .039$, $V = .295$; despite this, none of the follow-up pairwise comparisons using the z-test of two proportions with a Bonferroni correction ($p = .003$) were significant. Nonetheless, whereas most 4-year-olds (74%) did not behave spontaneously, all other age groups, except 7-year-olds (who behaved spontaneously only 42% of the time) did (see Figure 2).

Figure 2

Percentage of Children Who Were "Spontaneous" Across Age in Years



Prompt Score

Sixty-three children (47%) did not behave spontaneously and were subsequently prompted to retrieve a spoon. A Spearman rank-order correlation revealed a significant positive correlation between age in months and prompt score, $r_s(61) = .501$, $p < .001$, suggesting that, with age, children required less prompting. A Kruskal-Wallis *H* test further showed that the distribution of prompt scores significantly differed by age in years, $\chi^2(5) = 21.405$, $p < .001$, $\eta^2_H = .29$ (see Table 2). Pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction (p=.003) for multiple comparisons. This post hoc analysis revealed that the distribution of 4-year-olds' prompt scores differed significantly from those of 7-, and 8-year-olds (ps < .001). Performance between 4-year-olds and 6-year-olds also neared significance (p=.005). No other pairwise comparisons were significant.

Table 2

Distribution of Children's Prompt Scores Across Age

Prompt Score	Age in Years					
	4	**5**	**6**	**7**	**8**	**9**
3	3	3	6	11	8	4
2	4	3	1	0	0	4
1	1	0	0	1	0	0
0	9	2	1	2	0	0
Total	17	8	8	14	8	8

Note. This score was only assigned to children who did not behave spontaneously (n=63). Prompts were administered (beginning with the general prompt) until C retrieved/mentioned a spoon, or until all prompts were administered (the higher the score, the less prompting required).

Cognitive Correlates

A series of Pearson correlations (2-tailed) revealed that age in months significantly correlated with forward digit span, $r(124) = .559$, $p < .001$, backward digit span, $r(116) = .592$, $p < .001$, and verbal fluency subcategory switch score, $r(131) = .683$, $p < .001$. Furthermore, a Spearman rank-order correlation revealed a significant positive correlation between age in months and prospective memory score, $r_s(130) = .195$, $p = .026$. Age in months was thus used as a control variable when examining the potential relation between our exploratory correlates, and children's spontaneous and prompt scores.

Pearson correlations (2-tailed) controlling for age in months revealed that children's spontaneous score did not correlate with forward digit span ($p = .289$), backward digit span ($p = .906$), nor verbal fluency ($p = .541$) performance, but did significantly correlate to performance

on the prospective memory task, $r_{partial}(129) = .234$, $p = .007$. A series of Pearson correlations (2-tailed) controlling for age in months also revealed a significant positive correlation between prompt score and backward digit span, $r_{partial}(51) = .373$, $p = .006$, but not with forward digit span ($p = .175$), verbal fluency ($p = .178$), nor prospective memory ($p = .450$) performance. Table 3 shows the correlation coefficients for all study variables.

Table 3

Partial Correlations (Controlling for Age in Months) Between All Study Variables

Variable	*n*	*M*	*SD*	1	2	3	4	5	6
1. Spontaneous Score	134	.53	.50	-					
2. Prompt Score	63	2.08	1.22	-	-				
3. Forward Digit Span	126	5.32	1.13	.096	.181	-			
4. Backward Digit Span	118	3.48	1.11	.011	.373**	.302***	-		
5. Verbal Fluency Switch Score	133	6.09	3.15	-.054	.173	.258**	.151	-	
6. Prospective Memory	132	1.55	.670	.234**	.098	.063	-.135	.037	-

*$p < .05$. **$p < .01$. ***$p < .001$

Children's Future Thinking Questionnaire (CFTQ)

A series of Pearson correlations revealed that all three subscales of the CFTQ (Planning, Episodic Foresight, Prospective Memory) correlated with one another (all ps $< .001$). Age in months also correlated significantly with the Planning subscale, $r(121) = .202$, $p = .025$, and the Episodic Future Thinking subscale, $r(121) = .246$, $p = .006$, but not with the Prospective Memory subscale ($p = .359$). Controlling for age in months, a series of Pearson correlations

showed that children's spontaneous score did not correlate to Planning (p = .847), Episodic Future Thinking (p = .323), nor Prospective Memory (p = .905). Somewhat surprisingly, however, children's Prompt Score was negatively correlated to Prospective Memory (when controlling for age in months), $r_{partial}(55) = -.273$, p = .040, but not to Planning (p = .916) nor Episodic Future Thinking (p = .420). Interestingly, a Spearman's correlation showed the CFTQ Prospective Memory subscale did not significantly correlate to children's performance on the prospective memory task (p = .786).

Discussion

Simulating the future is most advantageous when these thoughts promote behaviours that satisfy future needs (Addis et al., 2007; Suddendorf & Busby, 2005). Indeed, the first evidence of human foresight is arguably found in the stone tools that were kept and transported for repeated use (Suddendorf & Corballis, 2007). Despite this, existing developmental EFT tasks (most notably Spoon tasks) *initiate* children's future-oriented behaviours through prompts, precluding children engaging such behaviours independently. As such, children's future-oriented behaviours may occur in the absence of underlying future-oriented representations. Because our novel task measures the capacity to *spontaneously* engage in a future-oriented behaviour (i.e., item retrieval), we argue that it is predicated on children's thought about the future.

Spontaneous Action Task Performance

As hypothesized, most 4-year-olds did not act spontaneously (74%), suggesting they required scaffolding from experimenter prompts to succeed. Comparatively, most 5-year-olds (65%) behaved spontaneously, and their rate of spontaneous performance did not significantly differ from that of older age groups. These findings suggest a developmental transition between 4 and 5 years from reliance on prompting to spontaneous future-oriented behaviour. This

contrasts with our hypothesis that this transition would occur around 6 to 7 years, based in part on developmental findings for children's spontaneous practicing and information seeking (Brinums et al., 2018; 2021).

It is possible that the development of spontaneous future-oriented behaviour is domain specific. Munakata and colleagues (2012) argue that the shift from reactive to proactive control is task dependent and may thus vary from infancy to post-adolescence. Item retrieval/preparation is more frequently modelled in children's daily lives than practice or information seeking. Indeed, there are many everyday opportunities for item preparation (e.g., bringing bags to the grocery store or a toy for a play date) whereas practicing and information seeking may be enacted outside of the home (e.g., practicing at the gym or soccer field) or covertly (e.g., on the computer). Thus, children may be more familiar with spontaneous item retrieval which is reflected by its earlier emergence in an experimental context. It may also be that children in our study felt more comfortable engaging in spontaneous behaviour in their own homes compared to an unfamiliar laboratory setting (Pham et al., 2024). Indeed, a recent naturalistic investigation showed that even 3-year-olds demonstrated spontaneous future-oriented behaviour outside the laboratory (Ayson & Atance, 2024).

Yet, by this same argument, one might have expected 8- and 9-year-olds in our study to reach ceiling performance on our task, which they did not – nor did they outperform 5-year-olds. Although it may be that the development of spontaneous behaviour is protracted, perhaps a likelier explanation is that our task was not developmentally appropriate for the older children in our sample. We intentionally tested a broad age range based on our predictions about when spontaneous behaviour would emerge. However, older children may have lacked motivation to retrieve the spoon during the phone call (perhaps knowing this was all a "game" or prioritizing

something else during this time). Importantly, however, most 6- to 9-year-olds who did not behave spontaneously mentioned the spoon immediately after the general prompt which could indicate that they already "knew" a spoon was needed.

Although we have thus far focused on the possibility that children pass traditional Spoon tasks based on association and/or prompting, some researchers have also questioned whether these tasks may be passed based purely on memory (Atance & Sommerville, 2014). One may thus wonder whether this same criticism applies to our task. We think not, because children could not simply "recast" their memory of the babies to pass our task. Although memory of the babies (and, more specifically, one baby needing a spoon) was necessary, it was not sufficient. Rather, children needed to identify and *initiate* a behaviour (i.e., retrieve the spoon) in anticipation of the upcoming event. Our data also support this claim given that the majority (73%) of children who did not behave spontaneously nonetheless "remembered" they needed a spoon, given that they succeeded on our task after prompting.

Cognitive Correlates

Our exploratory correlates related differently to spontaneous versus prompted performance, suggesting different underlying cognitive mechanisms.

Spontaneous Performance

Spontaneous performance positively correlated with our prospective memory task, suggesting shared cognitive mechanisms across the two. A common feature to both tasks is intention setting. In our prospective memory task, the experimenter set an intention for the child to remind them of the special surprise at the end of their games. Similarly, children who behaved spontaneously in our Spontaneous Action task likely set an intention to retrieve a spoon upon hearing they would meet the babies again and seeing E leave for the phone call. It is possible that

spontaneous children even formed implementation intentions (e.g., "While E is on the phone, I will get a spoon."). Our task encourages such thinking by telling children to "do whatever you want" while E is gone. Implementation intentions ("*When X occurs, I will do Y"*) boost the likelihood of a successful intention (Gollwitzer & Brandstätter, 1997) and improve prospective memory task performance (Chen et al., 2015, 2014). Moreover, executive functioning may not be needed when implementation intentions are used. Studies have found that implementation intentions improve PM recall and sensitivity to cues even when individuals have impaired executive abilities (Brom & Kliegel, 2014; Grilli & McFarland, 2011; Kardiasmenos et al., 2008; McFarland & Glisky, 2011). This may be why neither spontaneous nor prospective memory performance correlated to our executive functioning tasks.

Another shared feature of our spontaneous action and prospective memory tasks is motivation to get the special surprise. Indeed, the goals of both tasks were intertwined: to receive a special surprise, the child needed to soothe the babies *and* remind the experimenter of the special surprise. As we noted earlier, lack of motivation, rather than lack of foresight, may explain why 8- and 9-year-olds did not reach ceiling performance on the spontaneous action task. Eight- and 9-year-olds also did not reach ceiling performance on the prospective memory task [$M = 1.59$ ($SD = .590$) and $M = 1.68$ ($SD = .477$), respectively], which further suggests they lacked motivation to obtain the special surprise. In sum, key underlying mechanisms for spontaneous performance may not be executive function, but rather, intention-setting and motivation.

Prompted Performance

Prompted performance on the Spontaneous Action task correlated with backward (but not forward) digit span, suggesting the inhibitory control required in backward digit span may have

driven this correlation. Children in our task were only prompted if they did not spontaneously retrieve a spoon. It may be that these children did not realize there was a future "problem" which required action. One possibility is that, in response to a prompt (e.g., "What would be a good thing to get for the crying babies?"), children were problem solving and initiating inhibitory mechanisms to determine the "correct" answer (Swanson, 2006). This would be different from spontaneously engaging in future-oriented behaviour.

Prompted performance on our Spontaneous Action task did not correlate with our prospective memory task but, surprisingly, was *negatively* correlated with the prospective memory subscale on the CFTQ. Consistent with the former finding, Mazachowsky and Mahy (2020) also failed to detect a correlation between the (CFTQ) prospective memory subscale and children's performance on a prospective memory task. Yet, it is unclear why children's everyday prospective memory (as reported by their parents) would negatively correlate with their prompted performance on our task. Future studies in this area may want to further explore links between children's future thinking in the laboratory and in the home.

Limitations and Future Directions

We next highlight some of the limitations of our new paradigm with an eye to how these may inform future efforts to explore children's spontaneous future-oriented behaviour. First, we tested children remotely from their own homes due to COVID-19 restrictions at the time of data collection and, as a result, there was considerable variability between children's testing environments. While we strove to ensure children were not cued to the solution (i.e., in a room outside the kitchen with no spoons), it is possible that relevant cues were in the room without our knowledge. Moreover, children were sometimes tested with distracting toys or family members around them. The appeal of these distractions may have overridden children's goal

representation, leading them to play during the phone call instead of spontaneously retrieving the spoon. Although we advocate for the development of more controlled laboratory-based measures of children's spontaneous behaviour, it is important to note that children must learn to engage in future-oriented behaviours despite distracting and stimulating environments. Thus, the requirement to override distractions in their home suggests our study may in fact have taken place in a highly ecologically valid setting.

Another limitation to our study may be that telling children they would re-encounter the crying babies cued them to prepare. However, knowing about a future event does not necessarily mean that children will spontaneously prepare for it, as our data reflects. Nonetheless, one of the most challenging aspects of such tasks - and of measuring future thinking more broadly - is ensuring that children know they will be encountering a future event so that they are motivated to prepare. Future versions of our task, particularly those administered in person in a laboratory-based setting, may work around this by "training" children to move back and forth between two rooms, thus allowing them to independently anticipate returning to the event (Pham et al., 2024).

A third limitation of our study is that, due to online testing, we did not move children to a different room during their opportunity to prepare for the problem event, as is typically the case in Spoon tasks (e.g., Atance et al., 2015; Suddendorf et al., 2011). It could be argued that, because children remained in the same room, they were exposed to the same spatial cues as when they experienced the problem, which may have allowed them to rely on associative or non-episodic strategies. We did, however, temporally displace children by reading two storybooks (approximately 8 minutes). Moreover, in a previous Spoon task where spatial and temporal displacement were isolated (Suddendorf at al., 2011), temporal displacement had a significant

impact on performance, while spatial displacement did not. This suggests that temporal displacement is the more stringent criterion in these kinds of tasks.

Finally, our sample lacks diversity, consisting of predominantly White, university-educated families. It is important to extend this research to a broader demographic so that findings are more generalizable. Individual differences related to children's family structure and home life should also be considered. Notably, one parent mentioned that she was not surprised her child did not act spontaneously because typically "everything is done for him." Thus, a child's lived experience may play a pivotal role in the development of their spontaneous future-oriented behaviour.

Conclusion

Thinking about future events allows us to "try out" different possible outcomes to anticipate future needs (Schacter et al., 2008). Beyond simply thinking about the future, it is important to functionally engage these thoughts to enact appropriate "future-oriented" action. Acting spontaneously and proactively with the future in mind is critical to children's developing autonomy (Atance et al., 2023; Munakata et al., 2012; Schreiber et al., 2024). The present study provides a first step into investigating the development of the capacity to prepare spontaneously. Our novel methodology and findings can be used as a springboard for future research in this area.

References

Anderson, F. T., & McDaniel, M. A. (2019). Hey buddy, why don't we take it outside: An experience sampling study of prospective memory. *Memory & Cognition*, *47*(1), 47–62. https://doi.org/10.3758/s13421-018-0849-x

Atance, C. M., Ayson, G., & Martin-Ordas, G. (2023). Moving beyond "Spoon" tasks: When do children autocue their episodic future thought? *WIREs Cognitive Science*, *14*(4), e1646. https://doi.org/10.1002/wcs.1646

Atance, C. M., Celebi, S. N., Mitchinson, S., & Mahy, C. E. V. (2019). Thinking about the future: Comparing children's forced-choice versus "generative" responses in the "spoon test." *Journal of Experimental Child Psychology*, *181*, 1–16. https://doi.org/10.1016/j.jecp.2018.12.006

Atance, C. M., Louw, A., & Clayton, N. S. (2015). Thinking ahead about where something is needed: New insights about episodic foresight in preschoolers. *Journal of Experimental Child Psychology*, *129*, 98–109. https://doi.org/10.1016/j.jecp.2014.09.001

Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences*, *5*(12), 533–539. https://doi.org/10.1016/S1364-6613(00)01804-0

Atance, C. M., & Sommerville, J. A. (2014). Assessing the role of memory in preschoolers' performance on episodic foresight tasks. *Memory*, *22*(1), 118–128. https://doi.org/10.1080/09658211.2013.820324

Ayson, G., & Atance, C. M. (2024). Children's mental time travel into the future: A functional perspective. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *379*(1913), 20230399. https://doi.org/10.1098/rstb.2023.0399

Barker, J. E., Semenov, A. D., Michaelson, L., Provan, L. S., Snyder, H. R., & Munakata, Y. (2014). Less-structured time in children's daily lives predicts self-directed executive functioning. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.00593

Barsics, C., Van Der Linden, M., & D'Argembeau, A. (2016). Frequency, characteristics, and perceived functions of emotional future thinking in daily life. *Quarterly Journal of Experimental Psychology*, *69*(2), 217–233. https://doi.org/10.1080/17470218.2015.1051560

Baumeister, R. F., Hofmann, W., Summerville, A., Reiss, P. T., & Vohs, K. D. (2020). Everyday Thoughts in Time: Experience Sampling Studies of Mental Time Travel. *Personality and Social Psychology Bulletin*, *46*(12), 1631–1648. https://doi.org/doi.org/10.1177/014616722090841

Baumeister, R. F., Vohs, K. D., & Oettingen, G. (2016). Pragmatic Prospection: How and Why People Think about the Future. *Review of General Psychology*, *20*(1), 3–16. https://doi.org/10.1037/gpr0000060

Brinums, M., Imuta, K., & Suddendorf, T. (2018). Practicing for the Future: Deliberate Practice in Early Childhood. *Child Development*, *89*(6), 2051–2058. https://doi.org/10.1111/cdev.12938

Brinums, M., Redshaw, J., Nielsen, M., Suddendorf, T., & Imuta, K. (2021). Young children's capacity to seek information in preparation for a future event. *Cognitive Development*, *58*, 101015. https://doi.org/10.1016/j.cogdev.2021.101015

Brom, S. S., & Kliegel, M. (2014). Improving everyday prospective memory performance in older adults: Comparing cognitive process and strategy training. *Psychology and Aging*, *29*(3), 744–755. https://doi.org/10.1037/a0037181

Cameron, P. (1972). The Generation Gap: Time Orientation. *The Gerontologist*, *12*(2 Part 1), 117–119. https://doi.org/10.1093/geront/12.2_Part_1.117

Carlson, S. M. (2005). Developmentally Sensitive Measures of Executive Function in Preschool Children. *Developmental Neuropsychology*, *28*(2), 595–616. https://doi.org/10.1207/s15326942dn2802_3

Chen, X., Wang, Y., Liu, L., Cui, J., Gan, M., Shum, D. H. K., & Chan, R. C. K. (2015). The effect of implementation intention on prospective memory: A systematic and meta-analytic review. *Psychiatry Research*, *226*(1), 14–22. https://doi.org/10.1016/j.psychres.2015.01.011

Chen, X.-J., Wang, Y., Liu, L.-L., Shi, H.-S., Wang, J., Cui, J.-F., Shum, D. H. K., & Chan, R. C. K. (2014). The effect and mechanisms of implementation intentions on prospective memory in individuals with and without schizotypal personality features. *Memory (Hove, England)*, *22*(4), 349–359. https://doi.org/10.1080/09658211.2013.792841

D'Argembeau, A., Renaud, O., & Van der Linden, M. (2011). Frequency, characteristics and functions of future-oriented thoughts in daily life. *Applied Cognitive Psychology*, *25*(1), 96–103. https://doi.org/10.1002/acp.1647

Dickerson, K. L., Ainge, J. A., & Seed, A. M. (2018). The Role of Association in Pre-schoolers' Solutions to "Spoon Tests" of Future Planning. *Current Biology*, *28*(14), 2309-2313.e2. https://doi.org/10.1016/j.cub.2018.05.052

Duffy, J., & Cole, S. N. (2021). Functions of spontaneous and voluntary future thinking: Evidence from subjective ratings. *Psychological Research*, *85*(4), 1583–1601. https://doi.org/10.1007/s00426-020-01338-9

Dunn, O. J. (1964). Multiple Comparisons Using Rank Sums. *Technometrics*, *6*(3), 241–252. https://doi.org/10.1080/00401706.1964.10490181

Faul, F., Erdfelder, E., Buchner, A., & Lang, A.G. (2009). Statistical power analyses using G*Power 3.1: Tests for correlation and regression analyses. *Behavior Research Methods*, *41*(4), 1149–1160. https://doi.org/10.3758/BRM.41.4.1149

Gerlach, K. D., Spreng, R. N., Gilmore, A. W., & Schacter, D. L. (2011). Solving future problems: Default network and executive activity associated with goal-directed mental simulations. *NeuroImage*, *55*(4), 1816–1824. https://doi.org/10.1016/j.neuroimage.2011.01.030

Gollwitzer, P. M., & Brandstätter, V. (1997). Implementation Intentions and Effective Goal Pursuit. *Journal of Personality and Social Psychology*, *73*(1), 186–199. https://doi.org/10.1037/0022-3514.73.1.186

Gott, C., & Lah, S. (2014). Episodic future thinking in children compared to adolescents. *Child Neuropsychology*, *20*(5), 625–640. https://doi.org/10.1080/09297049.2013.840362

Grilli, M. D., & McFarland, C. P. (2011). Imagine that: Self-Imagination Improves Prospective Memory in Memory-Impaired Individuals with Neurological Damage. *Neuropsychological Rehabilitation*, *21*(6), 847–859. https://doi.org/10.1080/09602011.2011.627263

Guajardo, N. R., & Best, D. L. (2000). Do preschoolers remember what to do? Incentive and external cues in prospective memory. *Cognitive Development*, *15*(1), 75–97. https://doi.org/10.1016/S0885-2014(00)00016-2

Hallford, D. J., & D'Argembeau, A. (2022). Why We Imagine Our Future: Introducing the Functions of Future Thinking Scale (FoFTS). *Journal of Psychopathology and Behavioral Assessment*, *44*(2), 376–395. https://doi.org/10.1007/s10862-021-09910-2

Hanson, L. K., Atance, C. M., & Paluck, S. W. (2014). Is thinking about the future related to theory of mind and executive function? Not in preschoolers. *Journal of Experimental Child Psychology*, *128*, 120–137. https://doi.org/10.1016/j.jecp.2014.07.006

Kardiasmenos, K. S., Clawson, D. M., Wilken, J. A., & Wallin, M. T. (2008). Prospective memory and the efficacy of a memory strategy in multiple sclerosis. *Neuropsychology*, *22*(6), 746–754. https://doi.org/10.1037/a0013211

Kvavilashvili, L., & Rummel, J. (2020). On the Nature of Everyday Prospection: A Review and Theoretical Integration of Research on Mind-Wandering, Future Thinking, and Prospective Memory. *Review of General Psychology*, *24*(3), 210–237. https://doi.org/10.1177/1089268020918843

Mahy, C. E. V., Moses, L. J., & Kliegel, M. (2014). The development of prospective memory in children: An executive framework. *Developmental Review*, *34*(4), 305–326. https://doi.org/10.1016/j.dr.2014.08.001

Martin-Ordas, G. (2018). "First, I will get the marbles." Children's foresight abilities in a modified spoon task. *Cognitive Development*, *45*, 152–161. https://doi.org/10.1016/j.cogdev.2017.07.001

Mazachowsky, T. (2017). *The Development of the Children's Future Thinking Questionnaire: Establishing Validity and Reliability*. https://dr.library.brocku.ca/handle/10464/12931

Mazachowsky, T. R., & Mahy, C. E. V. (2020). Constructing the Children's Future Thinking Questionnaire: A reliable and valid measure of children's future-oriented cognition. *Developmental Psychology*, *56*(4), 756–772. https://doi.org/10.1037/dev0000885

McFarland, C. P., & Glisky, E. L. (2011). Implementation intentions and prospective memory among older adults: An investigation of the role of frontal lobe function. *Neuropsychology, Development, and Cognition. Section B, Aging, Neuropsychology and Cognition*, *18*(6), 633–652. https://doi.org/10.1080/13825585.2011.613449

Moffett, L., Moll, H., & FitzGibbon, L. (2018). Future planning in preschool children. *Developmental Psychology*, *54*(5), 866–874. https://doi.org/10.1037/dev0000484

Mulcahy, N. J., & Call, J. (2006). Apes Save Tools for Future Use. *Science*, *312*(5776), 1038–1040. https://doi.org/10.1126/science.1125456

Munakata, Y., Snyder, H. R., & Chatham, C. H. (2012). Developing cognitive control: Three key transitions. *Current Directions in Psychological Science*, *21*(2), 71–77. https://doi.org/10.1177/0963721412436807

Pham, Q. A., Ayson, G., Atance, C. M., & Blankenship, T. L. (2024). Measuring spontaneous episodic future thinking in children: Challenges and opportunities. *Learning & Behavior*. https://doi.org/10.3758/s13420-024-00644-1

Russell, J., Alexis, D., & Clayton, N. (2010). Episodic future thinking in 3- to 5-year-old children: The ability to think of what will be needed from a different point of view. *Cognition*, *114*(1), 56–71. https://doi.org/10.1016/j.cognition.2009.08.013

Scarf, D., Gross, J., Colombo, M., & Hayne, H. (2013). To have and to hold: Episodic memory in 3- and 4-year-old children. *Developmental Psychobiology*, *55*(2), 125–132. https://doi.org/10.1002/dev.21004

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2008). Episodic simulation of future events: Concepts, data, and applications. *Annals of the New York Academy of Sciences*, *1124*(1), 39–60. https://doi.org/10.1196/annals.1440.001

Schreiber, F., Schneider, S., Newen, A., & Voigt, B. (2024). Negative (but not positive) affective episodic future thinking enhances proactive behaviour in 5-year-old children. *Emotion*. https://doi.org/10.1037/emo0001345

Smallwood, J., Nind, L., & O'Connor, R. C. (2009). When is your head at? An exploration of the factors associated with the temporal focus of the wandering mind. *Consciousness and Cognition*, *18*(1), 118–125. https://doi.org/10.1016/j.concog.2008.11.004

Snyder, H. R., & Munakata, Y. (2010). Becoming self-directed: Abstract representations support endogenous flexibility in children. *Cognition*, *116*(2), 155–167. https://doi.org/10.1016/j.cognition.2010.04.007

Snyder, H. R., & Munakata, Y. (2013). So many options, so little control: Abstract representations can reduce selection demands to increase children's self-directed flexibility. *Journal of Experimental Child Psychology*, *116*(3), 659–673. https://doi.org/10.1016/j.jecp.2013.07.010

Suddendorf, T. (1994). Discovery of the fourth dimension: mental time travel and human evolution. University of Waikato, Hamilton, NZ. See http://cogprints.org/729/.

Suddendorf, T. (2017). The Emergence of Episodic Foresight and Its Consequences. *Child Development Perspectives*, *11*(3), 191–195. https://doi.org/10.1111/cdep.12233

Suddendorf, T., & Busby, J. (2005). Making decisions with the future in mind: Developmental and comparative identification of mental time travel. *Learning and Motivation*, *36*, 110–125. https://doi.org/10.1016/j.lmot.2005.02.010

Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, *30*(3), 299–313. https://doi.org/10.1017/S0140525X07001975

Suddendorf, T., Nielsen, M., & von Gehlen, R. (2011). Children's capacity to remember a novel problem and to secure its future solution: Future solutions of novel problems. *Developmental Science*, *14*(1), 26–33. https://doi.org/10.1111/j.1467-7687.2010.00950.x

Swanson, H. L. (2006). Cross-sectional and incremental changes in working memory and mathematical problem solving. *Journal of Educational Psychology*, *98*(2), 265–281. https://doi.org/10.1037/0022-0663.98.2.265

Troller-Renfree, S. V., Buzzell, G. A., & Fox, N. A. (2020). Changes in working memory influence the transition from reactive to proactive cognitive control during childhood. *Developmental Science*, *23*(6), e12959. https://doi.org/10.1111/desc.12959

Tulving, E. (1983). *Elements of Episodic Memory*. Oxford University Press.

Tulving, E. (2005). Episodic memory and autonoesis: Uniquely human? In H. S. Terrace & J. Metcalfe, *The missing link in cognition: Origins of self-reflective consciousness* (pp. 3–56). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195161564.001.0001

Zhai, S., Cheng, S., Moskowitz, N., Shen, M., & Gao, T. (2024). The development of commitment: Attention for intention. *Child Development*, *95*(1), 7–15. https://doi.org/10.1111/cdev.13955

Chapter 3: Children's Mental Time Travel Into the Future: A Functional Perspective

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An unpublished Appendix is included to help the committee better evaluate the research.

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Data accessibility. All data and accompanying information have been uploaded into OSF: https://osf.io/a2s6v/?view_only=c7354463b5f444d2bad12a6ab08416bc

Abstract

Children's episodic future thinking is typically assessed using experimental tasks that measure whether children select an item with future utility. Although these tasks – inspired by Tulving's (2005) seminal "Spoon test" – are passed around age 4, they tell us little about the functional significance of children's episodic future thinking in their day-to-day lives. We highlight how a naturalistic approach can shed light on this issue and present a small study where we recruited mothers to report on their children's (N = 12, 3- and 4-year-olds and 6- and 7-year-olds) future thinking over a 7-day period. We used thematic analysis to understand why children express future thoughts and derived the following themes: (1) expressing future desires and/or intentions, (2) future-oriented information-seeking, (3) connecting present actions with future outcomes, and (4) predicting future mental/physiological states. We compare these themes with recent accounts of the functional significance of future thinking in adults and conclude that children largely express their future thinking verbally to request information or support from their parent – likely because they do not yet possess enough control/autonomy to independently act for their own future. Our findings both complement and extend an experimental approach and further elucidate the functional significance of mental time travel in children.

Keywords: mental time travel, future thinking, cognitive development, naturalistic approach

Children's Mental Time Travel into the Future: A Functional Perspective

People think about the future daily and these thoughts affect how they feel and behave in the present. Episodic future thinking, in particular, involves mentally projecting the self forward in time to pre-experience personal events (Atance & O'Neill, 2001). A proposed taxonomy of episodic future thinking suggests four modes: simulation, prediction, intention, and planning (Szpunar et al., 2014). Moving through these modes may bring an individual closer to engaging in behaviour with the future in mind. For example, I can *simulate* spending time outdoors on my vacation in Portugal which leads me to *predict* being in rainy weather based on the time of year. In response to this prediction, I *intend* to pack appropriate clothing for my trip and, when packing, I *plan* for the rainy weather by packing my raincoat and rainboots in my suitcase. Planning is often necessary when carrying out intended behaviours because it involves converting a goal into "actionable" steps (Szpunar et al., 2014). Indeed, contemplating future events is argued to be adaptive precisely because it allows us to take action *now* to address possible futures (Atance et al., 2023; Barsics et al., 2016; Hallford & D'Argembeau, 2022; Suddendorf, 2017). My thought about about my upcoming vacation to Portugal is expressed through a concrete action that helps prepare me for what lies ahead (i.e., packing raingear in my suitcase). Of course, adults also "express" their future thoughts through language and conversation. For example, I may tell my friend about my upcoming vacation and she, in turn, gives me tips on travelling efficiently.

Our thoughts about the future, including those reflected in our actions and talk, serve numerous functions in our daily lives. For example, packing my suitcase for Portugal highlights what has been termed a "directive" function of future thinking that supports goal-pursuit, problem-solving, planning, and decision-making (Barsics et al., 2016; D'Argembeau et al., 2011;

Duffy & Cole, 2021; Hallford & D'Argembeau, 2022). Thinking about the future can also serve an "emotion regulation" function; specifically, thinking about positive future events (e.g., my upcoming vacation) can upregulate positive emotion in the present (Hallford & D'Argembeau, 2022) and thinking about negative future events (e.g., getting through airport security) can prepare me for potential adverse feelings (Barsics et al., 2016). Finally, thinking about the future contributes to forming and exploring one's identity, and sharing future thoughts with others can strengthen social bonds (Duffy & Cole, 2021; Hallford & D'Argembeau, 2022). For example, discussing my trip itinerary with my friend increases our feelings of closeness. In sum, adults *express* their future thoughts in a variety of ways (i.e., language, action) and these expressions serve numerous *functions* in their daily lives. Despite the prevalence of future thinking in adults, along with its numerous pragmatic benefits (Baumeister et al., 2020), we know little about the functions of future thinking in children's daily lives. The main reason for this gap in our knowledge is that research about children's future thinking has primarily been conducted using single tasks that often *direct* the child to consider the future, rather than children, themselves, functionally engaging their future thought.

Our over-arching goal in the current paper is thus to explore both how children express future thoughts in their daily lives and the functional role these thoughts may serve. We begin by briefly describing how children's episodic future thinking has traditionally been measured by focusing on what have come to be known as "Spoon" tasks. A key argument we make is that because these tasks have exclusively been implemented in the laboratory, they cannot speak to the diverse ways and reasons children express their future thinking. To address these issues a naturalistic approach is needed, and we subsequently outline a new methodology that recruits parents to report on their children's expressions of future thinking.

Measuring Children's Episodic Future Thinking: Experimental Tasks

One of the most popular means of measuring children's episodic future thinking has been heavily inspired by Tulving's "Spoon test" (2005):

> ". . . a young girl dreams about going to a friend's birthday party where the guests are served delicious chocolate pudding, her favorite. Alas, all she can do is to watch other children eat it, because everybody has to have her own spoon, and she did not bring one. So the next evening, determined not to have the same disappointing experience again, she goes to bed clutching a spoon in her hand." (p. 44)

Because it is the girl's action of retrieving a spoon that reflects her thought about the future, Tulving argued that the "test" is particularly well suited to assess whether non-human animals and young children can think episodically about the future. Tulving's test (see also earlier proposals by Suddendorf, 1994, and Suddendorf & Busby, 2005) has been translated into experimental "Spoon", "Two-room", or "Item-choice" tasks that typically entail children encountering a "problem" in which they lack a specific item (e.g., a key to unlock a box with stickers inside). Later, in a different location, children are presented with a set of items (including a key) and are asked to select one to bring with them to the original setting. Selecting the appropriate item is taken as evidence of children's capacity to anticipate and prepare for the future event. Numerous studies have shown that, around age 4, children pass these tasks (Atance et al., 2015; Scarf et al., 2013; Suddendorf et al., 2011).

However, as we have recently argued (Atance et al., 2023), these tasks do not require children to *independently* act with the future in mind because children are prompted – in the form of an explicit test question – to perform a future-oriented action. In this sense, such tasks deviate from Tulving's proposed test in which the girl acts of her own volition, or "spontaneously," to obtain a spoon. A second more fundamental issue that we tackle in the current paper is that such tasks do not capture the breadth of functions future thinking may serve in young children's

everyday lives. Indeed, Spoon tasks are best suited to measuring the "directive" function of future thinking, leaving other functions unassessed.

The Need for a Naturalistic Complement to Experimental Tasks

There has been a recent push for more naturalistic research in developmental psychology (Dahl, 2017; Rogoff et al., 2018). For example, Dahl (2017) points out that the term "naturalistic" was used in less than 5% of studies published in seven developmental journals between 1967 and 2017. This is non-trivial given that these (and other) authors argue that, without such work, it is impossible to capture children's "lived experience"; specifically, the everyday scenarios through which they develop their cognition (Rogoff et al., 2018). We echo these sentiments and argue that an experimental approach alone will not enable us to understand the diverse ways in which children express their future thinking and the various uses to which they apply this form of thought.

For example, consider whether a 3-year-old (who may fail the Spoon task) typically uses their future thoughts in a directive manner (as do adults). It is possible that they do; for instance, this 3-year-old may be capable of episodically projecting into the future to think about an upcoming playdate with their friend and this thought might motivate them to pack a toy to bring along (i.e., directive function). Alternatively, this 3-year-old may use their future thoughts quite differently than do adults. For example, thoughts about playing with their friend could lead them to seek assistance (e.g., "Can you help me find a toy?") or information ("Is it going to rain tomorrow?") from an adult. Our goal is not to determine whether Spoon tasks assess children's capacity to think about the future (see Atance et al., 2023, for an in-depth critique); rather, our main point is that they, and other experimental measures, cannot capture how children express their future thoughts in daily life and, hence, the possible functions they serve.

Addressing these issues requires adopting a naturalistic approach in which children are observed outside of the laboratory. The advantages of such an approach are twofold. First, it can shed light on the functional significance of mental time travel from its earliest emergence (thus complementing what we know from experimental tasks). Second, it can lead to the creation of experimental tasks that better reflect the kinds of situations, motivations, and challenges children experience in their daily lives (an issue to which we return in the Discussion section). Our aim is to use this approach to provide a preliminary account of how children express their future thoughts and the functions these serve.

A Naturalistic Investigation of Children's Future Thinking

The various functions of future thinking in adults have been identified using experience sampling and self-report studies in which participants are asked to monitor and report their own naturally-occurring future thoughts and perceived functions (Barsics et al., 2016; Baumeister et al., 2020; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022). While young children have been shown to "report" on their spontaneous memories in a laboratory setting (e.g., Krøjgaard et al., 2014, 2017; Kvavilashvili & Ford, 2022), they may find it difficult to monitor (and report on) their thoughts during their highly stimulating, daily lives. Accordingly, we recruited parents of 3- and 4-year-olds and 6- and 7-year-olds to identify and report "instances" of their children's future thinking over the course of one week. We use the term "instances" to reflect both children's verbal statements about, and actions for, the future. Our methodological approach was inspired by previous naturalistic research on children's memory (Nelson & Ross, 1980) and adults' spontaneous future thinking (Berntsen & Jacobsen, 2008). To determine the feasibility of our novel methodology, we ran a small proof-of-concept study with a sample of $N = 12$ children.

We hypothesized that parents would report more instances of future thinking in older (ages 6 and 7), as compared to younger (ages 3 and 4), children given the well-documented improvements in this form of thought over early to middle childhood (see Atance & Mahy, 2016 for a review). Moreover, we predicted that the parents of older, as compared to younger, children would report more future thinking actions, reflecting children's ability to proactively use their future-oriented thoughts to inform and direct their behaviour (Atance et al., 2023). Although we made no specific hypotheses about the potential functions of children's future thinking, we nonetheless expected that, as with adults, at least some of the instances reported by parents would reflect a "directive" function.

Methods

Participants

We recruited eleven English-speaking families from the University of Ottawa developmental laboratories database. All consenting parents were mothers. Mothers with more than one eligible child were given the option of tracking them and three agreed to track two of their children simultaneously. One mother was subsequently removed from analysis for being unable to maintain tracking. This mother was tracking a 6-year-old and a 7-year-old. Another mother stopped tracking her 7-year-old due to an overwhelming number of instances. This resulted in a final sample of 12 children (three 3-year-olds, three 4-year-olds, four 6-year-olds, and two 7-year-olds) and 10 mothers. To examine potential age-related differences, we compared the data of our younger (3- and 4-year-olds; n=6) and older (6- and 7-year-olds; n=6) age groups.

Procedure

Introductory Meeting

Mothers met with the first author on Zoom to learn more about the study and its requirements. They were told that they needed to identify and report their child's (or children's) *future thinking statements* and *future thinking actions*. Future thinking statements were defined as verbal utterances about the future (e.g., asking the parent to pack a snack for an outing tomorrow), and need not include future-oriented temporal terms (e.g., *tomorrow*, *later*). Future thinking actions were defined as any action performed by the child that the parent believed was executed with the future in mind (e.g., setting aside a drawing to finish later). Mothers were encouraged to include all instances (even those they were unsure of) to capture a wide breadth of instances (that would later be examined by the researchers). They were instructed to only report "spontaneous" instances of future thinking; that is, instances in which their child either did or said something "on their own", rather than being told/asked to do so by someone else. At the end of the meeting, mothers decided whether they were interested in participating, and all agreed. Verbal consent was then obtained and video-recorded on Zoom, and mothers chose the dates for their tracking period.

Tracking Period

Tracking dates were scheduled between July and August 2021, and lasted one week/seven days. Our study was conducted during a time when individuals were facing institutional closures and societal changes resulting from the COVID-19 pandemic. While outdoor facility restrictions were mostly lifted in Canada at this time, we intentionally scheduled tracking dates to be during the summer when children were not in school. During the informational meeting, we asked parents if their children were engaged in any online and/or in-

person activities during their time of tracking. Only two children were engaged in virtual activities (Spanish class, taekwondo). Three children attended in-person daycare or nursery school and five children attended in-person sports or music lessons.

When mothers observed an instance of their child's future thinking (i.e., future thinking action or statement), they were instructed to write down keywords to help them remember it and where/when it occurred. Mothers decided where and how to document their keywords, with most doing so on their phones or in a notebook. These keywords were not analyzed.

Mothers were instructed to complete a questionnaire (found in Appendix A) for each future thinking action or statement that they witnessed. The questionnaire asked mothers to describe the instance and what was happening at the time (i.e., surrounding context) in as much detail as possible. Mothers were asked to report where (e.g., inside their home) and what time of day (i.e., morning, afternoon, or evening/night) the instance occurred. Mothers were encouraged to complete the questionnaires at the end of each tracking day but could ultimately do so at their convenience. However, mothers could only schedule their wrap-up meeting once they had sent their completed questionnaires to the research team.

Wrap-up Meeting

Following their tracking period, mothers scheduled a wrap-up meeting with the first author to discuss their experience. They were asked if their tracking period was a "typical" or "atypical" week for the family. Seven out of 10 mothers reported their tracking days to be "typical" and the remaining three reported atypical tracking days because of a family member being sick (n=2) or a family trip occurring while tracking (n=1). Mothers also reported what percentage of their child's future thinking they felt they "missed" while tracking. The average percentage reported across parents was 33.5% (range 5% to 65%).

Analysis

Reflexive Thematic Analysis (Braun & Clark, 2006, 2022)

A reflexive thematic analysis (TA) was conducted by the first author to identify, analyze, and interpret patterns across reported instances. The guiding research question was "Why do children express their future thinking in their daily lives?". We chose reflexive TA because it is a data-driven approach that utilizes the researcher's field knowledge to flexibly derive meaning from the data. Our methodology was guided by Braun and Clarke's (2006, 2022) six phases, described below.

Phase 1: Data Familiarization

The researcher first entered all instances into an Excel file, and read, and re-read each data point (i.e., instance) to gain familiarity with the data. General notes were also made regarding initial, surface-level patterns.

Phase 2: Data Coding

The researcher began coding by assigning descriptive or semantic codes to each data point (e.g., child asking "'Can I…?' questions", child making "'I will…' statements"). In subsequent pass-throughs, the data was re-coded incorporating a deductive or "researcher-driven" viewpoint by grouping together codes with similar latent meaning (e.g., "stating what will happen in the future", "establishing a timeline/sequence of events"). On the fourth cycle of coding, the researcher printed out the data points (and their current codes) and visually sorted them.

Phase 3: Initial Theme Generation

The researcher further grouped together codes that shared a patterned "meaning" (e.g., expressing a want or desire) related to the guiding research question. Groups were re-sorted when data points or codes could be assigned to more than one theme.

Phase 4: Theme Development and Review

Themes from phase three were then reviewed by reading each instance within each theme. The researcher used guiding questions such as "Can I identify the boundaries of this theme?", "Is the data within this theme too diverse or wide-ranging?", and "Is there enough data or evidence to support this theme?" to support the theme structure. The researcher navigated between this phase and phase three until all instances supported their assigned theme and not any other.

Phases 5 & 6: Theme Refining, Defining, Naming, and Write Up

The researcher wrote a brief definition of the finalized themes to highlight the central organizing concept, the theme's boundaries and specificities, and what the theme contributes to the overall research question. These definitions are summarized in the Results section.

Results

Total Instances

The 10 mothers (N = 12 children) reported a total of 244 instances. After extensive discussion, the authors determined that 24 of mothers' reported instances were not future-oriented and were thus excluded from analyses (e.g., a child saying "Pretend I'm 16 years old" while playing a game). An additional five instances were excluded for having been prompted by an ongoing conversation, leaving a total of 215 analyzable instances.

Mothers reported an average of 17.9 future thinking instances over the one-week tracking period (range = 4-70). One mother reported 70 valid instances, which was over three times the number reported by the other mothers. However, because this was a new methodological approach with a small sample, we opted to keep this participant in our analyses. Table 1 summarizes the distribution of valid instances across participants. The instances occurred in the home (75.4%), car (14.9%), at a public establishment (1.9%), at a grandparent's house (1.4%), or at an outdoor location outside the home (6.5%). The total number of reported instances did not differ significantly between younger (*Mdn* = 12) and older (*Mdn* = 18.5) children, $U = 27$, $z = 1.451$, $p = .180$.

Table 1

Number of Reported Instances

Age Group	Age	Reported Instances	Statements	Actions
Younger	3*	12	12	0
Younger	3*	13	12	1
Younger	3†	12	12	0
Younger	4	17	16	1
Younger	4	8	7	1
Younger	4	4	4	0
Older	6	21	21	0
Older	6†	16	14	2
Older	6	70	69	1
Older	6	6	5	1
Older	7	24	21	3
Older	7	12	11	1
Total		**215**	**204**	**11**

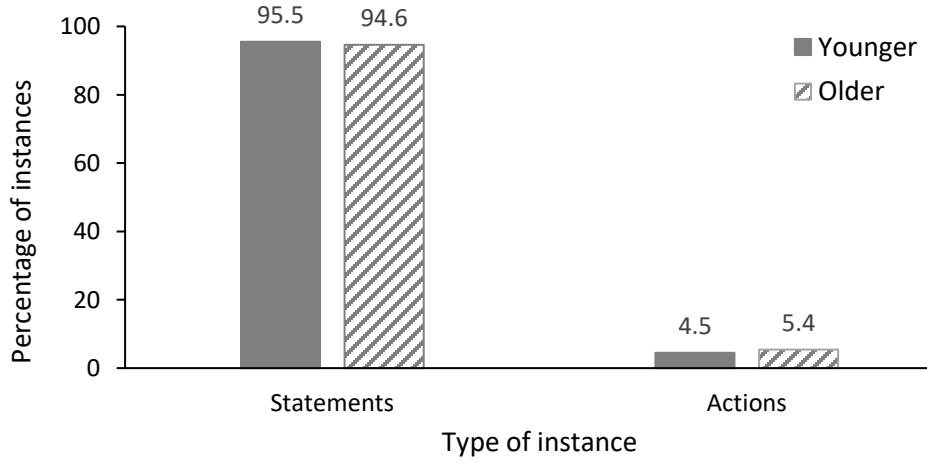
*Note. Individuals with * are siblings; individuals with † are siblings.*

A Friedman test showed that the proportion of reported instances did not significantly differ by tracking day, $\chi^2(6) = 9.455$, $p = .150$, but did significantly differ by time of day (morning, afternoon, evening/night; note, that six instances did not have a reported time of day), $\chi^2(6) = 10.978$, $p = .004$. A post-hoc analysis with a Bonferroni correction ($p = .017$) revealed a higher proportion of instances in the morning (M=.43) compared to the evening (M=.19), p = 0.005.

Whereas 94.9% of children's reported instances were statements (range = 83% - 100%), only 5.1% were actions (range = 0% - 17%). Percentage of actions and statements per age group are shown in Figure 1. Parents reported a significantly higher proportion of statements than actions, $t(11) = 24.669$, $p < .001$, and this proportion did not differ as a function of age, $t(10)$ = 1.224, $p = .249$.

Figure 1

Percentage of Statements and Actions by Age Group



Thematic Analysis (Braun & Clarke, 2006, 2022)

We derived four themes which we describe below and summarize in Table 2. Six instances (five statements and one action) were unclassified because they did not fit any theme.

Theme 1: Expressing Future Desires and/or Intentions

This theme included expressions of "want" or "desire" for something to happen in the future. This was the most prevalent theme in our data, comprising 98 instances (45.6% of all instances), all of which were statements. Specifically, this included children requesting permission to have or do something (e.g., "Next time can we make a fort?", "Can we go there when the virus is over?") and expressions of intentions (e.g., "When I'm a daddy I'm going to make s'mores the first day", "Tomorrow I will share it with you"). Instances in this theme resemble the "intention" mode of thinking in adults (Szpunar et al., 2014) in which future goals or wants are expressed. Interestingly, 52 of the 98 instances (53%) were requests for the parent to give or do something, which may reflect children's reliance on parental permission or support to fulfill their intentions.

Theme 2: Future-Oriented Information-Seeking

This theme pertained to children seeking information about what, whether, or when a future event would occur. This was the second most prevalent theme with a total of 60 instances (27.9% of all instances). All were statements, specifically questions, which were sorted into this theme on a largely semantic basis, in that they were questions about "what" "when" or "if" something would happen.

Theme 3: Connecting Present Actions to Future Outcomes

Instances in this theme demonstrated knowledge that something done now would impact the future. There were 43 instances in this theme (20% of all instances): 33 statements and 10

actions. To qualify under this theme, children's statements/actions needed to reflect a causal connection between the future and their current statement/action. Statements may also contain an intention or prediction, however, to be categorized into Theme 3, and not Themes 1 or 4, the child needed to explicitly identify a future consequence or outcome. Instances in this theme reflect the "planning" mode of future thinking (Szpunar et al., 2014) in which actionable steps in the present are identified toward a future outcome or goal. Interestingly, similar to Theme 2, a large portion of the instances in this theme (17 instances, 39.5%) were questions, requests, or reminders for the parent to act (e.g., a child asking their mom to call their friend's parent to arrange a playdate). Again, this signals children's dependence on parents to bring about a desired outcome.

Theme 4: Predicting Future Mental and Physiological States

This theme represented predictions about what the child (or somebody else) would feel like (or do) in the future. Although only eight instances (3.7% of all instances) fell into this theme, and all were statements, it was retained because of previous developmental literature on predicting future physiological and mental states (e.g., Atance & Meltzoff, 2005; Bélanger et al., 2014), and literature on the functionality of prediction in adults (i.e., "affective forecasting": Gautam et al., 2017; Gilbert et al., 2002; Suddendorf, 2017; and "prediction" as a key mode of propection: Szpunar et al., 2014). Thus, it is possible that, with a larger sample, this theme would be more prevalent.

Table 2

Summary of Themes

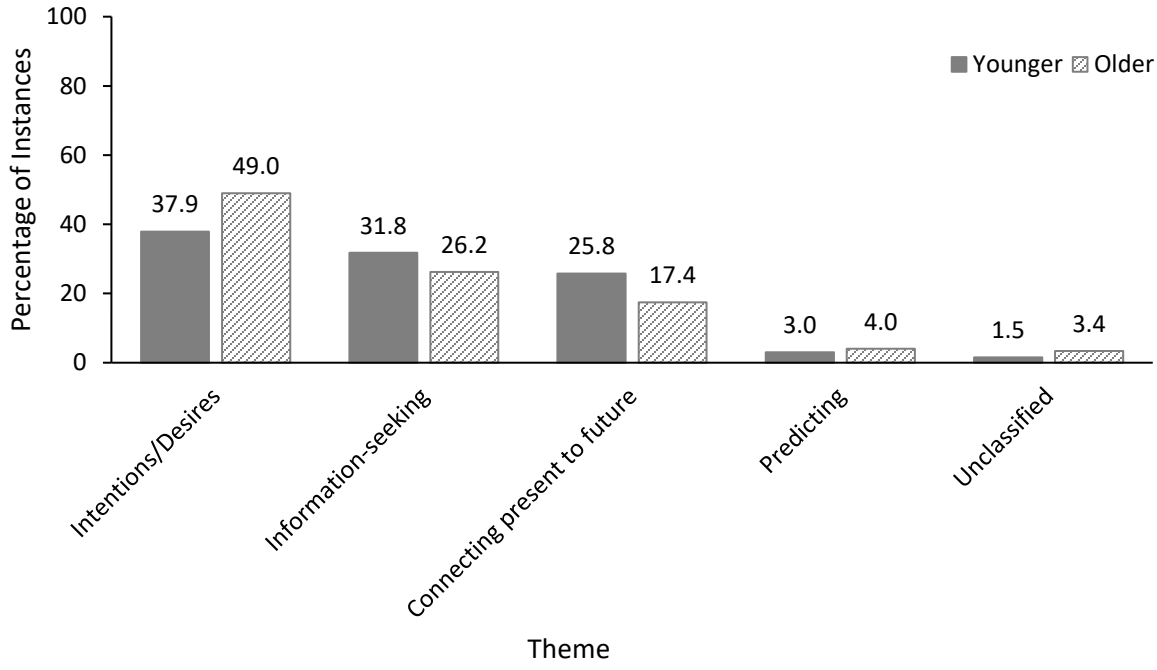
Theme	Definition	Examples from our data
Theme 1: Expressing future desires and/or intentions	Expressions of intention or "desire" for something to happen in the future	1) Child asked to call Grandma after breakfast. 2) "Next time we see a cat that doesn't have a home, can we take him?"
Theme 2: Future-oriented information-seeking	Questions about what will happen in the future or when a future event will occur	1) "Will I need braces when I'm older?" 2) "When can we go to daycare?"
Theme 3: Connecting present actions to future outcomes	Expressing (through statements or actions) knowledge that something done now will impact the future	1) Child grabbing toys for him and sister to play with in the car 2) "I don't want to go swimming today because the sun is not out and it will be too cold."
Theme 4: Predicting future mental and physiological states	Statements or questions about what the child (or somebody else) will feel like (or do) in the future	1) A child says that on her birthday she will be too excited to sleep in and will probably wake up at 6am. 2) "Won't everyone be surprised that they have to start with black when playing Go?"

A series of Mann-Whitney *U* tests revealed that the proportion of instances categorized into Theme 1, $U = 19.5$, $z = .245$, $p = .818$, Theme 2, $U = 15.5$, $z = -.402$, $p = .699$, Theme 3 $U = 16.5$, $z = -.243$, $p = .818$, and Theme 4, $U = 22$, $z = .714$, $p = .589$, did not significantly differ as a function of age group. The percentages of instances that were categorized into each theme across

age groups are shown in Figure 2.[1] Although reliability coding is not recommended in a reflexive thematic analysis – because themes are developed and not "found" in the data (Braun & Clarke, 2022) – we provided a second coder with our theme descriptions and 33% of our instances to determine whether they would classify these instances similarly into our corresponding themes. This second coder had 77% agreement with our original theme sorting, reflecting a substantial level of agreement, $\kappa = .662$, $p < .001$.

Figure 2

Percentage of Instances Across Themes for each Age Group



[1]We acknowledge a lack of independence in our data because two of our parents are represented twice in the data for tracking two children each. We ran our quantitative analysis without two of these children (one sibling from each pair: a 3-year-old and 6-year-old) and found that the loading across themes was similar.

Discussion

Children's daily experiences have received little attention in studies about their cognitive development (Rogoff et al., 2018). Research on children's future thinking is no exception as it has predominantly focused on developing structured, experimental tasks which have additional cognitive demands (e.g., language, memory, unfamiliarity) that may partly mask children's future thinking abilities. To our knowledge, this study is the first to investigate the various functions of children's future thoughts in their everyday lives. Our findings contrast with evidence from experimental tasks by showing that even 3-year-olds demonstrate sophisticated forms of future thinking in their own homes. It may be that experimental tasks underestimate children's future thinking abilities or that, in a naturalistic context, individual differences are more pronounced than age-related ones[2].

Reported Instances

On average, parents reported between two to three future thinking expressions a day. This amount is comparatively much smaller than in adults who report an average of 59 future thoughts a day (D'Argembeau et al., 2011). This difference may be both developmental and methodological. With respect to the latter, adults self-report on their own cognition, whereas our study uses a third-party observer (i.e., child's parent). Therefore, we are only obtaining instances of future thought that were expressed through the child's statements or behaviours and thus cannot be certain that the parent caught every future thinking expression their child made during the tracking period. In fact, on average, parents suspected they missed about one third of their child's future thinking while tracking. Due to these differences in methodology, comparisons between our findings and adult self-report findings should be made with caution.

[2] We thank an anonymous reviewer for making the interesting point that, in "everyday life", individual differences in future thinking may be more pronounced than age-related ones.

We found no age differences in the proportion of statements and actions that mothers reported, nor in their categorization by theme. However, these null findings should be interpreted cautiously as they could be due to our small sample size. That said, our lack of age differences is consistent with a recent diary study (Mahy et al., 2023) using a larger sample that reported no significant age differences in 2- to 6-year-olds' everyday prospective memory successes and failures. Although additional work is needed, age differences in future thinking using experimental tasks do not seem to be reflected in the naturalistic data. Alternatively, at least in our study, it is possible that mothers of younger children spent more time with them than mothers of older children which increased the number of reported instances. This could be mitigated by controlling for the number of hours the tracker spent with their child in subsequent analyses. While we asked mothers to report the number of hours they spent with their child each tracking day, we could not use this value in our analysis because some mothers wrote "all day" rather than providing a specific number.

We found that mothers reported less future thinking instances in the evening compared to the morning which is consistent with findings in adults where thoughts about the future (and the past) decrease throughout the day, while thoughts of the present increase (Baumeister et al., 2020). It may be that future thinking is optimized in the morning; perhaps getting ready for the day (e.g., picking out an outfit) primes children to think about upcoming events, whereas in the evening families may be discussing and reminiscing the day's events. It is also possible that the decrease in reported instances throughout the day is due to reporter fatigue. Mothers may tire by day's end which impacts their vigilance and, in turn, the number of instances they observe. In contrast, they may feel more energized in the morning which enables them to identify more

instances. However, mothers' reported number of instances did not significantly differ across tracking day suggesting that our methodology was feasible for them over the 7-day period.

Actions vs. Statements

Of the 244 instances analyzed, only 11 were actions. Given the small number of reported actions overall (5.1%), behavioural expressions of future thoughts may not be typical for younger nor older children. Instead, children may be more accustomed to expressing their future thinking in "words", not "action". If so, this suggests that despite behavioural measures being the favoured option in developmental research (e.g., because they do not rely on linguistic abilities; Suddendorf, 2017; Suddendorf & Busby, 2005), children, themselves, may mostly express their thoughts about the future verbally.

Notably, a prevailing way in which children expressed their future thoughts was in the form of questions and requests to their parent (135 instances; 66% of statements). This suggests that children seek their parents to validate their future predictions and carry out their intentions. Consistent with this claim, the high prevalence of Theme 1 instances ("Future-oriented information-seeking"; 27.9%), coupled with the low prevalence of Theme 4 instances ("Predicting future mental and physiological states"; 3.7%) suggests that children require information about the future before they can make predictions about it. Reliance on parental intervention may in fact "block" children from progressing their future-oriented thoughts into actionable "plans" because they are not in control, capable, and/or aware of the necessary steps required to do so (Quon & Atance, 2010). Indeed, 53% of Theme 1 instances ("Expressing future desires or intentions") were requests to the parent (e.g., "Can we go there when the virus is over?"). Furthermore, even though Theme 3 ("Connecting present actions to future outcomes")

reflects children's actionable planning, nearly half of those cases (39.5%) also required parental assistance (e.g., a child asking their parent to call a friend's mom to set up a playdate).

It is important to recognize, however, that parents may find it easier to identify (and report) statements made directly to them. Accordingly, our methodology may inflate the number of requests, and overall statements, reported. It might also be challenging for parents to detect future-oriented behaviours and statements a child makes to others because these could be done covertly and/or when their parent is not actively engaged with them. This may also be why there were few reported predictions. Children's predictions may be formulated internally and subsequently expressed as information-seeking (e.g., "Is it going to rain later?") or action-taking (e.g., packing an umbrella). Thus, a shortcoming of our methodology is that it does not capture children's potentially autonomous actions and thoughts when they are by themselves. It may be that our method particularly under-represents actions which older children, especially, might enact when a parent is not present.

Relations Between Our Themes and Adult Functions of Future Thought

Our findings allow us to compare the possible functions of future thinking in children to those proposed in adults, and that we outlined in our Introduction (Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022). We discuss each theme in the following sub-sections.

Theme 1: Expressing Future Desires and/or Intentions

Theme 1 may mirror the adult function of intention formation and goal-setting (Barsics et al., 2016; D'Argembeau et al., 2011; Hallford & D'Argembeau, 2022). It could be that children's intentions are formed and expressed in reaction to their immediate environment. For example, one 4-year-old passed an arcade in the car and stated that "when he is a daddy" he will live

beside the arcade and go there every day with his kids. This intention may not have been expressed to eventually be implemented but, rather, because the child was unable to visit the arcade in that moment. Therefore, it may be that some children express future intentions as a way of communicating their existing wants that are unattainable in the present. Statements such as the previous one may serve as a form of present-oriented emotion regulation (Duffy & Cole 2020), whereby the child is reassuring himself that he will – eventually – be able to go to the arcade.

Theme 2: Future-Oriented Information-Seeking

Theme 2 may also relate to an emotion-regulation function (Barsics et al., 2016; Duffy & Cole, 2021). Despite very few instances overall actually referring to children's present or future emotions, a possible emotion-regulation function is hinted at through the emotional valence of the events discussed by children. For example, inquiring about the occurrence of positive events (e.g., "When can we play Super Mario Brothers Wii again?") may promote positive feelings in the present (e.g., reassurance; Barsics et al., 2016). In contrast, inquiring about potentially negative events (e.g. "Will there be skeletons at the museum?") could be a way for children to prepare for adverse emotional reactions to future events (Hallford & D'Argembeau, 2022).

Importantly, information-seeking is a potential function of future thought that we believe is more unique and prevalent in children, as compared to adults. This is because adults less often need to seek information from others to confirm what will be happening in their near, or distant, futures. However, children, who do not typically set or control their own schedules, need to seek information to be able to anticipate, predict, and plan their future.

Theme 3: Connecting Present Actions to Future Outcomes

Theme 3 may reflect the directive function of future thinking that is ubiquitous in adults, whereby planning, problem-solving, and regulating behaviour are enacted in service of our future

goals (Duffy & Cole, 2021; Hallford & D'Argembeau, 2022). Interestingly, even parents of 3-year-olds reported instances in this theme, which is at odds with the argument that such "planning" develops later in development (Gerlach et al., 2011; Suddendorf, 2017).

Theme 4: Predicting Mental and Physiological States

Theme 4 may reflect the adult functions of "self-continuity" and "identity formation" (Duffy & Cole, 2021). Through their predictions of what they will feel in the future, children may also be developing their sense of identity and self-continuity. It is unclear whether the predictions reported from our sample also influence children's decision making, as they do with adults (Pilin, 2021; Wilson & Gilbert, 2005). Interestingly, this theme was minimally reflected – at least via parental report – in children's natural environment despite previous findings showing improvements in this capacity between ages 3 and 5 (e.g., Atance & Meltzoff, 2005; Bélanger et al., 2014). As we briefly discussed earlier, this may be due to predictions being generated internally and not expressed directly. Thus, it is possible that children do make predictions that inform decision-making but these are not reflected in our data as predictions (i.e., Theme 2) but instead as other themes such as taking action in the present (i.e., Theme 3). For example, a young child may have brought his toy on a long car ride – an action categorized as a Theme 3 instance – because he had made a prediction that he would be bored.

Limitations and Future Directions

Any new methodological approach has its limitations and ours is no exception. Most notably, because we have only gathered *expressions* of future thought observed by mothers, children's underlying thought processes must be inferred by the researcher via the reports provided. As such, we cannot rule out the possibility that some instances, despite being convincing to the children's mothers and the researchers, were not driven by any kind of mental

projection into the future. Due to this limitation, we can only speculate on the functional role that future thinking plays in children's daily lives. Furthermore, we refrained from developing sub-themes in our thematic analysis, due to our small sample; however, future research should investigate additional dimensions of future thought in reported instances, such as temporal distance and episodicity. It is also important to recognize that our data comes from a small sample ($N = 12$) and represents only a slice of time in children's lives (i.e., one week). Therefore our findings, particularly our quantitative analyses, should be interpreted with caution. Future naturalistic research with a larger sample and/or with a longitudinal design is necessary to continue to build on the data reported in this study.

Another important addition to our methodology would be to "train" parents to identify the potential "triggers" or cues of their children's spontaneous future thinking expressions; for example, noticing their child is using his Avengers water bottle when he asks to watch the Avengers movie when he's all grown up. Although we attempted to do so in the current study (see question 4 of the questionnaire found in Appendix A), parents in our sample did not appear to comprehend or recognize cues, even when they themselves stated one in the context description (e.g., a child asking to rent a specific movie from the library next time, while watching a movie that was rented from the library). It may be that the wording of our trigger question "Did you say or do anything…" primed parents to examine their own behaviour, rather than the environment itself, as a trigger. Moreover, parents may have assumed that triggers needed to be very specific to the child's statement (e.g., in the previous example, a cue related to the specific movie the child wanted to rent, rather than movies more broadly). Future iterations of this study should further train parents to identify environmental triggers/cues by giving them

examples and encouraging them to do a "scan of their environment" for cues relevant to what their child did and said.

Though our themes reflected three of the four proposed modes of future thinking in adults (Szpunar et al., 2014), "simulation" was notably absent. This may be because people's (including children's) simulations of the future are not often expressed and hence parents would have had difficulty identifying these. However, it is important to recognize that children's simulations may have been inherent to all our themes (Szpunar et al., 2014). Similar to our discussion on predictions, children may have simulated the future internally which subsequently led to expressions of intentions and/or plans. It is also possible that information-seeking instances in Theme 2 were expressed to lay the groundwork for simulations. For example, a child asking their parent about the upcoming day (e.g., "Will I go to daycare today?") may lead to subsequent simulation of the day's events.

Importantly, our methodology and findings can be built upon to create new experimental tasks. Through documenting children's statements, we gain insight into how children express and conceptualize the future. For example, in our sample, some children denoted temporal distance between the present and a future event by counting "how many sleeps". Some children also expressed the distant future as "when I'm a daddy/mommy". This wording is different from that used in experimental tasks to prompt distant future thinking; for example, Bélanger and colleagues' Future Preferences task (2014) describes the distant future as "when you're all grown up". Incorporating the terminology used by children in their everyday lives may thus serve to increase their understanding of various experimental tasks. Our methodology also allows for a better understanding of the contexts, motivations, and challenges that lead to children's future thinking expressions. This information can be used to inform new experimental tasks that

provide an experience that is more reflective of children's everyday lives. Finally, pairing our naturalistic approach with children's performance on experimental tasks is also a fruitful future direction. For example, do those children whose parents report instances in Theme 3 ("Connecting present actions to future outcomes") also perform well on experimental tasks designed to assess directive future thought (e.g., Spoon tasks)?

Conclusion

Naturalistic research is vital to understanding *why* children think about the future. Indeed, the developmental work in this area has leaned too heavily on experimental tasks that isolate future thinking from the contexts in which it is typically enacted. In fact, if we reconsider Tulving's (2005) Spoon test, it is notable that it involved a young girl spontaneously engaging in a behaviour (i.e., retrieving a spoon) *in her home* to achieve a future goal. Although children in our study sometimes engaged in similar acts (e.g., bringing a toy on a long car ride), they also expressed intentions (that most often required parental support), sought information about the future and, sometimes, made predictions. Exploring future thinking as it plays out in children's daily lives will put researchers on both new theoretical and methodological paths that further elucidate the functional significance of mental time travel from its earliest emergence.

References

Atance, C. M., Ayson, G., & Martin-Ordas, G. (2023). Moving beyond "Spoon" tasks: When do children autocue their episodic future thought? *WIREs Cognitive Science*, *14*(4), e1646. https://doi.org/10.1002/wcs.1646

Atance, C. M., Louw, A., & Clayton, N. S. (2015). Thinking ahead about where something is needed: New insights about episodic foresight in preschoolers. *Journal of Experimental Child Psychology*, *129*, 98–109. https://doi.org/10.1016/j.jecp.2014.09.001

Atance, C. M., & Mahy, C. E. V. (2016). Episodic Future Thinking in Children. In K. Michaelian, S. B. Klein, & K. K. Szpunar (Eds.), *Seeing the Future* (pp. 367–386). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780190241537.003.0018

Atance, C. M., & Meltzoff, A. N. (2005). My future self: Young children's ability to anticipate and explain future states. *Cognitive Development*, *20*(3), 341–361. https://doi.org/10.1016/j.cogdev.2005.05.001

Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences*, *5*(12), 533–539. https://doi.org/10.1016/S1364-6613(00)01804-0

Barsics, C., Van Der Linden, M., & D'Argembeau, A. (2016). Frequency, characteristics, and perceived functions of emotional future thinking in daily life. *Quarterly Journal of Experimental Psychology*, *69*(2), 217–233. https://doi.org/10.1080/17470218.2015.1051560

Baumeister, R. F., Hofmann, W., Summerville, A., Reiss, P. T., & Vohs, K. D. (2020). Everyday Thoughts in Time: Experience Sampling Studies of Mental Time Travel. *Personality and Social Psychology Bulletin*, *46*(12), 1631–1648. https://doi.org/doi.org/10.1177/014616722090841

Bélanger, M. J., Atance, C. M., Varghese, A. L., Nguyen, V., & Vendetti, C. (2014). What Will I Like Best When I'm All Grown Up? Preschoolers' Understanding of Future Preferences. *Child Development*, n/a-n/a. https://doi.org/10.1111/cdev.12282

Berntsen, D., & Jacobsen, A. S. (2008). Involuntary (spontaneous) mental time travel into the past and future. *Consciousness and Cognition*, *17*(4), 1093–1104. https://doi.org/10.1016/j.concog.2008.03.001

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. SAGE.

Dahl, A. (2017). Ecological Commitments: Why Developmental Science Needs Naturalistic Methods. *Child Development Perspectives*, *11*(2), 79–84. https://doi.org/10.1111/cdep.12217

D'Argembeau, A., Renaud, O., & Van der Linden, M. (2011). Frequency, characteristics and functions of future-oriented thoughts in daily life. *Applied Cognitive Psychology*, *25*(1), 96–103. https://doi.org/10.1002/acp.1647

Duffy, J., & Cole, S. N. (2021). Functions of spontaneous and voluntary future thinking: Evidence from subjective ratings. *Psychological Research*, *85*(4), 1583–1601. https://doi.org/10.1007/s00426-020-01338-9

Gautam, S., Bulley, A., von Hippel, W., & Suddendorf, T. (2017). Affective forecasting bias in preschool children. *Journal of Experimental Child Psychology*, *159*, 175–184. https://doi.org/10.1016/j.jecp.2017.02.005

Gerlach, K. D., Spreng, R. N., Gilmore, A. W., & Schacter, D. L. (2011). Solving future problems: Default network and executive activity associated with goal-directed mental

simulations. *NeuroImage*, *55*(4), 1816–1824. https://doi.org/10.1016/j.neuroimage.2011.01.030

Gilbert, D. T., Gill, M. J., & Wilson, T. D. (2002). The Future Is Now: Temporal Correction in Affective Forecasting. *Organizational Behavior and Human Decision Processes*, *88*(1), 430–444. https://doi.org/10.1006/obhd.2001.2982

Hallford, D. J., & D'Argembeau, A. (2022). Why We Imagine Our Future: Introducing the Functions of Future Thinking Scale (FoFTS). *Journal of Psychopathology and Behavioral Assessment*, *44*(2), 376–395. https://doi.org/10.1007/s10862-021-09910-2

Krøjgaard, P., Kingo, O. S., Dahl, J. J., & Berntsen, D. (2014). "That one makes things small": Experimentally induced spontaneous memories in 3.5-year-olds. *Consciousness and Cognition*, *30*, 24–35. https://doi.org/10.1016/j.concog.2014.07.017

Krøjgaard, P., Kingo, O. S., Jensen, T. S., & Berntsen, D. (2017). By-passing strategic retrieval: Experimentally induced spontaneous episodic memories in 35- and 46-month-old children. *Consciousness and Cognition*, *55*, 91–105. https://doi.org/10.1016/j.concog.2017.08.001

Kvavilashvili, L., & Ford, R. M. (2022). Metamemory for involuntary autobiographical memories and semantic mind-pops in 5-, 7- and 9-year-old children and young adults. *Child Development*, *93*(5). https://doi.org/10.1111/cdev.13794

Mahy, C. E. V., Kamber, E., Conversano, M. C., Mueller, U., & Zuber, S. (2023). A Parent-Report Diary Study of Young Children's Prospective Memory Successes and Failures. *Journal of Cognition and Development*, 1–23. https://doi.org/10.1080/15248372.2023.2277930

Nelson, K., & Ross, G. (1980). The generalities and specifics of long-term memory in infants and young children. *New Directions for Child and Adolescent Development*, *1980*(10), 87–101. https://doi.org/10.1002/cd.23219801008

Pilin, M. A. (2021). The past of predicting the future: A review of the multidisciplinary history of affective forecasting. *History of the Human Sciences*, *34*(3–4), 290–306. https://doi.org/10.1177/0952695120976330

Quon, E., & Atance, C. M. (2010). A Comparison of Preschoolers' Memory, Knowledge, and Anticipation of Events. *Journal of Cognition & Development*, *11*(1), 37–60. https://doi.org/10.1080/15248370903453576

Rogoff, B., Dahl, A., & Callanan, M. (2018). The importance of understanding children's lived experience. *Developmental Review*, *50*, 5–15. https://doi.org/10.1016/j.dr.2018.05.006

Scarf, D., Gross, J., Colombo, M., & Hayne, H. (2013). To have and to hold: Episodic memory in 3- and 4-year-old children. *Developmental Psychobiology*, *55*(2), 125–132. https://doi.org/10.1002/dev.21004

Suddendorf, T. (1994). *Discovery of the Fourth Dimension: Mental Time Travel and Human Evolution*.

Suddendorf, T. (2017). The Emergence of Episodic Foresight and Its Consequences. *Child Development Perspectives*, *11*(3), 191–195. https://doi.org/10.1111/cdep.12233

Suddendorf, T., & Busby, J. (2005). Making decisions with the future in mind: Developmental and comparative identification of mental time travel. *Learning and Motivation*, *36*, 110–125. https://doi.org/10.1016/j.lmot.2005.02.010

Suddendorf, T., Nielsen, M., & von Gehlen, R. (2011). Children's capacity to remember a novel problem and to secure its future solution: Future solutions of novel problems. *Developmental Science*, *14*(1), 26–33. https://doi.org/10.1111/j.1467-7687.2010.00950.x

Szpunar, K. K., Spreng, R. N., & Schacter, D. L. (2014). A taxonomy of prospection: Introducing an organizational framework for future- oriented cognition. *Proceedings of the National Academy of Sciences*, *111*(52), 18414–18421. https://doi.org/10.1073/pnas.1417144111

Tulving, E. (2005). Episodic memory and autonoesis: Uniquely human? In H. S. Terrace & J. Metcalfe, *The missing link in cognition: Origins of self-reflective consciousness* (pp. 3–56). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195161564.001.0001

Wilson, T. D., & Gilbert, D. T. (2005). Affective Forecasting: Knowing What to Want. *Current Directions in Psychological Science*, *14*(3), 131–134. https://doi.org/10.1111/j.0963-7214.2005.00355.x

Appendix A: Instance Questionnaire

Please fill out one questionnaire for each instance you witnessed. Select "Save As" and fill in a number at the end of the name (e.g. InstanceQuestionnaire_1).

Child: SUBJECT NUMBER HERE, FILLED BY GLADYS BEFORE SENDING

Day:

Date and Time this instance occurred:

Location where the instance took place:

Hours spent with child today:

1) *What did your child do or say? Provide as many details as you can!*

2) *What was happening at the time?*

3) *[For actions only] Did your child say anything while they were doing this?*

4) *Did you do or say anything (or was there something/someone in the environment) that you think "triggered" your child's action or statement about the future?*

5) *From a scale of 1 to 5 (5 being completely sure) how sure are you that your child did or said this with the future in mind? If you want, you can explain your rating!*

6) *Is this a routine thing for your child to do/say*?

7) *Any other notes or observations you'd like to add?*

Chapter 4: "Can We Please Go to the Zoo Tomorrow, Mommy?": A Naturalistic Investigation of Children's Spontaneous Future-Oriented Expressions

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This chapter describes unpublished work conducted by Gladys Ayson, Setenay Evsen, and Cristina Atance.

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Data accessibility. An anonymized version of the data can be found on OSF: https://osf.io/e2rwk/?view_only=07ce078efb3343a29fc4449071252575

Abstract

Understanding the nature of children's everyday future thinking is critical to identifying the functions this type of thought may serve. Yet, scientific knowledge about children's future thinking is predominantly built on evidence from laboratory tasks. This study presents a novel naturalistic methodology, developed from a proof-of-concept study (Chapter 3/Ayson & Atance, 2024), to explore the functions and triggers of children's spontaneous future-oriented expressions. Parents observed and reported their children's (N=42, 3- to 9-year-olds) future-oriented statements and actions over four days. Parents reported a higher proportion of statements than actions, $t(41) = 12.675$, $p < .001$, and older children had a significantly higher proportion of actions than younger children, $t(40) = 2.598$, $p = .013$. A thematic analysis on the functions of children's future-oriented expressions revealed five themes: 1) *Expressing future desires or intentions*, 2) *Future-oriented information-seeking*, 3) *Preparing for the future*, 4) *Predicting the future*, and 5) *Optimizing the future*. Most of children's instances were internally cued (55.8%) and had been previously observed by the parent (71.9%). Of these previously observed instances, 69% were frequently observed, suggesting that most instances were typical or routine. While no age differences were found for cue type or instance typicality, older children had a higher proportion of instances in Theme 3, *Preparing for the future*. These findings contribute to our understanding of children's future thinking in their day-to-day lives, highlighting motivation and instance typicality as key factors influencing the prevalence of unprompted future thoughts.

Keywords: mental time travel, future thinking, cognitive development, naturalistic approach

"Can We Please Go to the Zoo Tomorrow, Mommy?": A Naturalistic Investigation of Children's Spontaneous Future-Oriented Expressions

I conducted a second iteration of our Chapter 3 naturalistic study with a larger sample of children (*N*=42). Drawing on the insights gained from Chapter 3, I refined our approach to be less laborious for parents (see "Changes From Chapter 3"). I also included a secondary objective of investigating the cues which may have "triggered" children's spontaneous future thinking, focusing specifically on cue type, the typicality of the instances, and whether instances occurred in the same context as the future event. Moreover, I expanded the participant age range to include 8- and 9-year-olds (full age range from 3 to 9 years old) to learn more about children's naturally occurring future thinking expressions in middle childhood, and to parallel the age range used in Study 1 (Chapter 2), enabling me to draw insights across studies.

Similar to Chapter 3, the primary objective of this study was to investigate the functions of children's natural, spontaneous future-oriented statements and actions. This was achieved by running a thematic analysis (from Braun & Clarke, 2022) to identify patterns in children's expressions using the guiding question "Why did the child express this?". Our secondary objective was to understand what triggered children's spontaneous future thinking expressions by asking parents to identify relevant external (e.g., an object nearby) or internal (e.g., the child's emotional state) cues which they believe led to their child's expression[3]. It is important to note that our methodology heavily relies on parents' reports, observations, and interpretations. Our study's design reflects our confidence that parents know their children best. As such, when a

[3] In our Instance Questionnaire, parents responded to the question "In your opinion, what prompted your child to think about the future? If nothing, explain why." In my dissertation I have defined a "prompt" to be another individual's direct (verbal) instruction; however, in this case, "prompt" refers to cuing from the child's environment. This wording was used to ensure the utmost clarity for parents. Indeed, relevant cues in the environment may also "prompt" future thinking (see Berntsen & Jacobsen, 2008). To remain consistent throughout my dissertation, in this chapter I will use the term "trigger" to represent being cued/prompted by the environment.

parent listed an internal cue (e.g., their child's memory or emotion) as a trigger to their child's future thinking expression, it was impossible for us to verify this. However, we accepted parents' interpretations at face value and only added additional cues that we could identify through their description of the instance. For example, in one instance, a child was looking for red clothes to wear for Remembrance Day at school. Her parent described the trigger to be the child remembering that her teacher reminded the class the day before to wear red; however, in the description, the child is in front of her closet and may have been cued by seeing red clothing. Thus, this instance has two possible interpretations for cuing (visual and internal) and would be coded as "other/vague". Because our methodology does not use direct observation or self-report, findings related to triggers should be interpreted with caution.

Spontaneous (or "involuntary") future thoughts in adults are often related to their current surroundings, as found in a diary study on involuntary memories and future thoughts by Berntsen and Jacobsen (2008). Accordingly, we also examined whether each instance (e.g., a statement about a school activity occurring tomorrow) was made in the same context in which the event would occur (e.g., school entrance) or in a different context (e.g., child's bedroom). Spontaneous future thoughts in adults are also often reported to be thoughts the individual has had before – suggesting that these thoughts are "memories of the future" (Cole & Kvavilashvili, 2021; Jeunehomme & D'Argembeau, 2016). To investigate this in our sample, we also asked parents to report on whether the instance had been observed before (i.e., "Has your child said/done anything like this before?") to understand if repetition might play a role in triggering children's expressions.

We hypothesized parents would report significantly more statements than actions overall; however, older children (7-, 8-, and 9-year-olds) would demonstrate a higher proportion of

future-oriented actions than younger children (3-, 4- and 5-year-olds). We found preliminary evidence of this in Chapter 3 where parents reported significantly more statements than actions (95% and 5%, respectively) and reported more (albeit not significantly so) actions in older (6- and 7-year-olds) than younger (3- and 4-year-olds) children. We also hypothesized that younger children's instances would be triggered by external cue types (verbal and auditory) more often than those of older children, whose parents would report more internal cues. This hypothesis was based on evidence that younger children require more external scaffolding than older children to succeed in laboratory-based future thinking tasks (Atance et al., 2019; Dickerson et al., 2018; Scarf et al., 2013; Suddendorf et al., 2011). We predicted there would be no age difference in the proportion of instances in the "same" or "different" context. This is because there is evidence that adults' spontaneous future thoughts are often cued by their immediate environment (Bernsten & Jacobsen, 2008). We also did not predict age differences in the extent to which instances had been previously observed (i.e., less "novel"). This is because literature with adults reports a high proportion of spontaneous future thoughts to be ones that were had before (Jeunehomme & D'Argembeau, 2016).

This study employs a mixed-methods approach, in which our qualitative analysis (i.e., reflexive thematic analysis) is supplemented by quantitative methods. Specifically, we conducted quantitative analyses on the themes, including reliability coding—an approach not typically undertaken in reflexive thematic analysis (Braun & Clarke, 2022). The qualitative findings address our primary objective: understanding the function of children's future thoughts in daily life. In contrast, the quantitative analyses provide descriptive insights and support our secondary objective, which can be interpreted as more exploratory given the study's small sample size.

Methods

Participants

A total of 42 3- to 9-year-old children (23 girls, *M*age = 74.45 months, SD = 26.30, range: 37-118 months) participated in this study. Specifically, our sample contained eight 3-year-olds, six 4-year-olds, five 5-year-olds, five 7-year-olds, six 8-year-olds, and six 9-year-olds. An additional five children were recruited but excluded because their parent did not complete the tracking period. We grouped children together into "younger" (3-,4-, and 5-year-olds; *n*=19) and "older" (6-,7-,8-, and 9-year-olds; *n*=23) age groups. We chose to divide children into preschool (3, 4, and 5 years old) and elementary school (6, 7, 8, and 9 years old) age groups based on significant differences in future thinking performance previously found between these groups (Hajdas et al., 2021). I ran an a priori G*Power analysis to understand what sample size was needed to identify a large effect of age (t-tests: differences between two means, $d = .8$). This analysis revealed that a sample of 42 participants was needed ($1 - \beta = .8$). As such, our quantitative analyses are sufficiently powered to detect a large effect size between age groups. However, six parents tracked two children each, and as such we should be cautious in our interpretation of quantitative differences.

Our data was collected from February 2023 to March 2024. Some children (*n*=28) were tracked during summer holiday and others (*n*=14) during the school year. Participants were all English-speaking and were recruited from the uOttawa developmental laboratories participant database. While no medical diagnoses were disclosed by parents in the introductory or wrap-up meetings, two children were reported to wear hearing aids and one child was taking language development classes based on information from their instances. These children were nonetheless included in the analyses, given the practical difficulties of recruiting participants for a labour-

intensive study. The primary tracking parents (i.e., parents who completed the questionnaires) were predominantly mothers (*n*=34; 81%) and the remainder were fathers (*n*=8; 19%). Demographic information collected via an online Qualtrics survey showed our sample to be 50% White, 19% mixed race, 16.7% Asian, 2.4% Black and 11.9% undisclosed. Families received a $30 gift card to Amazon or Chapters/Indigo for agreeing to participate. Verbal consent was recorded during the introductory meeting prior to participation.

Materials

The Instance Questionnaire was a streamlined version of the questionnaire used in Chapter 3. After agreeing to participate, parents received the Instance Questionnaire as a Microsoft Word or Apple Pages document. Two parents requested and received the questionnaire template in Excel.

Changes From Chapter 3

While the current study had a similar objective to Chapter 3, we made some alterations to our methodology based on our previous findings. To reduce the time commitment and workload for the parents, the Instance Questionnaire used in Chapter 3 was streamlined by converting most response formats to checkboxes. We also collapsed two open-ended questions related to describing the instance and the surrounding context ("What did your child do or say? Provide as many details as you can!" and "What was happening at the time?") into one question ("Describe the instance. Include as many details as you can [e.g., what your child was doing at the time; where specifically it took place]"). We removed another open-ended question intended only for future-oriented actions ("Did your child say anything while they were doing this?") and instead instructed parents to report verbatim what their child said, when possible.

In our previous diary study (Chapter 3), two parents, who tracked two children simultaneously, were excluded from the study because they reported being overwhelmed by the number of instances they observed. To address this in our current study, parents who had more than one child participate (*n*=6 parents tracked two children) completed separate (rather than simultaneous) tracking periods for each child[4]. We also shortened our tracking period from one full week (seven days) to four days (2 weekdays and 2 weekends).

In Chapter 3, when more than one future thinking statement/action could be identified in a single reported instance, we only analyzed the first future thinking statement/action described in the instance. In this rendition, we separated instances where two or more future thinking expressions could be identified (e.g., a child telling her parent to put the toy shovel away as it is only needed in winter [Instance 1] then asking parent if they can build a snowman when winter returns [Instance 2]).

To address our secondary objective about what "triggered" children's future thinking expressions, we included the question "In your opinion, what prompted your child to think about the future?" in our Instance Questionnaire. In Chapter 3, we had attempted to investigate this objective with the question, "Did you do or say anything (or was there something/someone in the environment) that you think "triggered" your child's action or statement about the future?". However, parents appeared confused by (or unable to answer) this question because they often answered "nothing" or "I don't know", even when clear external cues were noted in their instance description. Thus, in addition to our change in wording, during the introductory meeting we also trained parents on identifying environmental cues by providing concrete examples and

[4] As pointed out by an anonymous reviewer for our Chapter 3 study, parents who tracked more than one child are represented twice in our data, compromising (to some degree) the independence of our data. This review came after data collection for the current study. However, with a limited participant pool, we wanted to take advantage of parents who were willing to dedicate the substantial amount of time and effort required to complete this study.

giving them an opportunity to ask clarification questions. Finally, we made a slight wording adjustment to the question asking parents if they had previously witnessed such an instance; whereas in the Chapter 3 Instance Questionnaire we asked "Is this a routine thing for your child to do/say?" (note, however, that we did not analyze this question in Chapter 3), in the current study, we asked "Has your child ever said/done anything like this before? Is this part of a household routine?". The Instance Questionnaire used in this study can be found in Appendix A.

Design and Procedure

Introductory meeting

I met virtually with all parents who expressed interest in participating in this study. This introductory meeting was intended for me to brief parents on the details of the study, obtain consent, and review tracking instructions. A full script of the introductory meeting can be found in Appendix B. For four participants, both parents joined the introductory meeting and were both involved in tracking. Importantly, only one parent was assigned as the "primary tracker" who was responsible for filling out all questionnaires, even for instances they did not personally observe.

Parents were instructed to identify spontaneous future thinking expressions or "instances" which we defined as *actions or statements about the future that were not prompted by the parent or another individual*. "Spontaneous" was defined as the child doing or saying the instance "all on their own" without the parent (or somebody else) telling them to do so. Future thinking actions were defined as actions enacted by the child which the parent believes were done with the future in mind (e.g., packing an umbrella for school). While this definition may be vague, it recognizes that we cannot conclusively infer what the child is thinking. Accordingly, we encouraged parents to use their discretion and intuition rather than be fully guided by the future

thinking examples given to them in the meeting. Future thinking statements were defined as something the child said about the future (e.g., talking about what they will do when they are "a daddy"); here, parents were encouraged to report statements verbatim when possible. Parents were also told to include instances that they felt unsure about and reassured that the research team would exclude any instances that did not fit the study's criteria for "future thinking". It was important to establish a wide scope for the kinds of future thinking actions and statements that parents could report because this study is among the first (in addition to Chapter 3) to gather evidence of children's naturally occurring spontaneous future thinking expressions.

Tracking Methodology. Parents received thorough instructions on how to track and document their children's instances using a two-step methodology inspired by Berntsen and Jacobsen (2008; also see Chapter 3 of this dissertation). Parents were instructed to document the future thinking instance at the time of its occurrence using keywords to help them remember what happened. For example, if they witnessed their child packing an umbrella in their schoolbag before leaving in the morning, the parent might write: "packed umbrella", "front door", and "morning". These keywords were not provided to the research team and could be noted anywhere the parent chose (e.g., on their phone, in a notepad). Importantly, at a later opportune time, the primary tracker filled out an Instance Questionnaire (Appendix A) for each instance witnessed. Parents were encouraged to complete the questionnaires at the end of each tracking day; however, this decision was ultimately left up to them.

After learning about the study's methodology and requirements, I asked parents if they were interested in participating. If they agreed to participate, parents provided verbal consent, which was recorded. They then selected their tracking days which needed to be two weekdays (consecutive or non-consecutive) and one weekend (consecutive, Saturday and Sunday). All

parents except one tracked their children on the weekdays before or after their tracking weekend. I sent reminder emails to parents on the morning of their tracking days. After the tracking period ended, parents uploaded their questionnaires to a restricted GDrive shared only with me. Parents also scheduled a "wrap-up" meeting with me to discuss interesting instances and observations and answer questions regarding the child's home environment (see Appendix C for the wrap-up meeting script). Due to thesis time constraints, I did not analyze questions regarding the child's home environment; however, we have posted the anonymized responses on OSF (https://osf.io/e2rwk/?view_only=07ce078efb3343a29fc4449071252575) to encourage future investigations.

Data Organization and Criteria

I entered all reported instances into an Excel file shared with the research team. I created summaries of parents' instance descriptions (i.e., their responses to "Describe the instance. Include as many details as you can.") and triggers to children's expressions (i.e., "In your opinion, what prompted your child to think about the future?"). Summaries included all information provided by the parent, only removing all identifying information (e.g., school name; friend or family member names). One of my co-authors, Setenay Evsen, created anonymized summaries of the responses to the frequency question ("Has your child ever said/done anything like this before?"). These anonymized summaries were used for the dataset shared on OSF (https://osf.io/e2rwk/?view_only=07ce078efb3343a29fc4449071252575).

Our research team collaboratively developed criteria for excluding instances where there was reasonable doubt that the child had engaged in future thinking (see Appendix D). Accordingly, we excluded instances related to an immediate goal (e.g., putting on shoes to leave the house), instances that appeared to address something in the immediate environment (e.g.,

steering their bike around a pothole), statements that did not identify a specific future time (e.g., "I want to go skiing at Mont Tremblant"), and statements that could be understood as past- or present-oriented (e.g., "I wonder if my sister is sleeping at home."). We aimed to be conservative in what we considered "future thinking" to diminish the risk of mistakenly assuming an instance involved future thinking, when it did not (similar to Hjuler et al., 2023). One hundred and eighty-four instances were excluded based on our criteria. For an additional 12 instances, our exclusion criteria did not readily apply, but nor did the instances appear future-oriented. For this reason, these instances were independently judged by the three individuals on the research team (myself, Cristina Atance, and Setenay Evsen) and only instances that were voted by consensus as being "future-oriented" were retained (n = 1). Thus, in total, 195 instances were excluded from analysis. Excluded instances and the rationale for each exclusion are noted on the dataset available on OSF.

Analysis Plan

Thematic Analysis (Braun & Clarke, 2022)

I ran a reflexive thematic analysis (based on Braun & Clarke, 2022) on the included instances. To maintain transparency, I kept a reflexive journal to document my thought process throughout the analysis. First, I familiarized myself with the dataset by reading all the instances numerous times (including multiple times to determine exclusions). Then, I printed out all the instances to aid in visual sorting. I only printed the anonymized summaries of the instance descriptions to ensure I only analyzed the child's expression and not other variables, such as what triggered the instance and whether it had been previously observed. This was to minimize parents' input and interpretation of the instance during analysis. My analysis was guided by the research question "Why did the child express this?", to reflect our primary objective.

I began the thematic analysis with an deductive approach where my first round of sorting was guided by the four themes I had previously derived in Chapter 3 (*Future-oriented information-seeking, Expressing future desires and/or intentions, Predicting future mental and physiological states,* and *Connecting present actions to future outcomes*). This was a slight deviation from the procedure outlined by Braun and Clarke (2022) to acknowledge my own subjectivity, having run an identical thematic analysis on similar data once before (see Reflexology Statement, below). After sorting all the instances into the four themes from Chapter 3 (including a group that did not fit any of the themes), I next identified salient elements or patterns within each grouping/theme. I then identified similar elements across groups to develop codes (e.g., conditional statements that included "if" or "in case"). This was done to understand whether new patterns could be derived from the data, which might lead to re-sorting the groupings. From these codes, I identified new patterns, predominantly in the *Connecting present actions to future outcomes* grouping. This led me to dissolve this group to identify new themes.

Reflexology Statement. Given that I ran the thematic analysis on similar data in Chapter 3, it was imperative that I approach the current thematic analysis with acknowledgement of my subjective research perspective. I have read and conducted research on children's future thinking for over six years. Two years prior to the current analysis, I ran a thematic analysis on children's naturally occurring future thinking expressions (Chapter 3) and identified four themes (*Future-oriented information-seeking, Expressing future desires and/or intentions, Predicting future mental and physiological states, Connecting present actions to future outcomes*). Thus, I began this analysis with an deductive approach; that is, shaping my analysis through the themes I had identified in Chapter 3.

Cue Types

We categorized the types of cues that parents reported to have triggered their children's instances. Recall that this was in response to the question "In your opinion, what prompted your child to think about the future?" in the Instance Questionnaire. Instances were sorted into one of the following cue types (see Table 1 for examples from the data): auditory (the child heard something), visual (the child saw something), internal (the parent either reported no cue, or reported it to be the child's current emotional/physical state [e.g., hunger, excitement]), and other/vague (when the parent reported a cue that did not fit into "auditory", "visual" or "internal," or the researcher identified an additional cue type from the instance description). Instances in the "visual" category were further classified by what specifically the child saw: a person, object, action, location, or animal. Table 2 shows examples from the data of each specific visual cue type. My co-author, Setenay Evsen, coded the instances for their cue types. A secondary coder coded 25% of the cue types and had moderate agreement, $\kappa = .572$, $p < .001$. The two coders then met to resolve differences and derive the final codes.

Table 1

Types of General Cues Identified to Trigger Children's Future Thinking Instances

Cue type	Example from data	
	Instance description	**Cue description**
Auditory	Child asked "Can we bring the pumpkins inside tonight?"	Child may have heard her parents talking about how there would be below-zero temperatures the next day.
Visual	Child told Parent to put her toy shovel away as it's only needed in winter.	She saw the shovel.
Internal	Child was lying in bed and asked "What are we doing tomorrow?"	Parent is unsure what prompted this.
Other/Vague	Parent accidentally deleted all the photos and videos off Child's electronic diary. Child was very upset. She said "Now whenever I want to watch that video I can't because it's gone!"	Parent reported that Child was thinking about all the videos on her diary that she can't see anymore (internal). However, Child was also looking at the diary when the statement was made (visual).

Table 2

Types of Specific Cues Identified When the General Cue was Reported to be "Visual"

Specific cue type	Example from data	
	Instance description	**Cue description**
Object	Child told Parent to put her toy shovel away as it's only needed in winter.	She saw the shovel.
Action	Child said "Can I have 2 wraps for lunch I was hungry yesterday"	Child was watching their parent make lunches.
Location	Child asked "Guys! Would you like to go on the four wheeler today or the park?"	Family drove past an open field.
Person	Child said: "I want to go to big kid school. I want to go Wednesday."	Child was watching older children play at the park.
Animal	Child asked: "When is [dog]'s mama coming to pick her up?" They were pet sitting a dog who was going home at some point that day.	The dog was near them when Child made the statement.

Instance Typicality

Parents reported whether they had observed their child doing this instance before. This was in response to the questions "Has your child ever said/done anything like this before? Is this part of a household routine?" from the Instance Questionnaire. We thus coded responses as a function of whether the instance had been observed before and, if so, how frequently. For example, if the reported instance was a child asking if they will go to daycare later, the parent might report that this has happened before and that it happens every morning (coded as "previously observed" and "frequent"). We coded previously observed instances as "frequent" if

the parent's response included a temporal adjective indicating the instance to be frequent (e.g., often, always, usually, every) and/or used present tense (e.g., "My child loves doing this"). We coded previously observed instances as "infrequent" if the parent's report included a temporal adjective indicating the instance to be infrequent (e.g., rarely, from time to time, occasionally). Some previously observed instances were not qualified by temporal adjectives indicating frequency, and were thus coded as "Indeterminate" (e.g., "Yes, this is not the first time she mentions graduation, college, or things like that"). Moreover, for some instances, parents did not respond to the question, "Has your child ever said/done anything like this before? Is this part of a household routine?", and these were thus coded as "Not reported".

Context

We also coded whether children's expressions pertained to future events that would occur in the same or different context/setting as the one in which the expression was made. For example, if a child said they wanted to watch TV in the living room later, we coded whether this statement was made in the same context (e.g., in the child's house) or a different context (e.g., in a car). Instances that did not specify a location for the future event were coded as "Not Applicable" (e.g., a child saying they did not want to get cavities).

Results

Descriptive Analyses

Thirty-six parents (N = 42 children) participated in the study. Collectively, they reported 729 instances from which 195 were excluded. Therefore, 534 instances were retained for analysis. Of these instances, 500 (93.6%) were observed directly by the primary tracking parent and 34 (6.4%) were observed by other adult family members. Parents reported on average 12.7 instances (range: 1 to 50) over the 4-day tracking period. Of the total number of instances, 444

(83.1%) were statements and 90 (16.9%) were actions. Instances mostly occurred in the home (370 instances; 69.3%), but also in a vehicle (83 instances; 15.5%), outside (32 instances; 6.0%), a different household (24 instances; 4.5%), an indoor facility (21 instances; 3.9%), on public transit (1 instance; 0.2%), or elsewhere (e.g., school pick-up lot; 3 instances; 0.6%). The average number of hours the primary tracking parent spent with their child did not significantly differ between younger and older age groups, as revealed by a Mann-Whitney *U*-test, $U = 261.500$, $z = 1.088$, $p = .277$. Therefore, hours spent with the child was not included as a covariate in subsequent analyses. The mean number of instances, statements, and actions by age in years and age group are reported in Table 3. A table showing each child's total instances, total instances witnessed by the primary tracker, and total number of statements and actions can be found in Appendix E.

Table 3

Mean Number of Instances by Age with Standard Deviation in Parentheses

Age	N	Reported Instances	Statements	Actions
3-year-olds	8	12.5 (12.1)	11.25 (10.0)	1.25 (2.4)
4-year-olds	6	21.7 (21.0)	20.2 (19.5)	1.5 (2.7)
5-year-olds	5	11 (5.9)	8.4 (4.8)	2.6 (2.3)
6-year-olds	6	12.3 (10.7)	11 (10.2)	1.3 (1.2)
7-year-olds	5	12.2 (12.1)	8.4 (8.9)	3.8 (3.4)
8-year-olds	6	9.5 (5.6)	6.8 (4.5)	2.7 (3.2)
9-year-olds	6	9.5 (5.8)	7.0 (4.7)	2.5 (2.4)
Younger	**19**	**15 (14.5)**	**13.3 (13.2)**	**1.7 (2.4)**
Older	**23**	**10.8 (8.3)**	**8.3 (7.1)**	**2.5 (2.6)**

The mean number of reported instances did not significantly differ between age groups, as revealed by an independent samples *t*-test, $t(40) = 1.171$, p = .249[5]. However, parents overall reported a significantly higher proportion of statements ($M = .82$) than actions ($M = .18$) as confirmed by a paired samples *t*-test, $t(41) = 12.675$, $p < .001$. Older children had a significantly higher proportion of actions (M=.24) than younger children (M=.11) as confirmed by an independent samples *t*-test, $t(40) = 2.598$, $p = .013$[6]. A Mann-Whitney *U*-test showed that the total number of instances did not significantly differ by sex, U=152, p=.092[7]. An independent samples *t*-test showed the proportion of actions to statements also did not significantly differ by sex, $t(40) = -1.444$, $p = .078$.

A one-way repeated measures ANOVA was run to compare the proportion of instances reported by time of day (morning, afternoon, and evening/night). This analysis was significant, $F(2,82) = 3.811$, $p = .026$, $\eta_p^2 = .085$. Although the post-hoc pairwise comparisons with a Bonferroni adjustment ($p = .017$) showed no significant differences between the three times of day, the proportion of instances in the morning (M=.43) and afternoon (M=.27) had the largest mean difference[8], with no significant differences from the evening (M=.30). A paired samples *t*-test revealed that parents did not report a significantly different proportion of instances based on

[5] Three outliers were identified in the younger age group. I also ran a nonparametric Mann-Whitney *U*-test and another independent samples *t*-test after changing the outliers up to .3 above the next highest value, maintaining their rank. Both tests were not significant, p =.478 (*U*-test) and .998 (*t*-test).

[6] One outlier was identified in the younger age group. I also ran a nonparametric Mann-Whitney *U*-test and an independent samples *t*-test after changing the outlier to .1 above the next highest value. Both tests were significant, p=.019 (*U*-test) and .013 (*t*-test).

[7] Three outliers were identified in the female group and one in the male group. I ran an independent samples *t*-test with the original values and the test was significant, $t(29.572) = -2.370$, p=.025. I also ran another independent samples *t*-test after changing the outliers up to .3 above the next highest value, maintaining their rank and this test was also significant, $t(32.977) = -2.445$, p=.020.

[8] Two outliers were identified in the proportion of afternoon instances. I also ran a nonparametric Friedman test and a repeated-measures ANOVA where the outliers were changed to .001 above the highest value. Both tests were significant, p=.012 (Friedman) and .011 (ANOVA). Pairwise comparisons for both tests showed a significant difference between proportion of instances in the morning and afternoon, p=.014 (Friedman) and .011 (ANOVA).

whether it was a weekend or weekday, $t(41) = -1.727$, $p = .092$[9]. A Friedman test was run to determine whether parents reported a different proportion of instances based on tracking day. The analysis was significant, $\chi^2(3) = 10.887$, $p = .012$. Post hoc pairwise comparisons with a Bonferroni correction ($p = .008$) revealed that the proportion of instances reported on Day 4 was significantly lower than on Day 2, $p = .007$. Notably, Day 4 had the shortest average of hours the primary tracker reported spending with their child (M=7.3), whereas Day 2 had the highest (M=9.7) compared to Days 1 (M=8.9) and 2 (M=8.7).

Thematic Analysis

To address our primary objective of understanding the functions of children's spontaneous future thoughts in daily life, I conducted a reflexive thematic analysis to explore why children expressed these thoughts. I derived five themes from my thematic analysis which are described and summarized in Table 4. Two themes (*Expressing future desires and intentions* and *Future-oriented information-seeking*) were identical to themes reported in Chapter 3. One theme (*Predicting the future*) was an expansion of Chapter 3's theme, *Predicting future mental and physiological states*. The final two themes (*Preparing for the future* and *Optimizing the future*) were novel; however, these instances would have previously fit into Chapter 3's theme, *Connecting present actions to future outcomes*. All themes were found in all ages (i.e., in 3- to 9-year-olds) in the same order of prevalence (*Expressing future desires/intentions, Future-oriented information-seeking, Preparing for the future*, *Predicting the future*, then *Optimizing the future*). Each theme is described in the subsequent sections.

[9] One outlier was identified in the proportion of weekend instances. I also ran a paired-samples t-test after changing the outlier to .01 below the lowest value and this test was also not significant, $t(41) = -1.825$, $p = .075$.

Theme 1: Expressing Future Desires or Intentions

This theme was the most prevalent with 242 instances (45.3% of the sample). All instances in this theme were statements where children expressed what they wanted to happen in the future. Desires could be in the form of requests (e.g., "Can we please go to the zoo tomorrow, Mommy?") or informative statements (e.g., "When I grow up, I want to be a witch."). Intentions were comprised of informative statements to announce a future intention (e.g., "Let's go to the library today after my ice-skating class."). Intentions also included instances where children asked their parents to remind them to act (e.g., telling their parent to let them know when they should start getting ready to leave) – which is an interesting parallel to prospective memory (i.e., remembering to act at a specified future time). Some instances could be interpreted as either a "desire" or "intention" (e.g., "I would like to bring seaweed to her house to share").

Theme 2: Future-Oriented Information-Seeking

This theme was the second most prevalent with 143 instances (26.8% of the data). All instances in this theme were statements, specifically questions, about future events. These statements appeared to reflect children's need to understand what's to come (e.g., "What are our plans tomorrow?") and, at times, why an event will unfold as such (e.g., asking why they have to go to soccer on Sundays) or how to prepare for it (e.g., "Do I have to pack my undies?").

Theme 3: Preparing for the Future

This was the third most prevalent theme, containing 60 instances (11.2% of the data). This theme included both actions and statements, where children appeared to be preparing for a future event. Actions involved children getting ready for a future event (e.g., getting dressed for Remembrance day at school), or making the occurrence of an event *easier* (e.g., clearing space at the table for dinner later). Statements involved children announcing a necessary action to

produce a predicted outcome (e.g., telling parent to wake up or they will miss swimming and it will be dark). Statements in this theme were distinct from intentions in Theme 1 (*Expressing future desires and intentions*) because children's intentions in Theme 1 were to do actions in the future without specifying an outcome (e.g., a child saying she needs to paint her parent's nails); in contrast, statements in this theme were intentions to do an action *immediately* with specification of the future outcome of this action (e.g., asking their parent to double-check their helmet and skate laces so nothing unpredictable will happen on the ice).

Theme 4: Predicting the Future

This theme contained 57 instances (10.7% of the data), all of which were statements. Formerly *Predicting future mental and physiological states* in Chapter 3, this theme was renamed to include, more broadly, children's predictions about what will happen in the future. Most predictions pertained to the occurrence of a future event (e.g., "I'm going to Cape Cod with my cousins and grandma and granddad!") or specific details of the future (e.g., "I think tomorrow will be warmer."). Children also made predictions of future mental states (e.g., "If I miss snack then I will be sad then I'll go home and tell mommy and daddy."); however, these types of predictions were rare *(n*=4). Children appeared to have made these predictions to demonstrate knowledge of the future (e.g., a child saying his class was going to win freezies for being the first class to bring back all their library books), for fun/entertainment (e.g., a child saying "he's going to die, he's definitely going to die" while watching a horror movie), or, perhaps, for emotion regulation (e.g., "I bet dad won't even notice my nails tomorrow.").

Theme 5: Optimizing the Future

This theme was the least prevalent, with 26 instances (4.9% of the data). The instances comprised actions and statements where children tried to change the immediate environment (or

upcoming actions) to bring about a different future outcome. Actions involved children trying to prevent negative future outcomes (e.g., a child lining their pillow with Kleenex in case they get a nosebleed). Statements consisted of children's requests to alter the current plan (e.g., asking to walk to school instead of being driven after an appointment) and their reasoning for doing so, always aimed at achieving a different future outcome (e.g., missing more school). Although some instances in this theme may reflect a form of preparation (e.g., a child hiding a chocolate bar to have it after lunch), they are distinct from Theme 3 (*Preparing for the future*) because instances in Theme 3 involve actions done to *ensure* the occurrence of a future event, or perhaps rendering the event easier or more efficient; in contrast, instances in this theme *improve* or *change* a future outcome (i.e., preventing a fight with his brothers over the chocolate bar).

Table 4

Summary of Themes

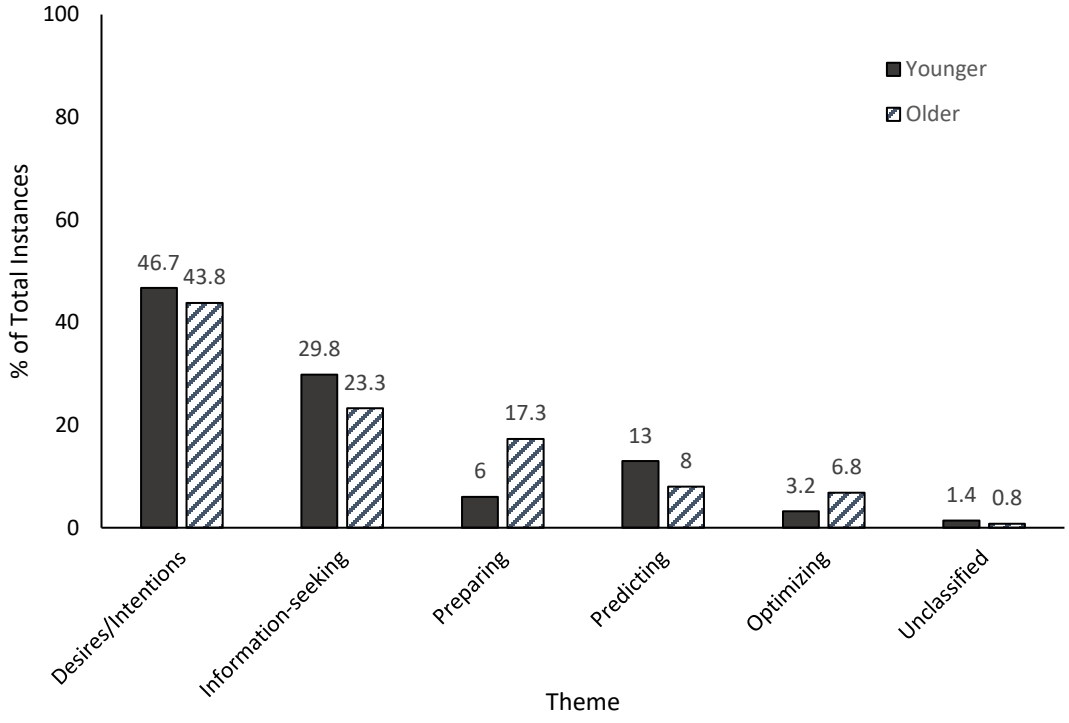
Theme	Definition	Examples from our data
Theme 1: Expressing future desires and/or intentions	Expressions of intention or desire for something to happen in the future.	1) Child asking to call Grandma after breakfast. 2) "Next time we see a cat that doesn't have a home, can we take him?"
Theme 2: Future-oriented information-seeking	Questions about the future.	1) "Which water park will we go to for my birthday?" 2) "Is it going to be warm or cold today?"
Theme 3: Preparing for the future	Preparing (through action or requests) for a future event.	1) Child changing into gymnastics clothes an hour and a half before her class. 2) Child charging his iPad before he leaves for a doctor's appointment.
Theme 4: Predicting the future	Statements about what will happen in the future.	1) "When we will be at the museum, I'll push buttons and the Paw Patrol song will play!" 2) Parent painted Child's nails for "blue day" at camp tomorrow. Child said "I bet Dad won't even notice my nails tomorrow"
Theme 5: Optimizing the future	Doing something (or requesting something) that will change a future outcome.	1) Child went to get a toy before Parent brushed her hair and said "Just in case I have a lot of knots in my hair, my toy will help me focus on something else so it doesn't hurt as much." 2) Child wrapping his Pokémon binder and putting it under the car seat to prevent heat damage.

Six instances were unclassified because they did not fit into any theme. Notably, three of these instances appeared to reflect children imagining or *simulating* the future (e.g., "Imagine that if I buy this house for myself and babies, and you can buy the house next door. We can live together!") but there was not enough evidence to render this a theme. A secondary coder coded 25% of the dataset (133 instances) using theme descriptions provided in Appendix F to determine whether they would classify these instances similarly to how I coded them. This secondary coder had 82% agreement with my original theme sorting, reflecting moderate agreement, $k = .736$, $p < .001$.

Figure 1 shows the distribution of themes across our two age groups. A series of independent samples *t*-tests revealed that the mean proportion of instances categorized into Theme 1, $t(40) = .350$, $p=.728$, Theme 2, $t(40) = .990$, $p = .328$, Theme 3, $t(40) = .930$, $p =.358$, and Theme 5, $t(26.627) = -1.255$, $p=.221$, did not significantly differ by age group. However, for Theme 4 (*Preparing for the future*), older children ($M =.17$) had a significantly higher proportion of mean instances than younger children ($M = .05$), $t(36.911) = -3.307$, $p=.002$.

Figure 1

Percentage of Instances Across Themes by Age Group



Cue Types

To address our secondary objective of understanding what triggers children's spontaneous future thoughts, we conducted an analysis on the types of cues parents identified at the time of the instance. Most instances were reported to be internally cued (298 instances; 55.8%), followed by visual (116 instances; 21.7%), auditory (101 instances; 18.9%), and then other/vague (14 instances; 2.6%). In five instances (0.9%), parents did not respond to the question "In your opinion, what prompted your child to think about the future?" and these instances were coded as "Not Reported". Table 5 shows the distribution of cue types across age group, including the percentage of instances from the age group's total instances. A series of independent-sample *t*-tests were conducted to investigate whether the mean proportion of cue

types differed by age group. Older and younger children did not significantly differ in the proportion of internal, $t(40)=.408$, p=.685, visual, $t(40) = -.584$, $p=.562$[10], and auditory, $t(40) = .239$, $p=.812$[11], cue types. Because the other/vague cue type represented different cue type combinations (e.g., visual and internal), I did not run an analysis to investigate the difference between age groups. Recall that the 116 instances in the visual category were further sorted into what specifically the child saw. Among parents who reported instances of their child being visually cued, the majority identified the cue as an object (71 instances; 61.2%), followed by an action (22 instances; 19.0%), a location (13 instances; 11.2%), a person (6 instances; 5.2%), or an animal (4 instances; 3.4%).

Table 5

Frequency and Percentage (in Parentheses) of Cue Types to Total Instances by Age Group.

Age group	Cue type					**Total**
	Internal	Visual	Auditory	Other/Vague	Not Reported	**Total**
Younger	161 (56.5)	58 (20.4)	58 (20.4)	6 (2.1)	2 (0.7)	**285**
Older	137 (55.0)	58 (23.3)	43 (17.3)	8 (3.2)	3 (1.2)	**249**
Total	**298**	**116**	**101**	**14**	**5**	**534**

[10] Two outliers were identified in the younger age group. I also ran a non-parametric Mann-Whitney *U*-test and another independent-samples *t*-test where I changed the outliers up to .02 above the next highest value, maintaining their rank. Neither test was significant, $p = .711$ (*U*-test) and .191 (*t*-test).

[11] Two outliers were identified in the younger age group. I also ran a non-parametric Mann-Whitney *U*-test and another independent-samples *t*-test where I changed the outliers within .02 of the next highest value, maintaining their rank. Neither test was significant, $p =. 898$ (*U*-test) and .773 (*t*-test).

Context

To further explore potential triggers of children's spontaneous future thoughts, we also analyzed whether the instances were related to the same context (i.e., location) in which the child was situated at the time. Of the total instances reported, 285 (53.4%) took place in a different context from the future event, 181 (33.9%) took place in the same context, and 68 (12.7%) could not be coded because the instance was not about a specific future location (e.g., child asking when her friend's birthday is). Independent samples *t*-tests revealed no significant difference between older and younger children's proportion of instances in the same context, $t(40) = .934$, $p=.356$[12], or different context, $t(40) = -.367$, $p=.716$. Table 7 shows the distribution of the context (same, different and not applicable) across age group, including its percentage of the age group's total instances.

Table 7

Frequency and Percentage (in Parentheses) of Context to Total Instances by Age Group

Age group	Context			**Total**
	Same	Different	N/A	
Younger	108 (37.9)	148 (51.9)	29 (10.2)	**285**
Older	73 (29.3)	137 (55)	39 (15.7)	**249**
Total	**181**	**285**	**68**	**534**

Instance Typicality

As a tertiary method for understanding the triggers of children's spontaneous future thoughts, we also analyzed parent reports about whether similar instances had been observed

[12] Three outliers were identified in the younger age group. I ran a non-parametric Mann-Whitney *U*-test and an independent-samples *t*-test changing these outliers within .02 of the next highest value, maintaining their rank. Neither test was significant, $p = .471$ (*U*-test) and .770 (*t*-test).

prior to the time of reporting. Additionally, for those instances reported as having been previously observed, we coded by typicality (i.e., whether they were frequently observed) to examine if repetition or habit might be influencing children's recurring future thoughts. Of the total instances, 384 (71.9%) had been previously observed and 136 (25.5%) were reported to be novel. Parents did not respond to the question "Has your child said/done anything like this before?" in 14 of the instances (2.6%) and, as such, these were coded as "Not Reported". Independent samples *t*-tests showed that the proportion of previously observed instances did not significantly differ by age group, $t(40) = -.615$, $p = .542$[13], nor did the proportion of novel instances, $t(40) = 1.053$, $p = .299$[14]. Of the 384 instances that had been previously observed, 265 (69%) were reported as frequent, whereas 77 (20.1%) were reported as infrequent. Forty-two instances (10.9%) did not contain enough information to be categorized by frequency (e.g., parent reporting "she has suggested this before"). Table 9 reports the number and percentage of previously observed instances (specifying level of frequency) and novel instances by age group. Independent samples *t*-tests showed no significant difference between the older and younger age groups' proportion of frequently observed instances, $t(40) = -720$, $p = .476$, and infrequently observed instances, $t(40) = -.561$, $p = .578$[15].

[13] 5 outliers were identified (3 in younger group, 2 in older group). I ran a Mann-Whitney *U*-test and another independent samples *t*-test changing the outliers within .02 of the next lowest value, maintaining their rank. These tests were not significant, $p = .426$ (*U*-test) and .561 (*t*-test).

[14] 2 outliers were identified in the younger age group. I ran a non-parametric Mann-Whitney *U*-test and an independent samples *t*-test after changing the outliers within .01 of the next lowest value. These tests were not significant, $p = .376$ (*U*-test) and .417 (*t*-test).

[15] 4 outliers were identified (3 in older group, 1 in younger group). I ran a non-parametric Mann-Whitney *U*-test and an independent samples *t*-test after changing the outliers within .02 of the next highest value, maintaining their rank. These tests were not significant, $p = .906$ (*U*-test) and $p = .953$ (*t*-test).

Table 9

Number and Percentage (in Parentheses) of Previously Observed Instances by Age Group

Age group	Not Observed	Previously Observed			Not Reported	**Total**
		Frequent	Infrequent	Indeterminate		
Younger	82 (28.8)	137 (48.1)	39 (13.7)	20 (7)	7 (2.5)	**285**
Older	54 (21.7)	128 (51.4)	38 (15.3)	22 (8.8)	7 (2.8)	**249**
Total	**136**	**265**	**77**	**42**	**14**	**534**

Discussion

Research on children's future thinking has been primarily conducted in laboratory settings. To date, and to the best of my knowledge, there has not been naturalistic observation of spontaneous future thinking in children – apart from the study presented in Chapter 3. The study conducted in this chapter employed a novel methodological approach to capturing children's spontaneous future thoughts as they naturally occur in everyday contexts. In doing so, it addresses a gap in our understanding of why children spontaneously think about the future and what may trigger such thoughts in daily life. Whereas laboratory studies often isolate specific events or problems for children to consider prospectively (e.g., encountering a locked box with stickers inside; Suddendorf et al., 2011), our naturalistic approach captures a range of everyday purposes and contexts in which children engage in future thinking. This is important as our findings provide evidence about the kinds of events children prospectively think about – insights that cannot be gleaned through laboratory-based methods alone. Indeed, naturalistic investigation should complement experimental efforts and could even inform experimental designs.

Descriptive Findings

We found that parents mostly reported future-oriented statements (83.1% of total data) as opposed to actions. This is consistent with what was found in Chapter 3, showing that children appear to mostly express their future thoughts verbally, rather than behaviourally. It is important, however, to temper this conclusion given that our data consists of observations by the child's parent, which may be subject to bias towards identifying statements (often made towards the parent) over actions (which could be enacted without alerting the parent). We also detected an age-related difference in the proportion of statements and actions, whereby older children (6- to 9-year-olds) had a higher proportion of actions (and lower proportion of statements) than younger children (3- to 5-year-olds). This age difference was not found in Chapter 3, suggesting that this difference may have emerged with our larger sample size and/or with the addition of 8- and 9-year-olds. Notably, this age difference cannot be attributed to a difference in the number of overall instances reported, nor the number of hours spent with the child, as these did not significantly differ by age group. One explanation for these findings may be that young children are not often given the autonomy to act independently, requiring permission or help from their parent. However, with age, children may take on more responsibility and have more opportunities to act independently. Indeed, Hajdas and colleagues (2021) found that 6-year-olds who were in first grade had higher prospective memory scores than 6-year-olds who were held back in kindergarten. These authors argue that this may be because school age children are given more opportunities to engage their prospective memory than preschoolers. The older children in our sample, who are elementary school age, may similarly have more opportunities to engage in future-oriented actions than preschoolers. However, our results in this respect should be

considered preliminary because of our relatively small sample size and because we do not have data from when children are in school/preschool; hence, more research is needed.

Functions of Everyday Spontaneous Future Thought

Findings from the thematic analysis largely support those from Chapter 3, where we also observed children expressing future desires and intentions, seeking information, and making predictions. The current dataset, which includes a considerably larger participant sample than that of Chapter 3, provides new insights about how children connect present actions to future outcomes (i.e., Theme 4 in Chapter 3). Specifically, children engaged in actions to either ensure or streamline a predicted future outcome (Theme 3: *Preparing for the future*), or to alter a future outcome in their favour (Theme 5: *Optimizing the future*). Using this methodology with an even larger dataset might provide further nuances to the themes found in the present study.

The themes identified in this dataset parallel functions of future thinking in adults. For example, expressing future desires and intentions (Theme 1) may reflect adult functions of intention formation and goal-setting (Barsics et al., 2016; D'Argembeau et al., 2011; Hallford & D'Argembeau, 2022). Likewise, information seeking (Theme 2) may serve an emotion regulation function whereby children inquire about positive and negative future events (Duffy & Cole, 2021). Many of the predictions (Theme 4) that parents reported were children's declarations of what is to come ("I'm going to Cape Cod with my cousins and grandma and granddad"), reflecting children's expressed understanding of the future. It is possible that such expressions may serve to build social bonds or alleviate boredom (Duffy and Cole 2021; Hallford & D'Argembeau, 2022).

Themes 3 and 5 (*Preparing for the future* and *Optimizing the future*) align with the directive function of future thinking in adults, whereby imagined future events are used to guide

current action (Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022). These findings support the pragmatic view of future thinking proposed by Baumeister and colleagues (2020): that future thinking is engaged primarily to inform action. Indeed, even some instances of information-seeking (e.g., asking what the weather will be), prediction (e.g., "I think tomorrow will be warmer"), and intention-setting (e.g., "I will go to my piano teacher's house last for trick-or-treating") are related to the child's active preparation for the future (e.g., choosing their clothes for the day or planning their Halloween route). Adults tend to think about the near future more concretely, which may in turn promote pragmatic thoughts, such as how to prepare (Baumeister et al., 2020; Liberman & Trope, 1998). It is possible that the near-future instances in this dataset reflect similar pragmatic orientations. However, not all near-future instances were pragmatic in nature – for example, predicting what will happen next in a TV show or asking why they need to go to soccer on Sundays. Because we did not code for temporal distance or whether an instance related to action planning, it is difficult to determine the extent to which children's naturally occurring future thinking is pragmatic.

Age Differences

No age differences were found across themes, with the exception of *Preparing for the future*. This suggests that, while older children may prepare more frequently, preschool- and school-aged children engage in future thinking in similar ways. It is also possible that, with a larger sample and greater variability, additional age-related differences in how children use their future thinking could emerge.

It is likely that other key factors are mitigating age-related differences in children's future-oriented expressions. One piece of evidence comes from a diary study on 2- to 6-year-olds' everyday prospective memory by Mahy and colleagues (2023). Similar to our results, they

found no age differences in the frequency of children's prospective memory successes (i.e., remembering to act) or failures (i.e., forgetting to act). Interestingly, the authors identified motivation and task typicality as significant predictors of children's prospective memory: motivation was associated with prospective memory success, whereas task typicality was associated with failures. These same factors – motivation and typicality – may also drive the prevalence of instances in our data. Regarding motivation, our most prevalent theme, *Expressing future desires and/or intentions*, was largely composed of statements involving activities that were especially exciting or desirable for children (e.g., getting ice cream later). This suggests that children are more likely to express future thoughts about events that are highly motivating or emotionally salient. Prior research supports this pattern, showing that EFT is strengthened in both children (Opriş et al., 2021) and adults (D'Argembeau & Van der Linden, 2004) when it involves emotionally positive events. With respect to typicality, most instances were identified as typical: 71.9% had been previously observed and, of them, 69% were frequently observed. While Mahy and colleagues (2020) found that task typicality predicted more prospective memory *failures*, this nonetheless suggests that intentions were frequently formed – even if they were not followed through. Our study captures intention-setting but does not track whether they were ultimately enacted, meaning that many frequently observed statements of intent may not have come to fruition. Thus, our findings align with those of Mahy and colleagues, suggesting that motivation and typicality play a key role in determining when children express everyday future thoughts.

Triggers to Spontaneous Future Thoughts

Our secondary objective was to better understand what "triggered" children's future thoughts by analyzing environmental cues, the typicality of the instances, and whether they

related to the immediate context. First off, we did not detect age differences for cue types, typicality, or context. Berntsen and Jacobsen's diary study (2008) showed that adults frequently have spontaneous future thoughts related to their current surroundings. Thus, it is possible that environmental cuing is an important trigger of spontaneous future thinking throughout the lifespan. Bernsten and Jacobsen found that most of adults' spontaneous future thoughts were externally-cued, with only 24% reported to be internally-cued. In contrast, most of the instances in our study were reported to be internally cued (55.8%). However, unlike Berntsen and Jacobsen, our methodology did not involve self-report, and it is possible that parents failed to identify visual or auditory cues that were present. Therefore, this finding should be interpreted cautiously and examined further in future studies.

While age did not appear to influence the triggers of children's spontaneous future thoughts, further understanding can be gleaned from our descriptive analyses. Similar to findings in Chapter 3, instances predominantly took place in the child's home (69.3% of the total data) and the family vehicle (15.5% of the total data). This may be because these locations are where parents most often spend time with their children. It may also be that children are more apt to *express* future thoughts when they are in familiar surroundings with familiar people (i.e., family members). Indeed, few instances were reported outdoors, at another household, or in an indoor facility (6.0%, 4.5% and 3.9%, respectively) where the child may be around unfamiliar people and surroundings. This reasoning has important implications for laboratory investigations of future thinking, in which children are in an unfamiliar setting interacting with a stranger (i.e., the experimenter). This, in turn, may make them apprehensive to act spontaneously (Pham et al., 2024). Anecdotally, during the introductory meeting of this study, the parent of a 4-year-old shared that his child was usually quite shy around new people. This parent reported 47 instances

– the most instances of all the 4-year-olds in the study – but, interestingly, when his child participated in a Spoon task in our lab, she did not "succeed" at spontaneously retrieving an item for a future event (Evsen et al., 2025). Yet, there were instances in this study where this child asked to bring an object to a future event (e.g., saying she needed to bring a dive ring to swim class on Saturday). Thus, children's level of comfort and familiarity with their surroundings may be important factors in translating spontaneous future thoughts into (measurable) expressions.

Parents in this sample reported a significantly higher proportion of instances in the morning compared to the afternoon, but not compared to the evening. This builds on a similar finding in Chapter 3 where we found significantly more instances in the morning compared to the evening. It is also consistent with findings in adults which show that thoughts about the future become less common as the day continues (Baumeister et al., 2020). When starting the day, children may be primed to think ahead to the rest of their day, and likely engage in routine morning activities (e.g., getting dressed) which may lead them to think about what their day holds (e.g., what the weather will be). It may be that, in some cases, children's future thoughts were *triggered* by the time of day (e.g., morning time leads to thinking about the day ahead). This may also explain the high number of internally-cued instances reported, where children are prompted by the time of day rather than by tangible stimuli in their environment. However, it is also possible that parents spent the most time with their children in the morning; something we cannot rule out because we only collected data on total time spent together during the day. Additionally, our defined "morning" window (wake-up to noon) may span more hours on average than the afternoon (noon to 5pm) or evening (5pm to bedtime) windows, particularly for early risers. Future research could clarify this pattern by asking parents to report hours spent with their child in each time block and by dividing the day into equal time increments.

Limitations and Future Directions

Despite our sample (*N*=42) having increased in size from Study 3/Chapter 3, it is still relatively small and, while it is significantly powered to identify large age effects, quantitative findings should be interpreted cautiously and replicated. Moreover, six parents tracked two children in the sample which means their reporting is represented twice in the data. Parents might differ in their reporting based on their schedule, their interest in the research, and/or their household routines. Higher representation of some parents/families might affect both our qualitative and quantitative findings, especially given our smaller sample size. However, the challenge in recruiting parents for a labour-intensive study like the current one informed our decision to allow parents to track two children. Indeed, parents in this study reported proportionally less instances on the last tracking day, which may signal their fatigue over the tracking period. Future research might alter our methodology to be less laborious for parents, perhaps by shortening the tracking period to two days, to allow for recruitment of a larger sample where families are only represented once.

Although some reported instances seem to have been driven by thoughts of a specific future event/time, we cannot conclude whether instances involved episodic future thinking, semantic future thinking, or a combination thereof. For example, a child who retrieved a toy before getting her hair brushed while stating, “just in case I have a lot of knots in my hair, my toy will help me focus on something else so it doesn't hurt as much” may indeed have been thinking about the future event of getting her hair brushed. However, she may also have drawn on associative knowledge gleaned from similar prior experiences (i.e., that hair brushing will hurt). In our data, 72% of all instances were reported to have been previously observed and, of these instances, most (69%) were frequently observed. This might signal that children use learned,

associative knowledge to anticipate the future. Repeated experiences may promote certainty or "knowledge" of what's to come, creating the opportunity for children to behave spontaneously in anticipation. Developmentally, it might make sense for children to first act on their semantic, as opposed to episodic, knowledge. Though we might theorize that semantic thinking is the prevailing form of future thinking in our data, this cannot be confirmed from our research.

There are also additional variables within our data that could be investigated; namely, temporal distance from the future event. Berntsen and Jacobsen (2008) found that most spontaneous future thoughts in adults were concrete and pertained to the near future. It would be interesting to code the temporal distance of each instance (near vs. distant) and investigate how it may differ across age group. Temporal distance might also differ by theme, with a higher proportion of near-future instances in themes related to action planning (i.e., *Preparing for the future* and *Optimizing the future*).

Another avenue for future research could involve examining how the attentional demands of the ongoing activity may influence the likelihood of spontaneous future thinking. Berntsen and Jacobsen (2008) found that spontaneous future thoughts most frequently arose when the ongoing task was not attention-demanding. This may also be the case for children in our study, with a substantial proportion of instances occurring during a car ride (15.5%) when children have little to do.

Finally, it is also important to acknowledge the value and insight that could be obtained from our excluded instances. We were stringent in our exclusion criteria to assure the instances we analyzed required, to the best of our knowledge, future thinking. However, it is important to note that parents believed *all* their reported instances involved their children thinking about the future. The excluded instances hold interesting insight into other aspects of prospection and

children's cognition. For example, some excluded instances involved "future thinking" within a fantastical timeline. One child read a storybook about a dwarf who steals toys left on the ground; this child's parent reported numerous instances in which their child picked toys up off the floor so that the dwarf would not steal them. This child even once left trash on the floor so that the dwarf could dispose of it. From this series of instances, one might evidence this book as a useful tool to support future-oriented actions related to cleaning. This and other excluded instances may hold interesting insights regarding strategies or tools that can promote children's spontaneous future-oriented behaviour.

Conclusion

This study builds on our limited understanding of children's spontaneous future-oriented expressions in everyday life. Our findings show that age might not be a critical factor related to the prevalence of children's spontaneous future thoughts or future-oriented behaviours. Indeed, children as young as 3 years old exhibited spontaneous future-oriented behaviours when they were in familiar surroundings or when acting with respect to a future event that they had experienced previously. While this may mean that children are relying on learned, semantic knowledge to behave for the future, the focus of this research was not to isolate a particular form of future thinking. Rather, this study interprets future thinking through a practical lens. More specifically, children spontaneously preparing for, or improving, their future by engaging in appropriate actions represents an important milestone in their growing autonomy. If semantic knowledge, built through repeated experiences, promotes such adaptive and autonomous behaviour, this is important for parents and caregivers to know. Our work addresses a deficit in naturalistic understanding of children's future thinking and, through demonstration of a novel methodology, provides a basis for future naturalistic research.

References

Atance, C. M., Celebi, S. N., Mitchinson, S., & Mahy, C. E. V. (2019). Thinking about the future: Comparing children's forced-choice versus "generative" responses in the "spoon test." *Journal of Experimental Child Psychology*, *181*, 1–16. https://doi.org/10.1016/j.jecp.2018.12.006

Barsics, C., Van Der Linden, M., & D'Argembeau, A. (2016). Frequency, characteristics, and perceived functions of emotional future thinking in daily life. *Quarterly Journal of Experimental Psychology*, *69*(2), 217–233. https://doi.org/10.1080/17470218.2015.1051560

Baumeister, R. F., Hofmann, W., Summerville, A., Reiss, P. T., & Vohs, K. D. (2020). Everyday Thoughts in Time: Experience Sampling Studies of Mental Time Travel. *Personality and Social Psychology Bulletin*, *46*(12), 1631–1648. https://doi.org/doi.org/10.1177/014616722090841

Berntsen, D., & Jacobsen, A. S. (2008). Involuntary (spontaneous) mental time travel into the past and future. *Consciousness and Cognition*, *17*(4), 1093–1104. https://doi.org/10.1016/j.concog.2008.03.001

Braun, V., & Clarke, V. (2022). *Thematic analysis: A practical guide*. SAGE.

Cole, S., & Kvavilashvili, L. (2021). Spontaneous and deliberate future thinking: A dual process account. *Psychological Research*, *85*(2), 464–479. https://doi.org/10.1007/s00426-019-01262-7

D'Argembeau, A., & Van der Linden, M. (2004). Phenomenal characteristics associated with projecting oneself back into the past and forward into the future: Influence of valence and

temporal distance. *Consciousness and Cognition*, *13*(4), 844–858. https://doi.org/10.1016/j.concog.2004.07.007

D'Argembeau, A., Renaud, O., & Van der Linden, M. (2011). Frequency, characteristics and functions of future-oriented thoughts in daily life. *Applied Cognitive Psychology*, *25*(1), 96–103. https://doi.org/10.1002/acp.1647

Dickerson, K. L., Ainge, J. A., & Seed, A. M. (2018). The Role of Association in Pre-schoolers' Solutions to "Spoon Tests" of Future Planning. *Current Biology*, *28*(14), 2309-2313.e2. https://doi.org/10.1016/j.cub.2018.05.052

Duffy, J., & Cole, S. N. (2021). Functions of spontaneous and voluntary future thinking: Evidence from subjective ratings. *Psychological Research*, *85*(4), 1583–1601. https://doi.org/10.1007/s00426-020-01338-9

Evsen, S., Bolic, M., Wilson, J., & Atance, C. (2025). *Laboratory Spontaneous Spoon Task* [Unpublished manuscript]. Department of Psychology, University of Ottawa, Ottawa, Canada.

Hajdas, S., Grzegorzewska, K., & Niedźwieńska, A. (2021). The importance of schooling and parental attitudes for children's prospective memory. *Cognitive Development*, *57*, 101006. https://doi.org/10.1016/j.cogdev.2021.101006

Hallford, D. J., & D'Argembeau, A. (2022). Why We Imagine Our Future: Introducing the Functions of Future Thinking Scale (FoFTS). *Journal of Psychopathology and Behavioral Assessment*, *44*(2), 376–395. https://doi.org/10.1007/s10862-021-09910-2

Hjuler, T. F., Sonne, T., Kingo, O. S., Berntsen, D., & Krøjgaard, P. (2023). "Workman made noise in my room. Me kept my hands on my ears!" A diary study of spontaneous

memories in 34- to 36-month-old children. *Applied Cognitive Psychology*, *37*(5), 980–991. https://doi.org/10.1002/acp.4095

Jeunehomme, O., & D'Argembeau, A. (2016). Prevalence and determinants of direct and generative modes of production of episodic future thoughts in the word cueing paradigm. *Quarterly Journal of Experimental Psychology*, *69*(2), 254–272. https://doi.org/10.1080/17470218.2014.993663

Liberman, N., & Trope, Y. (1998). The role of feasibility and desirability considerations in near and distant future decisions: A test of temporal construal theory. *Journal of Personality and Social Psychology*, *75*(1), 5–18. https://doi.org/10.1037/0022-3514.75.1.5

Mahy, C. E. V., Kamber, E., Conversano, M. C., Mueller, U., & Zuber, S. (2023). A Parent-Report Diary Study of Young Children's Prospective Memory Successes and Failures. *Journal of Cognition and Development*, 1–23. https://doi.org/10.1080/15248372.2023.2277930

Opriş, A. M., Cheie, L., & Visu-Petra, L. (2021). Back to the future: Relating the development of episodic future thinking to cognitive and affective individual differences and to motivational relevance in preschoolers. *Memory*, *29*(3), 362–378. https://doi.org/10.1080/09658211.2021.1896734

Pham, Q. A., Ayson, G., Atance, C. M., & Blankenship, T. L. (2024). Measuring spontaneous episodic future thinking in children: Challenges and opportunities. *Learning & Behavior*. https://doi.org/10.3758/s13420-024-00644-1

Scarf, D., Gross, J., Colombo, M., & Hayne, H. (2013). To have and to hold: Episodic memory in 3- and 4-year-old children. *Developmental Psychobiology*, *55*(2), 125–132. https://doi.org/10.1002/dev.21004

Suddendorf, T., Nielsen, M., & von Gehlen, R. (2011). Children's capacity to remember a novel problem and to secure its future solution: Future solutions of novel problems. *Developmental Science*, *14*(1), 26–33. https://doi.org/10.1111/j.1467-7687.2010.00950.x

Appendix A: Instance Questionnaire

Please fill out one questionnaire for each instance you witnessed. Select "Save As" and fill in a number at the end of the name (e.g. InstanceQuestionnaire_1).

Child: Subject number

For each question below, please check all that apply. ☒

Is this a future thinking action or statement?

Action ☐ Statement ☐

Observed by?

Primary tracker ☐ Other ☐ *please specify*____

Which day did this instance occur?

Day 1 ☐ Day 2 ☐ Day 3 ☐ Day 4 ☐

Weekend ☐ Weekday ☐

What time did this occur?

Morning (Wake up - Noon) ☐

Afternoon (Noon-5pm) ☐

Evening/Night (5pm-Bedtime) ☐

Where did this take place?

At home (inside) ☐

At home (outside; e.g., backyard, patio) ☐

In a Car/Vehicle ☐

Public transit ☐

Outdoors (e.g., park, public pool) ☐

Indoor facility (e.g., store, restaurant, dentist office) ☐

Different household (e.g., friend's house, grandparents') ☐

Other ☐ *please specify* _____

Please specify the approximate number of hours you spent with your child today (not including nighttime sleep)

Number of hours: _____

Describe the instance. Include as many details as you can (e.g., what your child was doing at the time; where specifically it took place). If possible, quote what your child said directly!

Type response here

In your opinion, what prompted your child to think about the future? If nothing, explain why.

Type response here

Has your child ever said/done anything like this before? Is this part of a household routine?

Type response here

Use this space for any other notes or observations you'd like to add

Type response here

Appendix B: Introduction Meeting Script

Thank you for your interest in our study! The reason we're meeting today is for you to hear more about it. Typically, our studies are these 20 to 40 minutes-long games that we play with your child. This study is a little different. It actually spans over 4 days. During this time, you'll be the researcher! You'll be doing what we call "observational" research: observing and tracking your child throughout their day when you are with them. This is more of a time commitment on your end, but we've designed it to be as flexible as possible to minimize interference with your daily schedule. You and your child do not need to change anything that you do regularly. You will simply be observing them during the times that you are together.

Background of the study:
In our lab, we are interested in how children think about the future. Thinking about the future allows us to plan for what will come next and prepare for unexpected changes. Better future thinking during childhood relates to many adaptive adult qualities, such as better decision making, better financial status and higher educational attainment. So, we study future thinking in children to learn how we can improve it. We've learned a lot from our research so far! For instance, we know that AGE-years-olds, like your child, CHILDNAME, is now able to think about what he'll/she'll be doing tomorrow and formulate basic plans for the near future!

I'm sure you can think of some examples where CHILD'S NAME seemed to be anticipating the future. Does anything come to mind right now? *Brief pause to let parent reflect and potentially list their own examples. If nothing:* Maybe they've planned to bring a toy or game to a friend's house, or have talked excitedly about something that will happen tomorrow.

In this new study, we're curious about these kinds of things – these <u>naturally occurring</u> instances of future thinking. We're wondering when, in their own homes, children do or say things (more spontaneously) with the future in mind? These natural instances of future thinking have never been documented in children, so we're going to be the first to do so!

That's where you can help us! We're asking you to monitor CHILD'S NAME for two weekdays and one weekend (i.e., 2 days) and write down any instances of what would appear to be "future thinking" actions or statements. Future thinking actions can be anything your child does that you believe they're doing with the future in mind. Of course, we'll never truly know what's going through a child's mind but if anyone could guess, it would be you, their parent. Because you know them better than anyone else! Some examples might be your child retrieving their mask before going outside, or setting aside a drawing to finish later. Similarly, future thinking statements can be anything your child says about the future. Some examples might be reminding you to bring a snack for an outing tomorrow, or stating that they want to go to the park tomorrow. We call these "spontaneous" instances, because you're not the one telling your child to think ahead but, rather, your child does or says this future thing on their own. Do you have any questions so far?

Don't overthink it! If you're unsure whether one of your child's actions or statements involves future thinking, include it anyway! Also, when an instance happens, be sure to quickly scan your environment for anything relevant to what your child did or said. It's possible that they may have

seen something or heard something which prompted them to think about the future. For example, if there's a box of masks visible by the front door it may prompt your child to take one for their outing!

Study instructions
While you are tracking your child's actions and statements throughout the four days, you'll need to jot down notes. I recommend keeping a little notebook with you, or you could type in your phone or even record voice notes. Whatever is easiest for you! These jotted notes are for your records only. So, when you see your child doing something or saying something that you think may be future-related (or "future-oriented"), jot down keywords to help you remember what happened and where/when this instance took place. For example, if you witness your child packing an umbrella for school in case it rains later, you could write "umbrella" "morning" "home to school". For statements, if time allows, writing your child's exact words would be ideal!

At the end of each day, or when you have the time, we ask you to complete a short questionnaire we call the "Instances questionnaire" for each of the actions and statements you witnessed that day. If other adult members in your household are interested in joining you in tracking, they absolutely can! We just ask that you are the one to fill out the questionnaire because you are the "primary tracker". Again, this is all to keep things consistent and standardized.

Before we go over the questionnaire, do you have any questions so far?

The Questionnaire:
Share screen the "Instances Questionnaire" and go through each question.

Show parents the examples of instances filled out in the form. Share screen with the "Examples_Instances" document and go through the questions and examples with the parent. Attach examples in "Ready, set, track" email.

Potential questions from parents:
More than one child?: We ask that you only track one child at a time so that your attention is focused. This will also ensure that your responses are comparable to those of other parents who are tracking just one child. If you'd like to do the study again with your other child, we can certainly set up another tracking period at our wrap-up meeting!

Can other people help me track? Yes! If other members of your household spot an instance and tell you about it, you can report that as well! We just ask that you are the one to fill out the questionnaire because you are the "primary tracker". Again, this is all with the efforts to keep things comparable and consistent between other parents and children. As well, when the questionnaire asks you how many hours you spent with your child, please fill that answer out for you only (the primary tracker).

After going over the questionnaire
Any questions? Does filling these out on Microsoft Word work for you? You can also print copies out and take pictures of the questionnaires to email to me. If you don't have access to a printer, we could arrange them to be mailed to you!

That's pretty must the gist of the study! What do you think? Are you interested in participating?

If no: That's totally okay! Thank you so much for your time! If you know anyone who would be interested in participating in this study please forward them my or our coordinator's email. Take care!

If parent needs to think about it: That's fine! How about I send you an email in a couple days and ask you again? Thank you so much for your time!

If yes
Great! We can get started right away! If it's okay with you I'll get your verbal consent on this call now and also ask you a few questions regarding your child's daily schedule. Is that alright? Okay, I'll start the recording now! *Start recording*

> *Verbal consent (Share "verbal consent" PPT)*
> Okay I'm going to ask you to read the following statement on the screen so we have it for our records.
>
> "I _____ agree to have my child _____ whose date of birth is _____ participate in the research conducted by Gladys Ayson and Dr. Cristina Atance from the University of Ottawa, School of Psychology, Faculty of Social Sciences."

Great, thank you so much. You are now ready to get started! What two weekdays and which weekend would you like to be your tracking period?

> DATES:

Great! I'll send you a reminder via email on the morning of your tracking days.

After tracking I'll ask you to meet with me one more time for a quick wrap-up session to discuss how it went!

Okay you're all set. I'll get the materials to you before your start date. Good luck and please don't hesitate to contact me anytime via email or text if you have any questions!

Appendix C: Wrap-up Meeting Script with Questions

Hello again! How was your experience? *Parent and E can talk about any specific instances that stood out to either of them. E will write down any exceptional instances on a doc (this part is not recorded so that parent feels comfortable reporting it).*

That sounds great! I just have a few last questions for you. These are to get a sense of CHILD's home life!

Questions
Household
Q1. How many people are currently living in your household? What are their relations to your child?

Q2. (if not answered with Q1) Does your child have any siblings? If so, how old are they?

Q3. What does your child do in a typical week at this time of year? Are they in school [or in summer camp]? How many hours a week?

Q4. Is your child enrolled in any other structured activities (e.g. music lessons, sports, tutoring, things like that?) How often do they do this in a week and how long? (Derive hours in a week)

Tracking period
Q5. Was your family's schedule throughout the tracking period typical or atypical? [if relevant] *If atypical:* How do you think this affected your tracking and the instances you saw?

Q6. What percentage of your child's future thinking did you feel you "missed" while tracking?

I have some more questions regarding your child's home life. This will give us some more context to their living environment. These can be answered using the Likert scale shown here (share screen slide)
Home life
Does your child choose what clothes they wear for the day?
Always – Almost always – Sometimes – Almost Never – Never

Is your child involved in any household chores?
Always – Almost always – Sometimes – Almost Never – Never

> ***If yes*: Do they engage in those chores voluntarily or need reminding?**
> Always or almost always voluntarily – Mostly voluntarily, sometimes reminded – sometimes voluntarily, sometimes reminded – Mostly reminded, sometimes voluntarily – Always or almost always reminded

Does your child choose what to do in his/her free time?
Always – Almost always – Sometimes – Almost Never – Never

Does your child choose when to do activities?
Always – Almost always – Sometimes – Almost Never – Never

Do you inform your child of the day's schedule so they know what to expect?
Always – Almost always – Sometimes – Almost Never – Never

Do you discuss upcoming events/activities with your child?
Always – Almost always – Sometimes – Almost Never – Never

Finally, I have some questions regarding future participation in our studies. Can you please answer these questions with yes or no. Your answers here do not affect your participation in this study:

> **Would you be interested in doing a study of this nature again?**
>
> **Do you give the CCLL researchers permission to re-contact you about future research?**
>
> **Do you give permission to other University of Ottawa child development Labs to contact you about their research?**

That's all my questions! If you're curious about what we find from this study, I would be more than happy to share our results with you when we get them! Would that be something you're interested in? *If yes:* Great! I'll note your email down and send you a copy of the paper when the study has been published! Please note the research process is quite slow so it likely will be in 1 or 2 years (possibly longer!). I'll stop the recording now. *Stop recording*

Appendix D: Exclusion Criteria

Present/Immediate Relevance

1. If a child expresses a want/desire which does not pinpoint a future time (e.g., "I want ice cream."). Without pinpointing a future time, it may be that the child is talking about their current desire/motivation. This future pinpoint may be explicitly provided by the child (e.g., "I want ice cream *after dinner*!") or through the reported context (e.g., Child saying "I want to rent mountain bikes at Mont-Tremblant!" after Parent telling their child that they will be going to Mont Tremblant next week).

    - The above criterion should be followed UNLESS the child identifies a step (or desire to do a step) that is needed to obtain a stated goal (e.g., writing down materials to build a fort, asking Parent to call their friend's mom to set up a playdate, asking Parent to check their skate laces so they don't fall on the ice) which may represent planning (i.e., identifying actionable steps toward a goal). Importantly, the "step" should take cognitive effort and not feel "reactive" (see point 3). For example, wanting to "walk" to a desired location, does not qualify as a step.

2. If the instance is present-oriented:

    - A statement not temporally displaced from the time of the instance (e.g., "Is sister awake at home?")

    - A statement brings about immediate action (or withheld action) by the child or another person (e.g., "Do you need help carrying those bags?"; Child announcing they are "going to" put their clothes away then do so right after). Unless this action is a step (see point 1) toward another stated goal.

    - If a child's action brings about an immediate desired result/outcome (e.g., plugging in the tablet charger to keep watching a show).

3. If the action seems to "reactively" address stimuli in the immediate environment (e.g., walking around a big puddle, putting shoes on to go outside).

Temporal (but not future)

1. If it is <u>possible</u> that the instance is:

    - past-oriented (e.g., "Weren't we going to build this LEGO car?")

    - based on a fantastical timeline (i.e., in pretend play; e.g., "I will be a shark and you will be my dinner.", "If we all have sourdough bread for heads, we will never be hungry!")

2. If the statement is factual/knowledge-based (e.g., “Where does the horse from the zoo sleep?” “I love Christmas because there are so many lights!”) and not related to time or a timeline. Statements such as “I can say different words when I will be bigger!” or “I will stay with you for 4 days this time!” are examples of factual statements that would be retained because they explicitly entail temporal information (about the future).

Too inferential

1. If the action/statement requires too much inference on behalf of the parent/researcher to be future-oriented (i.e., the instance itself should be interpreted easily as “future-oriented”). E.g., Child tidying their room in the morning and Parent interprets this as preparing for guests that evening, or Child pausing before making a move in a board game and Parent interprets this as them planning ahead.

Prompting

1. If another person prompts (through conversation or instruction) the child to do an action/statement and child does not provide any *new* information in their response.

2. If Child exactly repeats another person’s future oriented statement/behaviour

Uncertain Instances

1. Given the high variability surrounding the instances, there will inevitably be some instances that aren’t captured by our exclusion criteria. For these instances, we may still be uncertain about whether they involve future thinking. We will thus opt to be conservative about what we include (similar to Hjuler et al., 2023) and thus exclude instances where a consensus to include is not achieved among all three coders.

Appendix E: Instances Reported for Each Child

Age	Total Instances	Statements	Actions	Exclusions	Primary tracker Instances (% of Total Instances)
3	1	1	0	4	1 (100)
3	11	11	0	0	6 (54.5)
3[a]	12	12	0	10	12 (100)
3	40	33	7	22	38 (95)
3	3	2	1	5	3 (100)
3	16	15	1	3	16 (100)
3	9	9	0	2	9 (100)
3	8	7	1	5	8 (100)
4	47	47	0	1	47 (100)
4[b]	8	7	1	6	8 (100)
4	3	3	0	5	3 (100)
4	10	9	1	9	8 (80)
4	50	43	7	16	49 (98)
4	12	12	0	2	12 (100)
5	3	3	0	3	3 (100)
5[c]	10	9	1	1	10 (100)
5	19	16	3	0	17 (89)
5	9	6	3	4	9 (100)
5	14	8	6	0	14 (100)
6	5	5	0	3	5 (100)
6	11	9	2	5	7 (64)
6	2	2	0	7	1 (50)
6[d]	9	6	3	3	9 (100)
6[a]	15	14	1	7	15 (100)
6	32	30	2	13	26 (81)
7	21	13	8	9	21 (100)
7	5	3	2	2	4 (80)
7[b]	3	2	1	2	3 (100)
7	3	2	1	5	3 (100)
7	29	22	7	11	29 (100)
8[e]	17	15	2	1	16 (94)
8	5	4	1	2	5 (100)
8	8	8	0	1	6 (75)
8	16	7	9	12	11 (69)
8	7	5	2	0	7 (100)
8	4	2	2	3	4 (100)

9	15	9	6	1	15 (100)
9[e]	8	6	2	2	6 (75)
9[c]	16	15	1	5	16 (100)
9	2	2	0	0	2 (100)
9[d]	12	7	5	2	12 (100)
9	4	3	1	1	4 (100)

Note. Individuals with corresponding [a b c d e] symbols are siblings.

Appendix F: Theme Descriptions Provided to Second Coder

Theme 1: Future desires/intentions

Instances in this theme are statements about what the child wants (e.g., "Can I..", "I wish..") or intends to do ("I'm going to.."; "We need to.."). Intentions may be for the self or the parent (i.e., telling the parent that they need to do something). These statements are done so the child can express what they want to happen in the future. No subthemes here, other than a division between "desires" and "intentions". Desires are when children state or ask for permission to do or have something that they want in the future. Intentions are when children say they will do something or tell Parent they "should" or "need to" do something in the future. Intentions may seem preparatory (e.g., child saying they need to bring a dive ring on Saturday) but the preparatory actions are in the future and not happening "now" which distinguishes these instances from Theme 4: Preparing for the Future (i.e., the preparatory action is not the instance here, stating an *intention* for the preparatory action is the instance). It is unclear whether these intentions will hold over time to be executed as preparatory actions which is why they are not considered as such. Intentions may also include asking Parent to remind/tell/cue the child to act, resembling the "intention-setting" phase of prospective memory. Moreover, some instances could be either an intention or desire (for example, statements that begin with "I would like to") and this is why these aren't firm subthemes. Some intentions appear to be "matter of fact" statements of what they will do (e.g., "I'm not having poutine, hot dogs, or pop for dinner.") but these differ from Theme 4 (Forecasting) because they are things (typically actions) within the child's control (or perceived control) that express a sense of agency (e.g., "I will") whereas predictions lack this agency and are statements about what will happen (e.g., the day's schedule).

Theme 2: Future-oriented information-seeking

All instances in this theme are statements (specifically questions) about a future event. Children express this to *build future understanding* about what's to come, and at times, why the event is as such or how to prepare for the event. Instances in this theme may seem preparatory (e.g., asking parent if they should bring a raincoat outside) but the child is too uncertain to act independently based on their own thinking and needs confirmation/information from the parent, distinguishing these instances from "Preparing for the future".

Theme 3: Preparing for the future

The definition of "preparing" is to "put in proper condition or readiness". This theme includes statements and (mostly) actions. Instances in this theme are children doing (or telling someone to do) something that will prepare for a future event. Distinguishing from Theme 2 (Desires & Intentions), statements of intent in this theme include a predicted future outcome to the intention (e.g., telling parent to wake up or they will miss swimming and it will be dark). Children in these instances seem to know (perhaps through learned associations and scripts) what is required to make these events happen (i.e., knowing they need to pack a camera for Park Omega). Actions are done to prepare or get ready for the event or to make the occurrence of the event *easier* (e.g., clearing space or getting plates for dinner). The child may ready themselves (or items) that fit the event's script (e.g., red clothes for Remembrance Day). Preparations may be based on learned

associations and scripts (e.g., charging a phone/tablet) and do not necessarily require future projection to be carried out (e.g., you don't necessarily need to imagine a dead phone to know to charge your tech) which may also lead them to make "mistakes" (e.g., child giving parent a diaper bag when they leave the house without the baby). Distinguishing from Theme 5 ("Optimizing the future"), children are not doing anything to specifically *change* the outcome of the event, rather they are assuring the occurrence of the event (perhaps making this occurrence easier). Distinguishing from future intentions, statements in this theme include a predicted outcome to the intention.

Theme 4: Predicting the future

This theme includes statements where children make predictions about the future. These statements may have been made to demonstrate knowledge of the future (e.g., saying their class will get freezies tomorrow), for fun/entertainment (e.g., predicting a TV show's plot), or for emotion regulation (e.g., predicting Halloween night won't be as fun this time). Predictions of one's (or another's) mental state were scarce (much like in the 2021 dataset) and most predictions related to a specific future event.

Theme 5: Optimizing the future

Definition of optimize in the dictionary is "to make as effective, perfect, or useful as possible". This theme contains both actions and statements. In this theme, children are doing (or requesting something to be done) to *change* the predicted future outcome. Instances in this theme may be a form of preparation but they also involve deductive reasoning (potentially combining multiple learned scripts/associations) to *improve* the future outcome or prevent negative outcomes. For instance, wrapping a binder and hiding it under the seat so that it doesn't get ruined from the heat, takes deductive reasoning on the child's behalf beyond simply charging their phone, which can be done by association ("charge" and "phone"). Statements in this theme may be a request for something (e.g., can we go to an earlier mass, or can we walk to school) accompanied with a *changed* future outcome (i.e., so that mass can finish earlier or so I can miss more school), thus distinguishing from "future intentions" and "preparing for the future". Actions require "deductive" future thinking, perhaps involving the combinations of known scripts and predictions (e.g., waiting to change hearing aid batteries until after their swimming lesson, knowing they would not be needed during the lesson).

Chapter 5: General Discussion

Summary of Study Findings

This dissertation investigates the development of spontaneous episodic future thinking (EFT) in both experimental (Study 1) and naturalistic (Studies 2 and 3) contexts. It also explores factors that may contribute to the emergence of unprompted EFT-driven, future-oriented behaviour—such factors include executive functioning (Study 1) and cues types (Study 3).

Study 1 introduced a novel experimental paradigm designed to measure when children aged 4 to 9 would independently retrieve an item in preparation for a future event. This task is the first, to my knowledge, designed to capture EFT-driven behaviour in a controlled setting. Study 1 also included measures of executive functioning (i.e., inhibition, working memory, and activation of abstract representations), prospective memory, and the frequency of children's daily future-oriented behaviour in order to examine how these factors may relate to spontaneous performance. We hypothesized that children would begin to prepare spontaneously around age 7, coinciding with significant development in the executive control network that supports self-directed and proactive behaviour, including executive functioning (Gerlach et al., 2011; Munakata et al., 2012). Contrary to our hypothesis, most 5-year-olds (65%) prepared spontaneously, while most 4-year-olds (74%) required prompting to retrieve the item. This suggests a transitional period from more scaffolded to more autonomous future-oriented behaviour between ages 4 and 5. Moreover, children's spontaneous preparation correlated with performance on the prospective memory task and did not correlate with any executive functioning measures, while prompted preparation was associated with performance on a measure of working memory and inhibition (i.e., backwards digit span) – indicating that spontaneous and prompted preparation may rely on distinct cognitive mechanisms. These

findings suggest that executive functioning may not be critical to the emergence of EFT-driven behaviour; rather, factors such as motivation and intention setting may play a stronger role in predicting successful spontaneous preparation for a future event.

Study 2 investigated children's spontaneous EFT in their everyday environment, using a novel methodology run as a proof-of-concept study with a small sample of children (*N*=10; 3-, 4-, 6-, and 7-year-olds). Parents reported their children's unprompted expressions of future thinking (i.e., future-oriented actions and statements) over a seven-day period. The primary aim of this study was to understand the functionality of children's everyday future thoughts and how they might resemble the functions of future thinking identified in adults (e.g., Hallford & D'Argembeau, 2022). As this has not been previously studied, no specific hypotheses were made regarding functionality. However, we hypothesized that older children (6- and 7-year-olds) would produce more instances overall and a higher proportion of actions compared to younger children (3- and 4-year-olds). A thematic analysis addressing "why" children expressed these future thoughts revealed four themes: 1) *Expressing future desires and/or intentions,* 2) *Future-oriented information-seeking,* 3) *Connecting present actions to future outcomes,* and 4) *Predicting future mental and physiological states*. These themes could be linked to adult functions of future thinking: intention formation and goal-setting (Theme 1; Barsics et al., 2016; Hallford & D'Argembeau, 2022), emotional regulation (Themes 1 and 2; Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022), directive action planning (Theme 3; Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022) and self-continuity and identify formation (Theme 4; Duffy & Cole, 2021). The proportion of instances within each theme did not significantly differ by age group, suggesting that younger children engaged their future thinking similarly to older children.

Contrary to our hypothesis, we found no significant difference in the mean number of instances of older children compared to younger children. While older children did have a higher proportion of reported actions (5.4%) than younger children (4.5%), this difference was not significant. However, given the small sample size, findings should be interpreted with caution and replicated with a larger sample.

Study 3 aimed to extend findings from Study 2 by implementing a similar methodology with a larger sample of children (N=42; 3- to 9-year-olds). To address the limitations of Study 2, several methodological modifications were made to reduce the burden on participating parents (e.g., shortening the tracking period to four days). Study 3 also included a secondary objective exploring what may have "triggered" children's future-thinking expressions. To investigate this, parents reported the types of cues present during each expression (e.g., visual, auditory, internal), the typicality of the expression (i.e., how frequently it was observed), and whether the immediate context matched the anticipated future event – for example, whether a statement made at home referred to an event happening at home (same context) or elsewhere (different context). We hypothesized that older children (6- to 9-year-olds) would exhibit a higher proportion of actions than younger children (3- to 5-year-olds). We also predicted that younger children's expressions would be more frequently triggered by external cues (e.g., visual or auditory), whereas older children would show a higher proportion of internally generated cues.

A thematic analysis on the functionality of the expressions revealed five themes: 1) *Expressing future desires or intentions*, 2) *Future-oriented information-seeking*, 3) *Preparing for the future*, 4) *Predicting the future* and 5) *Optimizing the future.* These themes largely replicate thematic findings from Study 2, with two recurring themes (Themes 1 and 2), and one related theme (Theme 4) which expands on a Study 2 theme, *Predicting future mental and physiological*

states. Older children exhibited a higher proportion of instances coded under Theme 3 (*Preparing for the future*) compared to younger children, while no significant age differences were found in the other themes. This pattern suggests that, with a larger sample size and greater variability, age-related differences in the functionality of children's future thinking may become more evident. Similar to Study 2, parallels could be drawn between the themes and the functions of future thinking in the adult literature: intention formation and goal-setting (Theme 1; Barsics et al., 2016; Hallford & D'Argembeau, 2022), emotional regulation (Theme 2; Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022), directive action planning (Themes 3 and 5; Barsics et al., 2016; D'Argembeau et al., 2011; Duffy & Cole, 2021; Hallford & D'Argembeau, 2022), social bonding and reducing boredom (Theme 4; Duffy & Cole, 2021; Hallford and D'Argembeau, 2022).

Supporting our first hypothesis, older children had a significantly higher proportion of actions compared to younger children. Children's expressions were primarily internally cued (55.8%), previously observed (71.9%), and related to a different context (53.4%). Contrary to our second hypothesis, there were no age differences in the proportion of cue types. Similarly, no age differences were found in the typicality of the expression, or the context match. Findings from this study show that even 3- and 4-year-olds can exhibit sophisticated action planning (i.e., Theme 5, *Optimizing the future*), suggesting that naturalistic settings and familiar future events may uncover evidence of unprompted future-oriented behaviour sooner in development than standardized laboratory methods. Moreover, the typicality of the expression and the child's motivation appear to be strong drivers in the prevalence of children's unprompted future-oriented expressions.

Implications and Contributions to the Literature

Knowledge Contributions

The findings of this dissertation fill a critical gap in our understanding of the development of children's spontaneous EFT, an area that has been largely overlooked in the existing research. I had hypothesized that spontaneous EFT, as demonstrated by unprompted future-oriented behaviour, would emerge in middle childhood, around age seven. This hypothesis was based on developmental evidence for the emergence of unprompted future-oriented behaviour in other contexts (Brinums et al., 2018; 2021) and neuroscientific evidence suggesting it requires cognitive control and activation of the dorsolateral prefrontal cortex (DLPFC; Gerlach et al., 2011).

Development of Spontaneous EFT. Contrary to my original hypothesis, the results from my studies suggest that spontaneous EFT may emerge during the preschool years (ages 3 to 5). This parallels the development of more "prompted" EFT evidenced in previous work (e.g., Atance et al., 2019; Suddendorf et al., 2011). However, my dissertation diverges from this prior research by examining children outside of traditional laboratory settings. Even Study 1, which employed an experimental paradigm, was conducted in children's homes where they may feel more comfortable acting on spontaneous thoughts (Pham et al., 2024). Thus, although this work did not scaffold children's future thinking through prompting, observing them in a familiar environment may have made the measures more sensitive to detecting EFT. It is possible that a prompted version of Study 1 may show emergence of EFT before the preschool years, as has been seen in naturalistic observations (Nelson, 1989).

It might also be that cognitive control is not necessary for spontaneous EFT – further supported by findings from Study 1, which show no association between spontaneous

preparation and executive functioning. This aligns with dual-process theories of future thinking, which propose that future thoughts can arise through two distinct cognitive routes (Cole & Kvavilashvili, 2021; Jeunehomme & D'Argembeau, 2016; see also Berntsen, 1996 and Kvavilashvili & Ford, 2022 for similar theories on involuntary episodic memories). The first route is deliberate and involves the intentional construction and elaboration of a future scenario—such as purposefully planning a dinner party, as illustrated by my example in the General Introduction. The second route involves the rapid, involuntary[16] reactivation of previously imagined future events. For example, I might take a walk through a park and see a family enjoying a meal together which triggers a thought about my dinner party. This second route is less cognitively demanding and triggered through associative cuing (Kvavilashvili & Rummel, 2020). In adults, involuntary future thoughts occur more frequently in day-to-day life than deliberate future thoughts (Berntsen & Jacobsen, 2008). This may also be true for children. Indeed, the characteristics of the future-oriented expressions from Studies 2 and 3 largely resemble the characteristics of involuntary future thought. For instance, involuntary future thoughts are often reported "memories of the future" – thoughts the individual has had before (Cole & Kvavilashvili, 2021). Similarly, most expressions in Study 3 were reported to have been previously observed (71.9%) and, of those, frequently occurring (69%). Sloutsky (2015) argued that cognitive development in children is shaped not only by inherent maturation but also by the nature and frequency of experiences they encounter. He posits that younger children are particularly adept at compression-based learning, which involves passively absorbing patterns or regularities from "statistically dense" experiences in their environment. Compression-based

[16] Researchers in this field (e.g., Berntsen & Jacobsen, 2008; Kvavilashvili & Rummel, 2020) also refer to "involuntary" future cognition as "spontaneous", however, to maintain clarity for the reader, I will use the term "involuntary" when discussing their work.

learning is fast and automatic, recruiting the inferotemporal cortex. In contrast, uncommon or "statistically sparse" experiences require selection-based learning – which requires cognitive control, attention shifting, and inhibition, and recruits DLPFC (Sloutsky, 2015). Given that the majority of children's spontaneous future-oriented expressions in Study 3 were routine or frequently occurring, it is plausible that they stemmed from repeated exposure and associative learning, rather than effortful, strategic prospection.

EFT-driven behaviour. A central aim of my dissertation work is understanding when and how EFT translates into *behaviour*. This is what I argue to be a key adaptive function of EFT (Baumeister et al., 2016; Suddendorf et al., 2018). Indeed, involuntary future thoughts are often related to upcoming plans (Berntsen & Jacobsen, 2008), suggesting that even when future thinking is not intentional, it still serves a pragmatic function (Baumeister et al., 2016). In Study 1, children began to spontaneously prepare for a future event at age five—the same age at which they tend to succeed on more "generative" versions of the Spoon task (Atance et al., 2019; Moffett et al., 2018), as well as on versions that limit the use of associative strategies (Dickerson et al., 2018; Martin-Ordas, 2017). This convergence raises the possibility that, even in prompted paradigms, 5-year-olds may be drawing on their EFT to guide future-oriented behaviour.

Across the studies in this dissertation, there was some evidence of an age-related increase in future-oriented actions. Study 3 revealed that older children (6 to 9 years old) produced a higher proportion of actions than younger children (3 to 5 years old). Study 1 also showed a significant increase in spontaneous preparation between 4 and 5 years old. However, my findings also show that age may not be a reliable predictor of unprompted future-oriented behaviour. In Study 1, spontaneous performance in 5-year-olds did not significantly differ from that of 6- to 9-year-olds, suggesting that children were not more likely to spontaneously prepare as they got

older. Furthermore, in Studies 2 and 3, future-oriented actions were also reported in 3- and 4-year-olds (e.g., bringing a dive ring to swim class), albeit less frequently than older children. Taken together, these findings highlight that while age may contribute to the development of EFT-driven behaviour – particularly during preschool years – individual differences may play a more significant role in shaping when and how future thoughts translate into action.

One factor that appeared to influence the frequency of unprompted future-oriented behaviour across all my studies is children's motivation. In Study 1, the 8- and 9-year-olds did not perform at ceiling. While it may be that EFT-driven behaviour continues to develop during middle childhood and beyond, a more likely explanation is that older children were not sufficiently motivated by the study (or the "special surprise") to act spontaneously. This has important implications for understanding the translation of EFT into action: it is possible that older children anticipated needing an item but *chose* not to act on that thought. Motivation also emerged as an important factor in the prevalence of future-oriented expressions in Studies 2 and 3, with many expressions related to events that children were excited, curious, or interested about. Indeed, the most prevalent theme in Studies 2 and 3 entailed children expressing what they wanted in the future (i.e., *Expressing future desires and intentions*), suggesting they most frequently engage their future thinking for motivating, or emotionally salient events. These findings align with naturalistic and experimental research on children's future thinking. Mahy and colleagues' (2023) diary study found task motivation to be a significant predictor of children's successful prospective memory in everyday contexts. Similarly, Opriş and colleagues (2021) found that 3- to 6-year-olds performed better on Spoon tasks with emotionally positive events (i.e., where the child gains from a correct response) compared to neutral or emotionally negative events. Complimenting this, research with adults has shown that positive future events

produce more vivid pre-experiencing than negative events (D'Argembeau & Van der Linden, 2004). While further research is needed to better understand the emotional nature of the future events children typically anticipate, this dissertation offers preliminary evidence that they may be more inclined to act on their future thoughts when those events are positive or rewarding.

Methodological Contributions

The studies within this dissertation introduce new methodologies designed to capture and measure spontaneous future thinking in children. Study 1 is the first developmental paradigm, to my knowledge, designed to elicit evidence of spontaneous EFT that is translated into actionable preparation. Inspired by Tulving's (2005) original proposal of the "Spoon test" as a behavioural demonstration of EFT, and the criteria later formalized for measuring EFT in young children (Suddendorf et al., 2011), this task produced strong evidence that children's unprompted item retrieval is driven by their own thought of a specific future event.

Studies 2 and 3 contribute a novel and feasible methodology for sampling real-life examples of children's future-oriented behaviour. This approach highlights the value of parental involvement to better understand children's cognitive development. Due to limitations in verbal communication and self-reporting, young children's cognitive processes are often studied using an outside perspective (e.g., by observing their behaviour). Parents, who spend the most time with their children – particularly in the preschool years – have unique insight into their child's personality, memories, and motivations, providing important context for interpreting their behaviours. Moreover, children feel more comfortable around their parents than with unfamiliar experimenters which may encourage more authentic expressions of their cognition.

Studies 2 and 3 also highlight the importance of naturalistic investigation into children's future thinking. Currently, there is a gap in the naturalistic understanding of children's future

thinking, as the literature predominantly focuses on experimental paradigms. Experiments are valuable for isolating and assessing specific cognitive processes (Dahl, 2017). However, experimental tasks operationalize abstract psychological constructs in ways that don't necessarily reflect real-world complexity (Diener et al., 2022). When evidence is built predominantly on experimental paradigms, it can shape the questions researchers ask and the answers they find. Dahl (2017) asserts that experimental researchers often make "ecological commitments" or assumptions about children's everyday lives. While experimental tasks play a critical role in advancing our understanding of cognitive development, it is equally important to balance these findings with insights from naturalistic investigations to ensure that research remains relevant to children's everyday experiences. To illustrate, in experimental research, EFT is typically operationalized as a deliberate and effortful process. However, naturalistic studies with adults show that most future thoughts occur involuntarily and with little cognitive effort (Berntsen & Jacobsen, 2008). Cole and Kvavilashvili (2021) similarly argued that most existing future thinking paradigms are designed to measure effortful, deliberate construction of future scenarios—for instance, by asking participants to generate a future event in response to a cue word (Addis et al., 2007). Their arguments parallel my critique of experimenter prompting. Researchers often prompt participants to produce effortful and "correct" responses– such as stating a plausible event or bringing an appropriate item to a future context. In doing so, these tasks typically overlook the presence of spontaneous EFT, which might occur without effortful retrieval (Kvavilashvili & Rummel, 2020). My dissertation work omits any prompting, allowing children to act on internally generated, spontaneous future thoughts. This approach may better reflect how EFT naturally occurs in children's everyday lives.

Practical Implications

Understanding when children independently engage in future-oriented behaviour – such as preparing for an event or acting on a future goal – has important practical implications. As argued above, much of the existing research on children's EFT has relied on prompting or structured tasks, which, while informative, do not reflect how future thinking unfolds in children's everyday lives. In contrast, my dissertation demonstrates that even young children (e.g., 3-year-olds) can act on future-oriented thoughts spontaneously – particularly when the context is familiar, meaningful, or motivating.

These findings are relevant for parents, caregivers, and educators who often scaffold children's planning and preparation through prompts (e.g., telling them to wear their toque outside on a cold day). Understanding the conditions under which children initiate future-oriented behaviours *independently* can inform how we support their autonomy. Findings from this dissertation suggest that children's motivation may play a pivotal role in their enactment of future-oriented behaviour. Taking a practical lens, caregivers might encourage children's autonomous engagement by highlighting the emotional salience or positive outcomes of the behaviour, rather than prompting it directly. Indeed, previous work has also evidenced that imagining positive emotional outcomes has encouraged future-oriented behaviour (Brinums et al., 2023; Zhang et al., 2024).

Study 3 showed that most of the future-oriented behaviours children expressed were repeated or related to routine events in their daily lives. This suggests that predictability in a child's environment may foster opportunities for spontaneous future-oriented action. Indeed, findings from Studies 2 and 3 show that a great deal of children's future thinking is dedicated to seeking information or understanding about the future. When children know what to expect—

like a regular swimming lesson or school day—their future thinking could instead be used to anticipate needs and act accordingly. For parents and educators, this underscores the value of consistent routines in supporting children's autonomy and planning skills. While repeated events and routines may support the self-directed enactment of future-oriented behaviour, further research is still needed to understand how to foster children's self-directed cognition. Barker et al. (2014) found that children who engaged in less-structured activities – defined as periods during which children, not adults, decide what they do – demonstrated stronger self-directed executive functioning, which enables them to independently determine goal-directed actions. Although this finding might suggest that less-structured time can support autonomy more effectively than a highly regimented schedule, it does not necessarily contradict my dissertation findings (e.g., a child may experience a regularly scheduled time for unstructured play). Rather, both the existing literature and my dissertation highlight the need to further explore how family structures and household routines influence children's developing cognition and autonomy.

In sum, findings across my dissertation studies carry practical significance for understanding how to support children's growing independence. By fostering predictable environments and promoting motivation, caregivers and educators can help create the conditions that naturally support the emergence of volitional, goal-directed behaviour.

Limitations and Future Directions

Like all research, this body of work carries certain limitations that also serve as opportunities for future investigation. In Study 1, older children (8- to 9-year-olds) did not perform at ceiling, which may reflect a lack of motivation rather than a true absence of spontaneous EFT. The "special surprise" used to extrinsically motivate children to act may not have been sufficiently engaging or meaningful for this age group. Future research should

consider adapting the structure of this paradigm to be more age-appropriate to older children. This might include developing a problem event and reward that is more intrinsically motivating (e.g., a monetary reward). This will allow for a more appropriate assessment of spontaneous EFT and EFT-driven behaviour in middle childhood. Moreover, prompting, as defined in this dissertation, refers to an explicit verbal instruction signalling the need to act. Although Study 1 did not directly prompt children to retrieve an item, they were still prompted by being told to "get up and do whatever they want" during the phone call. Thus, it could be argued that prompting was not fully eliminated in this methodology, but rather reduced. Furthermore, children were *cued* to think about the future by being told they would meet the crying babies again. Prompting and cuing may be conceptualised as existing along a continuum, with direct instruction providing the highest level of scaffolding for initiating behaviour and more subtle visual or auditory environmental cues constituting the lowest level. Future research could investigate the developmental emergence of future-oriented behaviour along this continuum.

In Studies 2 and 3, it is not possible to distinguish whether children's expressions were episodic or semantic in nature (e.g., "When will I become a soccer player?"). Since Tulving's (1972) original proposal of semantic and episodic systems for mental time travel, this distinction has been central to the subsequent research and experimental design in the field. However, recent work has questioned whether such a distinction can be made, particularly in naturalistic contexts (Addis & Szpunar, 2024; Duff et al., 2020). Notably, Addis and Szpunar – researchers who had previously supported the semantic–episodic distinction (e.g., Addis et al., 2007; Szpunar et al., 2014) – have recently argued for a more nuanced framework. Acknowledging the challenges of classifying mental representations in everyday contexts, they propose a multidimensional model that moves beyond the episodic-semantic dichotomy (Addis & Spzunar, 2024). From this

perspective, the ambiguity in my naturalistic data (Studies 2 and 3) may reflect the inherent complexity of real-world mental time travel, rather than a limitation of the current methodology.

Studies 2 and 3 are also limited by the individual differences and biases among parent reporters. Although I met with each parent individually to, ideally, increase their motivation to participate, some parents may have been more diligent than others in observing and tracking their child's behaviour. Parents also differ in their household schedules. While we asked them to report the number of hours spent with their child, we could not account for the *quality* of that time, which likely varied both within and between participants. Additionally, some parents tracked two of their children, meaning their reporting was represented twice in the dataset. These reporting differences have important implications for the quantitative analyses for these studies, which should be interpreted cautiously. Previous research has highlighted discrepancies between parent-report and children's self-report, particularly regarding children's internal mental states (Lagattuta et al., 2011; Stokes et al., 2011). Thus, while parent-report is a feasible method for naturalistic observation of young children, it is important to acknowledge its limitations.

Future research should replicate the methodologies developed in this dissertation to further establish their feasibility and validity. One experimental direction for future research could involve manipulating the motivational value of engaging in future-oriented behaviour. For example, Study 1's paradigm could be adapted to include between-subject conditions which vary reward level (e.g., winning 10 cents vs. winning 10 dollars). Researchers could also examine the influence of event typicality on unprompted future-oriented behaviour. This may be done by varying frequency of exposure to a novel event (e.g., single time vs. five times), or by comparing spontaneous preparation for typical, routine events (e.g., getting ready for school) versus unique or uncommon events (e.g., bringing a key to open a locked box). A third future research direction

may be to investigate whether children's spontaneous EFT is typically retrieved involuntarily (i.e., with low-effort) or deliberately (i.e., with high-effort). Previous research has shown that 5-year-olds were capable of retrospectively identifying their own involuntary autobiographical memories (Kvavilashvili & Ford, 2022), thus indicating the metacognitive capacity for children this age to identify how their future thoughts typically arise. Importantly, naturalistic investigations should continue to build real-world evidence of when and how children engage their future thinking.

Conclusion

This dissertation sheds light on a critically understudied aspect of children's cognitive development: spontaneous EFT and EFT-driven behaviour. Study 1 introduced a novel paradigm to capture spontaneous preparation in an experimental context, revealing that EFT-driven behaviour emerges around age five, operating independently of executive functioning. Studies 2 and 3 extended this inquiry into children's natural environments, using parent-report methods to identify the functions of children's everyday future-oriented thought. The findings underscore the pragmatic and self-initiated nature of future thinking in childhood, suggesting that even very young children use future thinking to plan, anticipate, and navigate daily life in meaningful ways.

Collectively, this work not only advances theoretical understanding of the development of EFT, but also provides researchers with new, replicable methods for studying spontaneous EFT in children. By shifting focus away from prompted tasks and toward more naturalistic, child-initiated behaviours, this research invites a richer and more ecologically valid understanding of how children mentally project themselves forward in time. Future studies may build on this work by understanding how motivation and event typicality affect EFT-driven

behaviour and exploring whether spontaneous EFT in children is typically deliberate or involuntary. As research in this area continues to grow, it will further clarify how best to support children's development into autonomous, forward-thinking individuals.

References for General Introduction and General Discussion

Addis, D. R., & Szpunar, K. K. (2024). Beyond the episodic–semantic continuum: The multidimensional model of mental representations. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *379*(1913), 20230408. https://doi.org/10.1098/rstb.2023.0408

Addis, D. R., Wong, A. T., & Schacter, D. L. (2007). Remembering the past and imagining the future: Common and distinct neural substrates during event construction and elaboration. *Neuropsychologia*, *45*(7), 1363–1377. https://doi.org/10.1016/j.neuropsychologia.2006.10.016

Andrews-Hanna, J. R., Smallwood, J., & Spreng, R. N. (2014). The default network and self-generated thought: Component processes, dynamic control, and clinical relevance: The brain's default network. *Annals of the New York Academy of Sciences*, *1316*(1), 29–52. https://doi.org/10.1111/nyas.12360

Atance, C. M., Ayson, G., & Martin-Ordas, G. (2023). Moving beyond "Spoon" tasks: When do children autocue their episodic future thought? *WIREs Cognitive Science*, *14*(4), e1646. https://doi.org/10.1002/wcs.1646

Atance, C. M., Celebi, S. N., Mitchinson, S., & Mahy, C. E. V. (2019). Thinking about the future: Comparing children's forced-choice versus "generative" responses in the "spoon test." *Journal of Experimental Child Psychology*, *181*, 1–16. https://doi.org/10.1016/j.jecp.2018.12.006

Atance, C. M., Louw, A., & Clayton, N. S. (2015). Thinking ahead about where something is needed: New insights about episodic foresight in preschoolers. *Journal of Experimental Child Psychology*, *129*, 98–109. https://doi.org/10.1016/j.jecp.2014.09.001

Atance, C. M., & Mahy, C. E. V. (2016). Episodic Future Thinking in Children. In K. Michaelian, S. B. Klein, & K. K. Szpunar (Eds.), *Seeing the Future* (pp. 367–386). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780190241537.003.0018

Atance, C. M., & O'Neill, D. K. (2001). Episodic future thinking. *Trends in Cognitive Sciences*, *5*(12), 533–539. https://doi.org/10.1016/S1364-6613(00)01804-0

Ayson, G., & Atance, C. M. (2024). Children's mental time travel into the future: A functional perspective. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *379*(1913), 20230399. https://doi.org/10.1098/rstb.2023.0399

Barsics, C., Van Der Linden, M., & D'Argembeau, A. (2016). Frequency, characteristics, and perceived functions of emotional future thinking in daily life. *Quarterly Journal of Experimental Psychology*, *69*(2), 217–233. https://doi.org/10.1080/17470218.2015.1051560

Baumeister, R. F., Hofmann, W., Summerville, A., Reiss, P. T., & Vohs, K. D. (2020). Everyday Thoughts in Time: Experience Sampling Studies of Mental Time Travel. *Personality and Social Psychology Bulletin*, *46*(12), 1631–1648. https://doi.org/doi.org/10.1177/014616722090841

Baumeister, R. F., Vohs, K. D., & Oettingen, G. (2016). Pragmatic Prospection: How and Why People Think about the Future. *Review of General Psychology*, *20*(1), 3–16. https://doi.org/10.1037/gpr0000060

Beaty, R. E., Benedek, M., Silvia, P. J., & Schacter, D. L. (2016). Creative Cognition and Brain Network Dynamics. *Trends in Cognitive Sciences*, *20*(2), 87–95. https://doi.org/10.1016/j.tics.2015.10.004

Berntsen, D. (1996). Involuntary Autobiographical Memories. *Applied Cognitive Psychology*, *10*(5), 435–454. https://doi.org/10.1002/(SICI)1099-0720(199610)10:5<435::AID-ACP408>3.0.CO;2-L

Berntsen, D., & Jacobsen, A. S. (2008). Involuntary (spontaneous) mental time travel into the past and future. *Consciousness and Cognition*, *17*(4), 1093–1104. https://doi.org/10.1016/j.concog.2008.03.001

Botzung, A., Denkova, E., & Manning, L. (2008). Experiencing past and future personal events: Functional neuroimaging evidence on the neural bases of mental time travel. *Brain and Cognition*, *66*(2), 202–212. https://doi.org/10.1016/j.bandc.2007.07.011

Brinums, M., Imuta, K., & Suddendorf, T. (2018). Practicing for the Future: Deliberate Practice in Early Childhood. *Child Development*, *89*(6), 2051–2058. https://doi.org/10.1111/cdev.12938

Brinums, M., Redshaw, J., Nielsen, M., Suddendorf, T., & Imuta, K. (2021). Young children's capacity to seek information in preparation for a future event. *Cognitive Development*, *58*, 101015. https://doi.org/10.1016/j.cogdev.2021.101015

Brinums, M., Franco, C., Kang, J., Suddendorf, T., & Imuta, K. (2023). Driven by emotion: Anticipated feelings motivate children's deliberate practice. *Cognitive Development*, *66*, 101340. https://doi.org/10.1016/j.cogdev.2023.101340

Bromberg-Martin, E. S., Matsumoto, M., & Hikosaka, O. (2010). Dopamine in motivational control: Rewarding, aversive, and alerting. *Neuron*, *68*(5), 815–834. https://doi.org/10.1016/j.neuron.2010.11.022

Busby, J., & Suddendorf, T. (2005). Recalling yesterday and predicting tomorrow. *Cognitive Development*, *20*(3), 362–372. https://doi.org/10.1016/j.cogdev.2005.05.002

Caza, J. S., & Atance, C. M. (2019). Children's behavior and spontaneous talk in a future thinking task. *Psychological Research*, *83*(4), 761–773. https://doi.org/10.1007/s00426-018-1089-1

Cole, S., & Kvavilashvili, L. (2021). Spontaneous and deliberate future thinking: A dual process account. *Psychological Research*, *85*(2), 464–479. https://doi.org/10.1007/s00426-019-01262-7

Dahl, A. (2017). Ecological Commitments: Why Developmental Science Needs Naturalistic Methods. *Child Development Perspectives*, *11*(2), 79–84. https://doi.org/10.1111/cdep.12217

Daniel, T. O., Said, M., Stanton, C. M., & Epstein, L. H. (2015). Episodic future thinking reduces delay discounting and energy intake in children. *Eating Behaviors*, *18*, 20–24. https://doi.org/10.1016/j.eatbeh.2015.03.006

D'Argembeau, A., Renaud, O., & Van der Linden, M. (2011). Frequency, characteristics and functions of future-oriented thoughts in daily life. *Applied Cognitive Psychology*, *25*(1), 96–103. https://doi.org/10.1002/acp.1647

D'Argembeau, A., & Van der Linden, M. (2004). Phenomenal characteristics associated with projecting oneself back into the past and forward into the future: Influence of valence and temporal distance. *Consciousness and Cognition*, *13*(4), 844–858. https://doi.org/10.1016/j.concog.2004.07.007

Diamond, A. (2002). Normal development of prefrontal cortex from birth to young adulthood: Cognitive functions, anatomy, and biochemistry. In D. Stuss & R. Knight, *Principles of Frontal Lobe Function* (pp. 466–503). Oxford University Press.

Dickerson, K. L., Ainge, J. A., & Seed, A. M. (2018). The Role of Association in Pre-schoolers' Solutions to "Spoon Tests" of Future Planning. *Current Biology*, *28*(14), 2309-2313.e2. https://doi.org/10.1016/j.cub.2018.05.052

Diener, E., Northcott, R., Zyphur, M. J., & West, S. G. (2022). Beyond Experiments. *Association for Psychological Science*, *17*(4), 1101–1119. https://doi.org/doi.org/10.1177/174569162110376

Duff, M. C., Covington, N. V., Hilverman, C., & Cohen, N. J. (2020). Semantic Memory and the Hippocampus: Revisiting, Reaffirming, and Extending the Reach of Their Critical Relationship. *Frontiers in Human Neuroscience*, *13*, 471. https://doi.org/10.3389/fnhum.2019.00471

Duffy, J., & Cole, S. N. (2021). Functions of spontaneous and voluntary future thinking: Evidence from subjective ratings. *Psychological Research*, *85*(4), 1583–1601. https://doi.org/10.1007/s00426-020-01338-9

Enomoto, K., Matsumoto, N., Nakai, S., Satoh, T., Sato, T. K., Ueda, Y., Inokawa, H., Haruno, M., & Kimura, M. (2011). Dopamine neurons learn to encode the long-term value of multiple future rewards. *Proceedings of the National Academy of Sciences of the United States of America*, *108*(37), 15462–15467. https://doi.org/10.1073/pnas.1014457108

Gerlach, K. D., Spreng, R. N., Gilmore, A. W., & Schacter, D. L. (2011). Solving future problems: Default network and executive activity associated with goal-directed mental simulations. *NeuroImage*, *55*(4), 1816–1824. https://doi.org/10.1016/j.neuroimage.2011.01.030

Hallford, D. J., & D'Argembeau, A. (2022). Why We Imagine Our Future: Introducing the Functions of Future Thinking Scale (FoFTS). *Journal of Psychopathology and Behavioral Assessment*, *44*(2), 376–395. https://doi.org/10.1007/s10862-021-09910-2

Hanson, L. K., Atance, C. M., & Paluck, S. W. (2014). Is thinking about the future related to theory of mind and executive function? Not in preschoolers. *Journal of Experimental Child Psychology*, *128*, 120–137. https://doi.org/10.1016/j.jecp.2014.07.006

Hasher, L., Lustig, C., & Zacks, R. (2007). Inhibitory mechanisms and the control of attention. In *Variation in working memory* (pp. 227–249). Oxford University Press.

Hertrich, I., Dietrich, S., Blum, C., & Ackermann, H. (2021). The Role of the Dorsolateral Prefrontal Cortex for Speech and Language Processing. *Frontiers in Human Neuroscience*, *15*, 645209. https://doi.org/10.3389/fnhum.2021.645209

Hill, E. L. (2004). Executive dysfunction in autism. *Trends in Cognitive Sciences*, *8*(1), 26–32. https://doi.org/10.1016/j.tics.2003.11.003

Hudson, J. (2006). The Development of Future Time Concepts Through Mother-Child Conversation. *Merrill-Palmer Quarterly*, *52*, 70–95. https://doi.org/10.1353/mpq.2006.0005

Irish, M., Addis, D. R., Hodges, J. R., & Piguet, O. (2012). Considering the role of semantic memory in episodic future thinking: Evidence from semantic dementia. *Brain*, *135*(7), 2178–2191. https://doi.org/10.1093/brain/aws119

Irish, M., & Piguet, O. (2013). The Pivotal Role of Semantic Memory in Remembering the Past and Imagining the Future. *Frontiers in Behavioral Neuroscience*, *7*. https://doi.org/10.3389/fnbeh.2013.00027

Jeunehomme, O., & D'Argembeau, A. (2016). Prevalence and determinants of direct and generative modes of production of episodic future thoughts in the word cueing paradigm. *Quarterly Journal of Experimental Psychology*, *69*(2), 254–272. https://doi.org/10.1080/17470218.2014.993663

Klein, S. B. (2013). The complex act of projecting oneself into the future. *WIREs Cognitive Science*, *4*(1), 63–79. https://doi.org/10.1002/wcs.1210

Klein, S. B., Rozendal, K., & Cosmides, L. (2002). A Social-Cognitive Neuroscience Analysis Of The Self. *Social Cognition*, *20*(2), 105–135. https://doi.org/10.1521/soco.20.2.105.20991

Kvavilashvili, L., & Ford, R. M. (2022). Metamemory for involuntary autobiographical memories and semantic mind-pops in 5-, 7- and 9-year-old children and young adults. *Child Development*, *93*(5). https://doi.org/10.1111/cdev.13794

Kvavilashvili, L., & Rummel, J. (2020). On the Nature of Everyday Prospection: A Review and Theoretical Integration of Research on Mind-Wandering, Future Thinking, and Prospective Memory. *Review of General Psychology*, *24*(3), 210–237. https://doi.org/10.1177/1089268020918843

Lagattuta, K. H., Sayfan, L., & Bamford, C. (2012). Do you know how I feel? Parents underestimate worry and overestimate optimism compared to child self-report. *Journal of Experimental Child Psychology*, *113*(2), 211–232. https://doi.org/10.1016/j.jecp.2012.04.001

Le Heron, C., Kolling, N., Plant, O., Kienast, A., Janska, R., Ang, Y.-S., Fallon, S., Husain, M., & Apps, M. A. J. (2020). Dopamine Modulates Dynamic Decision-Making during

Foraging. *The Journal of Neuroscience*, *40*(27), 5273–5282. https://doi.org/10.1523/JNEUROSCI.2586-19.2020

Mahy, C. E. V., Kamber, E., Conversano, M. C., Mueller, U., & Zuber, S. (2023). A Parent-Report Diary Study of Young Children's Prospective Memory Successes and Failures. *Journal of Cognition and Development*, 1–23. https://doi.org/10.1080/15248372.2023.2277930

Marlatt, G. A. (1978). Craving for Alcohol, Loss of Control, and Relapse: A Cognitive-Behavioral Analysis. In *Alcoholism* (pp. 271–314). Springer, Boston, MA. https://doi.org/10.1007/978-1-4613-2874-2_11

Martin-Ordas, G. (2018). "First, I will get the marbles." Children's foresight abilities in a modified spoon task. *Cognitive Development*, *45*, 152–161. https://doi.org/10.1016/j.cogdev.2017.07.001

Moffett, L., Moll, H., & FitzGibbon, L. (2018). Future planning in preschool children. *Developmental Psychology*, *54*(5), 866–874. https://doi.org/10.1037/dev0000484

Mulcahy, N. J., & Call, J. (2006). Apes Save Tools for Future Use. *Science*, *312*(5776), 1038–1040. https://doi.org/10.1126/science.1125456

Mullally, S. L., & Maguire, E. A. (2014). Memory, Imagination, and Predicting the Future: A Common Brain Mechanism? *The Neuroscientist*, *20*(3), 220–234. https://doi.org/10.1177/1073858413495091

Munakata, Y., Snyder, H. R., & Chatham, C. H. (2012). Developing cognitive control: Three key transitions. *Current Directions in Psychological Science*, *21*(2), 71–77. https://doi.org/10.1177/0963721412436807

Nelson, K. (1989). *Narratives from the crib* (pp. viii, 350). Harvard University Press.

Okuda, J., Fujii, T., Ohtake, H., Tsukiura, T., Tanji, K., Suzuki, K., Kawashima, R., Fukuda, H., Itoh, M., & Yamadori, A. (2003). Thinking of the future and past: The roles of the frontal pole and the medial temporal lobes. *NeuroImage*, *19*(4), 1369–1380. https://doi.org/10.1016/S1053-8119(03)00179-4

Opriş, A. M., Cheie, L., & Visu-Petra, L. (2021). Back to the future: Relating the development of episodic future thinking to cognitive and affective individual differences and to motivational relevance in preschoolers. *Memory*, *29*(3), 362–378. https://doi.org/10.1080/09658211.2021.1896734

Pham, Q. A., Ayson, G., Atance, C. M., & Blankenship, T. L. (2024). Measuring spontaneous episodic future thinking in children: Challenges and opportunities. *Learning & Behavior*. https://doi.org/10.3758/s13420-024-00644-1

Quon, E., & Atance, C. M. (2010). A Comparison of Preschoolers' Memory, Knowledge, and Anticipation of Events. *Journal of Cognition & Development*, *11*(1), 37–60. https://doi.org/10.1080/15248370903453576

Russell, J., Alexis, D., & Clayton, N. (2010). Episodic future thinking in 3- to 5-year-old children: The ability to think of what will be needed from a different point of view. *Cognition*, *114*(1), 56–71. https://doi.org/10.1016/j.cognition.2009.08.013

Scarf, D., Gross, J., Colombo, M., & Hayne, H. (2013). To have and to hold: Episodic memory in 3- and 4-year-old children. *Developmental Psychobiology*, *55*(2), 125–132. https://doi.org/10.1002/dev.21004

Schacter, D. L., & Addis, D. R. (2007). The cognitive neuroscience of constructive memory: Remembering the past and imagining the future. *Philosophical Transactions of the Royal*

Society B: Biological Sciences, *362*(1481), 773–786. https://doi.org/10.1098/rstb.2007.2087

Sloutsky, V. (2015). Conceptual Development. In L. S. Liben & R. M. Lerner (Eds.), *Handbook of child psychology and developmental science.* (Seventh edition, Vol. 2). Wiley.

Smallwood, J., & Schooler, J. W. (2015). The science of mind wandering: Empirically navigating the stream of consciousness. *Annual Review of Psychology*, *66*(1), 487–518. https://doi.org/10.1146/annurev-psych-010814-015331

Spreng, R. N., Mar, R. A., & Kim, A. S. N. (2009). The Common Neural Basis of Autobiographical Memory, Prospection, Navigation, Theory of Mind, and the Default Mode: A Quantitative Meta-analysis. *Journal of Cognitive Neuroscience*, *21*(3), 489–510. https://doi.org/10.1162/jocn.2008.21029

Stokes, J., Pogge, D., Wecksell, B., & Zaccario, M. (2011). Parent–Child Discrepancies in Report of Psychopathology: The Contributions of Response Bias and Parenting Stress. *Journal of Personality Assessment*, *93*(5), 527–536. https://doi.org/10.1080/00223891.2011.594131

Suddendorf, T. (1994). *Discovery of the Fourth Dimension: Mental Time Travel and Human Evolution*.

Suddendorf, T. (2017). The Emergence of Episodic Foresight and Its Consequences. *Child Development Perspectives*, *11*(3), 191–195. https://doi.org/10.1111/cdep.12233

Suddendorf, T., Bulley, A., & Miloyan, B. (2018). Prospection and natural selection. *Current Opinion in Behavioral Sciences*, *24*, 26–31. https://doi.org/10.1016/j.cobeha.2018.01.019

Suddendorf, T., & Corballis, M. C. (1997). Mental time travel and the evolution of the human mind. *Genetic, Social, and General Psychology Monographs, 123*(2), 133–167.

Suddendorf, T., & Corballis, M. C. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences*, *30*(3), 299–313. https://doi.org/10.1017/S0140525X07001975

Suddendorf, T., Nielsen, M., & von Gehlen, R. (2011). Children's capacity to remember a novel problem and to secure its future solution: Future solutions of novel problems. *Developmental Science*, *14*(1), 26–33. https://doi.org/10.1111/j.1467-7687.2010.00950.x

Suddendorf, T., & Redshaw, J. (2013). The development of mental scenario building and episodic foresight. *Annals of the New York Academy of Sciences*, *1296*(1), 135–153. https://doi.org/10.1111/nyas.12189

Szpunar, K. K., Spreng, R. N., & Schacter, D. L. (2014). A taxonomy of prospection: Introducing an organizational framework for future- oriented cognition. *Proceedings of the National Academy of Sciences*, *111*(52), 18414–18421. https://doi.org/10.1073/pnas.1417144111

Tulving, E. (1972). *Episodic and semantic memory.* In E. Tulving & W. Donaldson (Eds.), *Organization of Memory* (pp. 381–403). New York, NY: Academic Press.

Tulving, E. (1983). *Elements of Episodic Memory*. Oxford University Press.

Tulving, E. (1985). Memory and consciousness. *Canadian Psychology/Psychologie Canadienne*, *26*(1), 1–12. https://doi.org/10.1037/h0080017

Tulving, E. (2005). Episodic memory and autonoesis: Uniquely human? In H. S. Terrace & J. Metcalfe, *The missing link in cognition: Origins of self-reflective consciousness* (pp. 3–56). Oxford University Press. https://doi.org/10.1093/acprof:oso/9780195161564.001.0001

Vincent, J. L., Kahn, I., Snyder, A. Z., Raichle, M. E., & Buckner, R. L. (2008). Evidence for a frontoparietal control system revealed by intrinsic functional connectivity. *Journal of Neurophysiology*, *100*(6), 3328–3342. https://doi.org/10.1152/jn.90355.2008

Zhang, J., Vohs, K. D., & Carlson, S. M. (2024). Imagining the future improves saving in preschoolers. *Journal of Experimental Child Psychology*, *246*, 105966. https://doi.org/10.1016/j.jecp.2024.105966