The Development of Self-Projection and its Relation to Simulative and Cognitive Abilities

Leia Kopp

Thesis submitted to the University of Ottawa
in partial fulfillment of the requirements for the
Ph.D. in Clinical Psychology.

School of Psychology
Faculty of Social Sciences
University of Ottawa

Table of Contents

Acknowledgements iv

Content of Dissertation and Contributions of Authors v

Abstract vi

Chapter 1: General Introduction 1

Mental Time Travel: The Basics *1*

Dissertation Overview *3*

The Development of Mental Time Travel *3*

Episodic Memory: The Past Self 3

Episodic Future Thinking: The Future Self 7

The Link between Episodic Memory and Episodic Future Thinking *12*

MTT and Other Projective Abilities: Theory of Mind and Executive Function *16*

Children's Understanding of Changes in Mental States Across Time *17*

Changes in Preferences Across Time 19

Dissertation Objectives *25*

Chapter 2: Self-Projection in Early Development: Preschoolers' Reasoning About Changes in Their Future and Past Preferences 27

Abstract *28*

Introduction *29*

Experiment 1: Future Preferences *34*

Method 35

Results and Discussion 39

Experiment 2: Past Preferences *43*

Method 45

Results and Discussion 47

General Discussion: Experiments 1 & 2 ..... *54*

References *60*

Chapter 3: Relations Between Self-Projection, Theory of Mind, and Executive Function Abilities in Early Development 66

Abstract *67*

Introduction *68*

Method *76*

Results *87*

Discussion *94*

References *104*

Chapter 4: General Discussion 114

Summary of Findings *114*

Contributions to Research About the Development of Self-Projection *115*

Remaining Questions, Limitations, and Future Directions *117*

Conclusion *123*

References for General Introduction and General Discussion 124

Appendices 139

Appendix A: Faces Rating Scale *139*

Appendix B: Experiment 1 Sample Protocol *140*

Appendix C: Gender-Matched Adults *147*

Appendix D: Experiment 2 Sample Protocol *148*

Appendix E: Gender-Neutral Baby *155*

Appendix F: Experiment 3 Sample Protocol *156*

Acknowledgements

First and foremost, I'd like to thank my supervisor, Dr. Cristina Atance. From our chance encounter at the Canadian Psychologist Association's Annual Convention in 2013, you have afforded me life-changing opportunities for which I am truly grateful. I am especially fortunate for your encouragement, mentorship, expertise, and inspiration throughout this process as well as your support and flexibility through both easy and challenging moments. I could not have asked for a better supervisor.

To my thesis committee members, Dr. Patricia Brosseau-Liard, Dr. Stuart Hammond, and Dr. Erin Maloney, thank you for your valued insights, thoughtful suggestions, and support in seeing my doctoral research through. I am thankful for your diverse expertise and guidance. I would further like to acknowledge Dwayne Schindler for his statistical mentorship and teachings throughout my time at the University of Ottawa. Thank you for the countless consultations and for sharing your knowledge. A very special thank you to Lojain Hamwi, Alex Noble, Bronwyn O'Brien, Danielle Ovtsyn, and Ronan Sampson for your invaluable contributions in making this research possible. My sincere appreciation to the many families and children who participated.

To my family, I am forever grateful for your steadfast love, support, and encouragement. I truly could not have done it without you.

Finally, I would like to acknowledge the University of Ottawa, The Natural Sciences and Engineering Research Council of Canada, and the Government of Ontario for support in funding this research.

Content of Dissertation and Contributions of Authors

This dissertation is comprised of a multiple-article format including two articles. The first article, "Self-Projection in Early Development: Preschoolers' Reasoning about Changes in Their Future and Past Preferences" was published in the peer-reviewed *Journal of Cognition and Development* (Kopp, Hamwi, & Atance, 2021). The author of this dissertation, Leia Kopp, appears as the first author with fellow lab-member, Lojain Hamwi, and dissertation supervisor, Cristina M. Atance, as co-authors. Lojain Hamwi contributed to data collection and provided feedback on the manuscript. The second article, "Relations Between Self-Projection, Theory of Mind, and Executive Function Abilities in Early Development", will be submitted for publication to a peer-reviewed journal.

Leia Kopp's contributions to both articles included literature review, theoretical and methodological formulation, ethics application, data collection, transcription/preparation, and analysis, and thesis proposal and manuscript preparation and revision. Dr. Atance provided expert guidance and support in conceptualization, experimental developmental research design, and academic writing throughout this dissertation project.

Abstract

This dissertation investigates self-projection (i.e., future and past preferences reasoning) and possible underlying mechanisms [Theory of Mind (ToM), executive function (EF)] in early development. All children were tested in person prior to the COVID-19 pandemic. Our first objective was to explore preschoolers' understanding that the preferences they may hold in the future (Future Preferences task, adapted from Bélanger, Atance, Varghese, Nguyen, & Vendetti, 2014; Experiment 1), and likely held in the past (Past Preferences task; Experiment 2), differ from their current preferences. To do so, we implemented a novel continuous measure of children's preferences (faces rating scale; Kopp et al., 2017; adapted from; Wong & Baker, 1988) in addition to the more standard categorical response measure (item selection) used in children's future preferences reasoning research (Bélanger et al.). In addressing our second objective to investigate children's *past* preferences reasoning, we designed a new task (Past Preferences task) to complement our Future Preferences task.

In Chapter 2 (Experiments 1 & 2), we found 3-, 4-, and 5-year-olds' success in reasoning about their future and past preferences generally improved with age. Results from our continuous preferences measure further revealed subtle developments in preschoolers' preferences reasoning not gleaned from our categorical data alone. We found that, around age 4, children demonstrate some understanding that they will prefer child items less and adult items more in the future (as an adult) than they do now and, around age 3, children similarly demonstrate some understanding that they preferred child items less in the past (as a baby) than they do now. While cross-experiment comparison in Chapter 2 revealed asymmetry in preschoolers' preferences reasoning (future, relative to past, preferences reasoning was more challenging), this asymmetry was not replicated in Chapter 3 using a more rigorous within-subjects design.

Besides clarification of asymmetry in preferences reasoning, our final objectives were to confirm the relation between preschoolers' reasoning about changes in their future and past preferences and explore possible mechanisms underlying children's self-projective abilities. In Chapter 3, children's ability to reason about their future and past preferences were significantly correlated – but not after controlling for their receptive language ability. Unexpectedly, we did not find support for asymmetry in children's self-projection abilities; that is, children did not find it more difficult to reason about their future as compared to their past preferences. Finally, children's future and past preferences reasoning were not related to or predicted by their performance on the ToM and EF tasks after controlling for age, language ability, and sex.

Taken together, this dissertation provides unique and timely contributions to the literature on self-projection and, specifically, how this capacity develops, as well as children's reasoning about how preferences change over time.

Keywords: episodic future thinking, episodic memory, self-projection, preferences, theory of mind, executive function

Chapter 1: General Introduction

Mental Time Travel: The Basics

Mentally re-experiencing our past (i.e., episodic memory) and pre-experiencing our future (i.e., episodic future thinking; EFT) are broadly conceptualized as mental time travel (MTT; Suddendorf & Corballis, 1997; 2007) and are relied upon during both everyday and major life decisions (e.g., deciding which flavour of ice cream to enjoy versus deciding which career path to pursue). Buckner and Carroll (2007) introduced the term "self-projection" to describe these shifts in *perspective* from the present to alternatives including our personal futures (i.e., EFT; Atance & O'Neill, 2001; Russell, Alexis, & Clayton, 2010; Suddendorf, Nielsen, & von Gehlen, 2011) and personal pasts (i.e., episodic memory; Suddendorf, Addis, & Corballis, 2009; Tulving, 1984). EFT is necessary for successful future planning while episodic memory enables reflection on past experiences to construct and simulate these possible futures. In combination, EFT and episodic memory enable us to reflect and plan in an effort to avoid repeating past mistakes. Broadly speaking, the ability to mentally travel through time is an adaptive skill that allows one to revisit, reconstruct, anticipate, or imagine events to best prepare for and influence possible future outcomes.

Episodic memory involves the recollection of *personal* past experiences that can be repeatedly revisited (e.g., recalling your wedding day; Suddendorf et al., 2009; Tulving, 1984). It is distinct from what Tulving (1984) defines as *semantic memory*, which involves the retention and retrieval of everyday facts (e.g., "snakes are reptiles") and script-based knowledge of how events generally unfold (e.g., the server will bring the bill after I finish my meal at a restaurant; Tulving, 1972; 1985a; 1985b; 2001). Tulving's distinction between the semantic and episodic memory systems reflects our ability to *know* versus our ability to *remember* and it is this early work that inspired significant exploration of MTT (both into the past and future) and its development across the lifespan.

Both the episodic and semantic memory systems are considered fundamental components of our ability to engage in EFT, an area of research which has recently received intensive investigation by psychologists (e.g., D'Argembeau & Van der Linden, 2004; Martin-Odas, Atance, & Louw, 2012; Schacter, Addis, & Buckner, 2008; Schacter, Addis, Hassabis, Martin, Spreng, & Szpunar, 2012). Consistent with episodic memory, EFT can also be distinguished from a knowledge-based system known as *semantic future thinking*, or our general knowledge of the future (e.g., taxes are due every spring; Atance & O'Neill, 2001; Busby & Suddendorf, 2005). Specifically, EFT and episodic memory involve a projection of the *self as experiencer*, or what Tulving (1985b; 2001) describes as *autonoetic consciousness*, rather than knowledge of how events generally unfold, as is the case with both the semantic memory and future thinking systems.

Episodic memory allows us to draw on past experiences as a source of data, which can then be used to hypothesize about and prepare for possible personal future events. Further, thinking about one's personal past and future have been shown to share similar cognitive and neural mechanisms (Addis, Wong, & Schacter, 2007; Buckner & Carroll, 2007; Szpunar, Watson, & McDermott, 2007; Williams et al., 1996). The abilities to reflect on the past and think about the future have also been found to emerge simultaneously during early development, suggesting an important relation between mentally re-experiencing and pre-experiencing the self through time (Suddendorf, 2010; Quon & Atance, 2010). However, developmental scientists have only recently begun to investigate MTT and thus little is known about the emergence and function of this cognitive ability during children's development. Developmental investigations of MTT are especially relevant given the implications of this skill for our success in adapting to an ever-changing environment in anticipation of our futures (Quon & Atance, 2010).

Dissertation Overview

In this dissertation, I explore children's capacity to think about both their personal pasts and futures within the context of their reasoning about preferences. In the General Introduction, I begin with a broad overview of the development of children's MTT. In this overview, I first provide a review of research about children's MTT into the past (episodic memory) followed by relevant work on children's MTT into the future (EFT). I then provide an overview of research highlighting the relation between episodic memory and EFT followed by a brief overview of theoretically-relevant simulative (theory of mind) and cognitive (executive function) abilities to MTT. Next, I describe children's understanding of changes over time including a review of research within the area of mental state reasoning and, preferences, in particular. Finally, I conclude with objectives for this dissertation.

Following the General Introduction, two of three experiments are presented together in manuscript format (Chapter 2: Kopp, Hamwi, & Atance, 2021) followed by the third and final experiment, also presented in manuscript format (Chapter 3). Chapter 2 includes an investigation of preschoolers' reasoning about changes in their future (Experiment 1) and past (Experiment 2) preferences with the introduction of a novel preferences rating scale and exploratory cross-experiment analyses. Chapter 3 involves an investigation of the relation and possible asymmetry between preschoolers' future and past preferences reasoning and exploration of possible underlying mechanisms (i.e., ToM and EF). Finally, this dissertation concludes with the General Discussion (Chapter 4) including a general overview of limitations, future research directions, and applications of the main findings from the three experiments.

The Development of Mental Time Travel

Episodic Memory: The Past Self

A great deal of developmental research has focused on memory. This research

suggests that even newborn infants have some capacity to engage in basic memory processing (e.g., demonstrating a preference for their mother's face and voice; DeCasper & Spence, 1986; Pascalis, de Shonen, Morten, Deruelle, & Fabre-Grenet, 1995). It is also generally accepted that by 6 months of age, infants can engage in more complex memory tasks reflecting semantic-based cognition (e.g., for a review see, Colombo & Hayne, 2010; Hayne, 2004; 2007). Although there is age-related variability, infants demonstrate memory following delays spanning hours through months (e.g., Bauer, 2007; Hayne, 2004). For example, infants as young as 1 year old demonstrate memory for an action sequence after a six-month delay (Bauer, Hertsgaard, & Dow, 1994). Following the development of these basic memory skills during infancy, episodic memory and other foundations of cognitive development including self-awareness and imagination begin to emerge (Suddendorf & Corballis, 2007).

While some researchers argue that episodic memory doesn't emerge until around the age of four (e.g., Levine, 2004; Perner & Ruffman, 1995; Suddendorf & Corballis, 1997; Wheeler, Stuss, & Tulving, 1997), others suggest that episodic memory is a system that gradually emerges while developing in complexity over time (e.g., Bauer, 2007; Nelson & Fivush, 2004). Although these approaches to episodic memory development diverge, research within the areas of childhood amnesia, past-oriented language development, source memory, and self-recognition provide support that bridges both perspectives.

To begin, some developmental researchers argue that prior to the age of three, children lack the ability to encode and recall past personal experiences (e.g., Perner & Ruffman, 1995; Suddendorf & Corballis, 1997). That is, children younger than three years old do not appear to have the capacity to recall past events with a sense of having experienced them from a first-person perspective, or through Tulving's (1985b; 2001) *autonoetic consciousness*. Despite this inability to recall personal experiences prior to the age

of three, also known as “childhood amnesia”, children as young as two years old have been noted to engage in talk about the past (Eisenberg, 1985; Fivush & Hamond, 1990; Sachs, 1983). However, there is no evidence to suggest that this talk reflects actual reliance on the episodic memory system or that 2-year-olds have a true understanding and representation of the self in time. In fact, younger children’s talk about the past is largely regarded as demonstrating general *knowledge* of the past, as opposed to *remembering* the past per se, highlighting the distinction between the semantic and episodic memory systems, respectively (Nelson, 2001).

Fivush and Hamond (1990) further note that, when discussing the past, younger children are much more reliant on recall cues and prompting from adults than are older children. Furthermore, younger children’s talk about past events qualitatively differs from the reports of older children and adults (Fivush & Hamond, 1990), including less detail, coherence, and temporal and causal structure (Fivush, Haden, & Adam, 1995). Notably, it isn’t until around the age of four that children begin to demonstrate accuracy in reporting personally experienced events from their past (Busby & Suddendorf, 2005). That is, it is only by the age of four that children begin to gain an understanding of the causal connection between past events and the past self as the experiencer of those particular events. Further supporting this claim, a study conducted by Busby-Grant and Suddendorf (2011) revealed that specific temporal terms (e.g., “yesterday”) increase in frequency of use, accuracy, and specificity across the preschool years and into middle childhood. Overall, this research suggests a gradual maturation of language for the past during the preschool years, with the emergence of episodic memory occurring sometime around the age of four.

Research in the area of source knowledge provides additional support for the developmental trajectory of episodic memory. Developmental researchers argue that children cannot experience episodic memory until they have developed insight into their own source

knowledge, or how they know what they know (Perner, 2001). In support of this, 3-year-olds experience significant difficulty in identifying the source of their knowledge acquisition (for a review see, Bartsch, Horvath, & Estes, 2003; O'Neill, Astington, & Flavell, 1992; O'Neill, & Chong, 2001; O'Neill & Gopnik, 1991). Although younger children can accurately report their general knowledge of something, they experience considerable difficulty reporting *how* they obtained this knowledge. For example, Gopnik and Graf (1988) found that, when presented with several drawers of varying contents, 5-year-olds, but not 3-year-olds, were able to accurately report both the contents of the drawers as well as the source of this knowledge, including whether they were told, inferred this information from a clue, or had seen the actual contents of the drawers. In this study, 3-year-olds were only able to accurately report the contents of the drawers but were not able to report how they knew this information.

Interestingly, children's ability to identify the source of their knowledge has also been found to correlate with their performance on free recall tasks (e.g., recalling a series of pictures without prompting; Perner & Ruffman, 1995). Tulving (1985b) notes that free recall tasks reflect activation of the episodic memory system. Thus, by the age of four, children are able to correctly identify the source of their knowledge, which arguably reflects some reliance on the episodic memory system. Besides being able to identify the source of one's knowledge, researchers also note that by the age of four, children begin to understand the temporal distances of past events (Friedman & Kemp, 1998). It is also during this time that children begin to demonstrate an enduring cognitive representation of the self in time (Nelson, 2001; for a review see, Povinelli, 2001).

Povinelli (2001) and Nelson (2001) posit that an experiential self, or Tulving's (1985b; 2001) *autonoetic consciousness*, is a necessary prerequisite for episodic memory to develop but is lacking in children younger than four years old. For example, Povinelli and colleagues (for a review see, Povinelli, 2001) conducted a series of delayed self-recognition

studies whereby an experimenter covertly placed a brightly coloured sticker on the heads of 2-, 3-, and 4-year-olds during an interactive game. The experimenter either took photographs or video-recorded the duration of the game to include footage of the placement of the sticker for children to view afterwards. Povinelli (2001) argued that children who reached up to remove the sticker from their heads after viewing the video or photographs have not only recognized themselves in the video or photographs but also have an understanding that this event was personal, or had just happened to them. Results from these studies revealed that none of the 2-year-olds removed the sticker from their heads, while only 25% of 3-year-olds did so. Conversely, 75% of 4-year-olds demonstrated self-recognition by removing the sticker, thus indicating that children younger than four years old lack insight concerning the personal nature of experiences (Povinelli, Landau, & Perilloux, 1996; Povinelli, Landry, Theall, Clark, & Castille, 1999). Thus, self-recognition research indicates that only by the age of four do children demonstrate insight that they, themselves, have experienced a particular past event.

In sum, the research on children's episodic memory suggests that around age four, children can begin to encode and recall memories from their personal pasts, accurately report past experiences, identify the source of their knowledge, and demonstrate an understanding of the experiential self.

Episodic Future Thinking: The Future Self

Building on Tulving's (e.g., 2001) distinction between episodic and semantic memory, Atance and O'Neill (2001) coined the terms *episodic future thinking* and *semantic future thinking* to describe the mental projection of the self to pre-experience an event in the future and our general knowledge of potential future events, respectively. Following this description, additional terms were proposed to describe future-oriented MTT including *projection* (Okuda et al., 2003), *prospection* (Gilbert, 2006; Buckner & Carroll, 2007),

simulation (Schacter & Addis, 2007; Schacter et al., 2008), and *episodic foresight* (Suddendorf & Moore, 2011). Regardless of differences in terminology used to describe future MTT, the underlying features remain consistent, including the mental projection of the self into the future as well as action in the present that reflects an anticipation of these potential future events. Investigated to a lesser extent than episodic memory, episodic future thinking (EFT) in children is noted to have a similar developmental trajectory as episodic memory, emerging sometime between ages three and four (Atance & O'Neill, 2005a). Developmental research in the areas of future-oriented language, planning and the anticipation of future needs, and saving and delay of gratification provide insight into the early development of EFT and related behaviours.

As 2-year-olds begin to talk about the past they also begin to talk about possible events in the future (Sachs, 1983). Yet, younger children's talk of the past and possible future both reflect a reliance on the semantic memory and future thinking systems such that the content of this talk largely constitutes more knowledge- and script-based observations as opposed to specific episodes. Emerging around the same time as episodic past-oriented talk, future-oriented talk is noted as becoming more episodic in nature around age three (e.g., Atance & O'Neill, 2005b; O'Neill & Atance, 2000). To illustrate, Atance and O'Neill (2005b) asked 3-year-olds to pretend they were going on a trip and to select items that they would need to bring with them. After selecting an item, children were asked to explain why they had chosen it. Children's verbal explanations were categorized using a future-oriented coding scheme. Results revealed that even 3-years-olds' language reflected an ability to anticipate future events involving the self. Consistent with episodic past-oriented talk, Busby-Grant and Suddendorf (2011) also found that future-oriented temporal terms (e.g., "tomorrow"; "when I get bigger"), increased in frequency, accuracy, and specificity throughout the preschool years. Thus, children's use of future-oriented language emerges

sometime around three years old, while becoming more complex over the preschool years.

Children between the ages of three and five years also experience significant improvement in their ability to plan in anticipation of future needs (e.g., Carlson, Moses, & Claxton, 2004; McColgan & McCormack, 2008; Quon & Atance, 2010). For example, Quon and Atance (2010) investigated the relationship between children's future-oriented talk and possible personal future events. In this study, 3-, 4-, and 5-year-olds were asked to provide responses to several future-oriented statements according to events and activities that they were likely going to do in the future (e.g., "What are you going to do at playtime tomorrow?"). After answering this series of questions, children's parents were then consulted to provide accuracy ratings about their child's statements. Findings from this study revealed that, as age increased, children became significantly more accurate at predicting future events and activities.

Further research concerning children's planning abilities includes forced-choice tasks whereby children are asked to select an item to address a possible future need. These so-called "spoon tests" were inspired by an old Estonian tale that describes a young girl who places a spoon under her pillow after having a dream the previous night where she finds herself unable to eat pudding at a party because she doesn't have a spoon (Tulving, 2005). From this, an item-selection paradigm was developed to examine planning in children. In this paradigm, children are first presented with a problem requiring a particular solution (e.g., locked treasure chest without a key, Scarf, Gross, Colombo, & Hayne, 2013; puzzle board without puzzle pieces, Suddendorf & Busby, 2005). Then, children are taken to a different room and are presented with a set of items, including an item that can solve the initial problem (e.g., key, puzzle pieces). By the age of four, children are able to correctly select the appropriate item to solve the initial problem, thus suggesting future-oriented anticipation of using the item to resolve a future need. However, some researchers have argued that

children's selection of the correct item in these studies reflects semantic-based knowledge (e.g., puzzle pieces go with a puzzle board) rather than EFT (e.g., Atance, Louw, Clayton, 2015; Russell, Alexis, & Clayton, 2010).

In response to this criticism, researchers adjusted the item-selection paradigm to better capture a reliance on EFT to solve the task. For example, Suddendorf, Nielsen, and von Gehlen (2011) provided children with a variety of keys (so that children could not simply associate "key" with "lock") to choose from after being presented with the locked chest. However, only one of these keys was the appropriate shape to open the lock on the treasure chest. Again, by age 4, children selected the appropriately shaped key to subsequently open the treasure chest.

Using yet a different paradigm, Atance, Louw, and Clayton (2015), presented 3-, 4-, and 5-year-olds with two rooms, one with toys to play with and the other without. Children were then taken to a separate area, presented with a box of toys, and asked to allocate the toys to one of the two rooms in anticipation of a future visit. Results revealed that 4- and 5-year-olds, but not 3-year-olds, allocated the toys to the appropriate location (i.e., room without toys), thus indicating foresight to avoid boredom while spending time in the empty room. Finally, and more recently, Moffett, Moll, and Fitzgibbon (2018) devised a planning task in which 4-, and 5-year-olds were required to create the solution to an initial problem (i.e., drawing a picture of a missing object to continue a game in a previous room). Similarly, results from this study revealed that children as young as four years old can recall and create an appropriate solution to an initial problem in order to meet a future need. Thus, by the age of four, children are able to engage in planning for the future, including situations involving a mental projection of the self.

Another area of research that provides insight into the development of children's EFT involves their ability to save in the present with a future goal in mind. Following a similar

age trajectory as other future-oriented behaviours, developmental research about children's saving suggests that this skill emerges sometime between the ages of three and five (e.g., Atance, Metcalf, & Thiessen, 2017; Metcalf & Atance, 2011). For example, Atance et al. examined saving behaviour in 3-, 4-, and 5-year-olds using a marble-game paradigm. Specifically, children were presented with two marble games differing in desirability and were either prompted to save their marbles for the larger and more desirable marble run or did not receive this prompt. Results revealed that saving behaviour not only increased with age but also was significantly higher in children who received the suggestion/prompt to do so.

A similar future-oriented skill to that of saving, delay of gratification, involves foregoing a current smaller reward (e.g., two mini-marshmallows) in anticipation of receiving a larger reward in the future (e.g., ten mini-marshmallows). Inspired from an early delay of gratification paradigm (for a review see, Mischel, Shoda, & Rodriguez, 1989), some researchers investigate this ability within the context of the development of future-oriented behaviours, or what has been described as "future-oriented self-control" (Mischel et al.,1989). For example, Thompson, Barresi, and Moore (1997) used a modified delay of gratification paradigm with 3-, 4-, and 5-year-olds. Children needed to decide whether to choose an immediate reward (e.g., one sticker) or to forgo this choice for a larger future reward (e.g., two stickers). Results showed that children's tendency to choose delayed rewards increases with age. Similarly, Prencipe and Zelazo (2005) examined the ability of 3- and 4-year-olds to delay gratification for rewards including coins, stickers, and candies. The results from this study provide convergent evidence to show that as age increases, so does children's tendency to delay immediate gratification for a larger future reward. In a recent delay of gratification study, Barragan-Jason, Atance, Kopp, and Hopfensitz (2018) also demonstrated age-related improvements from three to five years old in the ability to delay for

a larger non-food reward (e.g., 3s versus 1-min video clips). Overall, these studies demonstrate that between the ages of three and four, children begin to forgo immediate gratification in anticipation of obtaining a larger reward for their future selves.

In summary, around age four, children begin to demonstrate accuracy in describing possible personal events that will be experienced in the near future, plan for the future in anticipation of meeting a future need, engage in saving behaviour, and delay immediate gratification for a larger future reward.

The Link between Episodic Memory and Episodic Future Thinking

Around the time that Tulving (1984; 1985a; 1985b) elaborated on episodic memory, Ingvar (1979; 1985) also introduced the idea of *memory for the future*. Drawing on his observations as a brain physiologist, Ingvar argued that memory can be used to simulate multiple future situations, which allows an individual to adapt their behaviour to best prepare for an anticipated outcome. Consistent with Ingvar's perspective as well as the common developmental trajectory of past and future MTT described previously, research within the areas of memory impairment, psychological functioning, neuroimaging, cognition, and early development provides support for the relationship between the abilities to engage in episodic memory and EFT.

Some of the first evidence to suggest a link between episodic memory and EFT was observed in individuals with memory impairment (for a review see, Schacter, Addis, & Buckner, 2007). For example, the widely known case of an amnesic patient known as "K.C." illustrates the inter-dependence of episodic memory and EFT. After enduring a head injury, K.C. demonstrated significant impairment in reporting both personal events from his past as well as potential personal events likely to occur in the future (for a review see, Rosenbaum et al., 2005). Recent studies provide converging evidence for this observed reliance between the episodic memory and EFT systems. For example, Race, Keane, and Verfaellie (2011) found

that individuals with damage to their medial temporal lobe also experienced deficits in reporting both personal past and future events, compared to healthy individuals. Further, research within the area of psychological functioning also provides support for the link between episodic memory and EFT.

For example, Williams et al. (1996) found that, when presented with word cues to which they were asked to generate personal past or possible future events, depressed individuals with suicidal ideation generated significantly less detail in their past and future accounts than non-depressed individuals. Using a similar word cue paradigm, D'Argembeau, Raffard, and Van der Linden (2008) found that individuals with schizophrenia also demonstrated deficits in both episodic memory and EFT by recalling less personal events in the past and even fewer for their possible future than non-schizophrenic individuals. Overall, these studies based on physiology and psychological health, suggest an important relationship between past and future MTT. That is, for some individuals whose physiological or psychological health is compromised (i.e., injury to a specific brain region or experience of a particular psychological disorder), so too is their ability to re-experience their personal past and pre-experience their personal future.

Neuroimaging research with healthy individuals also provides support for the link between episodic memory and EFT (for a review see, Schacter, Benoit, & Szpunar, 2017). To illustrate, several studies using neuroimaging (e.g., functional magnetic resonance imaging; positron emission tomography) paired with participant instruction to either think about or to discuss personal past experiences and possible future events have found significant overlap in the activation of specific brain regions (e.g., Addis, Wong, & Schacter, 2007; Okuda et al., 2003; Szpunar, Watson, & McDermott, 2007). Recent meta-analysis research has since confirmed a shared core network of brain areas (medial temporal and frontal lobes, posterior cingulate and retrosplenial cortex, and lateral parietal and temporal areas) that activate during

both episodic memory and EFT simulation tasks (Stawarzyck & D'Argembeau, 2015).

Another area of research that supports the link between episodic memory and EFT includes cognitive research with healthy individuals. For example, D'Argembeau and Van der Linden (2004) investigated the subjective experience of MTT into both the personal past and future. Results indicate that projecting oneself into the past and future were similarly influenced by the temporal distance of that event from the present (e.g., projection of the self was more difficult for events of greater temporal distance) as well as the valence of that event (e.g., positive events elicited more sensory detail than negative events). In a follow-up study, D'Argembeau and Van der Linden (2006) found further similarities in individual differences of visual imagery (e.g., participants with a greater predisposition toward visual imagery reported greater detail and clearer representations of past and future events) and emotion regulation (e.g., emotional suppression affected the phenomenological experience of past and future events) during simulations of episodic memory and EFT.

Developmental research has also explored the relationship between episodic memory and EFT. Early research conducted by Harner (1975), for example, investigated younger children's understanding of temporal terms including "yesterday" and "tomorrow". Specifically, 2-, 3-, and 4-year-olds were asked to identify which toys they had played with at the lab the previous day (i.e., "yesterday's" toys) and which toys they were told they would have the chance to play with the following day (i.e., "tomorrow's" toys). Results revealed significant improvement in temporal term understanding with age, with both terms equally understood by the age of four. Busby and Suddendorf's (2005) study discussed previously also provides converging evidence with Harner's (1975) findings. Again, 4- and 5-year-olds, but only a minority of 3-year-olds, were able to accurately report events from their pasts (e.g., "yesterday") and probable futures (e.g., "tomorrow").

Further developmental research has examined preschoolers' ability to discuss and

elaborate on events from their past and possible futures. Specifically, 3- and 5-year-olds were shown a personalized timeline including photographs of themselves across different events in their life (Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011). Children were then asked to discuss several events differing in temporal distance including something that (1) happened yesterday, (2) happened earlier that day, (3) will happen later that day, and (4) will happen tomorrow. Results revealed that both 3- and 5-year-olds were able to discuss personal past and future events, with the amount of detail and information about these events increasing with age. Interestingly, 3-year-olds used first-person referencing (i.e., "I" or "we" statements) at a frequency comparable to 5-year-olds when discussing past and future events. Overall, these findings suggest that, when provided with structure and prompting, even 3-year-olds demonstrate a reliance on episodic memory and EFT when discussing personal past and future events.

Similar research has also been conducted with older children and adults. Specifically, Coughlin, Lyons, and Ghetti (2014), explored the phenomenological experience of MTT in 5-, 7-, and 9-year-olds and adults. In this study, children and adults were asked to generate personal narratives based on word cues (e.g., cake) provided by the experimenter. Participants were asked to "think of a time" (last week, last year, next week, next year) that the word cue reminded them of. Overall, the reported past and future events became less generalized (e.g., "cake is something delicious with frosting on it") and more episodic (e.g., "Turning 21...I imagine eating cake at my house...it'll be chocolate and there will be lots of decorations...colorful and bright...and I imagine Bubba my dog wearing a party hat...") as age increased, a finding consistent with other research with children in middle childhood (e.g., Wang, Capous, Koh, & Hou, 2014).

Overall, these studies highlight shared neural, psychological, cognitive, and developmental components between episodic memory and EFT. Thus, episodic memory and

EFT not only show a similar developmental trajectory but also appear to rely on common mechanisms. Yet, despite these commonalities, some developmental research also finds that self-projecting into the future may be more difficult than self-projecting into the past. For example, children tend to have greater success understanding, reasoning, and communicating about the past as compared to the future (e.g., Busby-Grant & Suddendorf, 2009; Friedman, 2003; Harner, 1975; Zhang & Hudson, 2018). Researchers speculate that this asymmetry could be due to factors such as increased cognitive demands during future-oriented reasoning and self-projection (e.g., Zhang & Hudson, 2018) or a lack of proficiency in imagining the future relative to imagining the past (e.g., Atance, 2015). These issues will be further explored in Chapter 3.

MTT and Other Projective Abilities: Theory of Mind and Executive Function

Theoretically-relevant simulative (ToM) and cognitive (EF) abilities may bridge the link between episodic memory and EFT. Considered to be another form of mental projection of the self alongside episodic memory and EFT (Buckner & Carroll, 2007), ToM is the ability to understand that the mental states of others (e.g., beliefs, desires) may be different from one's own and from reality (Premack & Woodruff, 1978). EF is argued to be a critical cognitive skill underlying episodic memory and EFT (e.g., Atance & Jackson, 2009; Ünal & Hohenberger, 2017) and includes abilities such as inhibitory control (i.e., the capacity to regulate an automatic action) and cognitive flexibility (i.e., the ability to easily shift one's perspective when new information challenges prior beliefs). Theoretically, both ToM and EF require a shift in perspective not unlike the shift required when someone assumes the perspective of their past or future selves during MTT (Hanson, Atance, & Paluck, 2014). Specifically, past and future MTT require a shift in perspective from the current self to the past and future selves, whereas ToM and EF require a shift in one's own perspective to that of another person or conflicting position, respectively.

In support of the similarities in "projection" between past and future MTT, ToM, and EF, neurophysiological research examining perspective-taking in adults finds overlap between activation of particular brain regions during past and future MTT and when taking the perspective of someone else (e.g., Buckner & Carroll, 2007; Spreng & Grady, 2010; Viard et al, 2011). Researchers also note a similar developmental trajectory of ToM and EF to that of MTT, with significant improvements between the ages of three and five (e.g., Atance & Jackson, 2009; Suddendorf & Corballis, 2007; Wellman & Liu, 2004). Developmental work has also started to test relations between MTT, ToM, and EF. Although some studies have not found relations between past and future MTT, ToM, and EF (e.g., Hanson et al., 2014), more recent evidence has. For example, children's episodic memory ability was found to be positively predicted by their performance on an EF task in a study by Ünal and Hohenberger (2017). Similarly, Adornetti et al. (2021) found relations between ToM and EFT abilities in older (8- to 10-year-old) children. Thus, it is quite plausible that ToM and EF are important mechanisms underlying successful MTT.

Children's Understanding of Changes in Mental States Across Time

Despite the recent surge of interest in past and future MTT in children, few studies have explored children's understanding of changes in mental states over time and within the same individual. Rather, the majority of research about mental states has focused on children's understanding of changes, or differences, in the mental states of others (i.e., ToM; Premack & Woodruff, 1978). For example, in a classic ToM task examining children's understanding of the false beliefs of others (Baron-Cohen, Leslie, & Frith, 1985), children are told a story about a character, Sally, who places a ball into a box. After Sally leaves the room, another character, Anne, enters the room and moves the ball to a different location. Sally then returns to the room to retrieve her ball but has no knowledge that Anne has moved it. At this point, children are asked where Sally will look for her ball. If children state that she will look

for her ball in the box they understand that Sally holds a different belief from their own and from reality, thus demonstrating an understanding of false belief and a well-developed ToM (Wellman, Cross, & Watson, 2001). Consistent with children's development of MTT, ToM meta-analyses research shows a steady progression of below to above chance performance in false belief tasks across the preschool years (Wellman et al., 2001).

What evidence is there for children's understanding that their *own* mental states can change over time? Early research by Gopnik and Slaughter (1991) entailed preschoolers experiencing a particular mental state, after which this state was changed, and children were then asked to report their initial, or past, state. For example, 3- and 4-year-olds were asked to reason about changes in their own 'desires' from the recent past to present. Specifically, children stated their desire for one of two paired-item choices: either one of two picture books or one of two opaque boxes with unknown objects inside. Following their selection, children's desire was fulfilled by either reading the selected book or viewing the contents of the selected box. Children were then asked to state their current desire, to which all children chose the alternate, previously unchosen item. Finally, children were asked to recall which of the two items from the pairs they had first desired. Results revealed that 4-year-olds, but not 3-year-olds, correctly acknowledged that their past desire was different from their current desire. Thus, 3-year-olds demonstrated difficulty in understanding that their past desire (i.e., their first item selection) differed from their current desire (i.e., their subsequent item selection).

Research also reveals that younger preschoolers have difficulty appreciating changes in their own knowledge. For example, Atance and Caza (2017) investigated whether 3-, 4-, and 5-year-olds understand that they will know more in the future than they do now. In this study, children were shown a gender-matched photograph of an adult and were told that one day they would be all grown up, just like the adult in the picture. They were then told that

they would be asked some questions about what they would know once they were all grown up. Children were then asked a series of questions concerning knowledge they would acquire as an adult (e.g., "...will you know what the word *ambiguous* means?"). Results revealed that only 5-year-olds demonstrated understanding (i.e., significantly better than chance level) that their future selves would know more than their current selves. Conversely, 3- and 4-year-olds experienced difficulty with this task, with 4-year-olds performing just above chance (non-significant), and 3-year-olds performing at chance level.

These findings complement previous research conducted by Caza, Atance, and Bernstein (2016) that examined younger children's understanding that their own current knowledge differs from their past knowledge (e.g., when they were 6 months old). In this study, 3-, 4-, and 5-year-olds were asked a series of questions about their current general knowledge (e.g., "Do you know that clocks tell time?") and the knowledge they held as a baby (e.g., "When you were a baby, did you know that clocks told time?"). Results from this study found that 5-year-olds, but not 4- or 3-year-olds, demonstrate an understanding that their past selves knew less than their current selves. Thus, 3- and 4-year-olds have difficulty understanding that their own current knowledge differs both from their past knowledge and potential future knowledge. Overall, these studies demonstrate that younger preschoolers experience difficulty in reasoning about changes in their own mental states.

Changes in Preferences Across Time

Children's understanding of changes in mental states across time, including changing preferences, has also started to gain attention in the MTT literature. Yet, traditionally, research about children's understanding of changes/differences in preferences and desires has focused primarily on children's reasoning about the preferences of others (within the context of ToM), as opposed to their own changes in preferences (e.g., Atance, Bélanger, & Meltzoff, 2010; Cassidy et al., 2005; Rakoczy, Warnecken, & Tomasello, 2007). For example, early

research on preferences and perspective-taking (e.g., Flavell, Botkin, Fry, Wright, & Jarvis, 1968; Zahn-Waxler, Radke-Yarrow, & Brady-Smith, 1977) introduced a gift-giving paradigm in which children were presented with a series of child-preferable items (e.g., toy truck) and adult-preferable items (e.g., necktie), from which they were asked to select a gift for their parents. Results revealed that 3-year-olds, but not older children, consistently selected the child-preferable items for their parents. This finding demonstrates that 3-year-olds have difficulty appreciating that the preferences of others (e.g., parents) can differ from their own, especially when their own preferences conflict with those of the other person.

More recent studies examining conflicting preferences also provide convergent evidence for the finding that younger children have difficulty inferring the preferences of others when their own preferences differ. For example, Moore et al. (1995) presented children with a story about a character who experienced a negative event with a cat. Children were then asked which of two stickers (i.e., a larger more attractive cat sticker or a smaller and plainer flag sticker) the character would likely select for themselves. Findings revealed that both 3- and 4-year-olds incorrectly chose the more attractive cat sticker for the character, thus showing difficulty identifying another person's preference when this preference conflicted with their own. Cassidy et al. (2005) conducted a similar study, which yielded the same results in 3-year-olds. Cassidy et al. (2005) also argued (and demonstrated) that younger children's difficulty with conflicting preferences is activated under specific circumstances (i.e., when the preferences of the other person have to be inferred and when the preferences of the other person conflict with those of the child's) and improve when these elements are absent.

Also in support of Cassidy et al.'s (2005) argument, while drawing on Flavell et al.'s (1968) gift-giving paradigm, Atance, Bélanger, and Meltzoff (2010) asked 3-, 4-, and 5-year-olds to select an appropriate gift for their mother (e.g., magazine) after having first selected a

gift for themselves (e.g., stuffed toy). Results showed that 3-, 4-, and 5-year-olds who had the opportunity to first select a gift for themselves were significantly more likely to select an appropriate gift for their mother, compared to children who did not have their preferences initially fulfilled. This research suggests that the fulfillment of one's own preferences allows an individual to make more accurate inferences about the preferences of others, even for children as young as three.

Overall, research about preferences has primarily focused on children's ability to infer the preferences of others, especially when these preferences conflict with their own. In contrast, children's understanding of changes in their *own* preferences is an area of research that has received limited empirical investigation. Yet, understanding that our own preferences can change over time is an important skill for successful decision-making throughout one's lifetime. Thus, gaining a greater understanding of the emergence of this skill not only provides insight about its development over time but can reveal potential areas for improvement, resulting in a greater avoidance of potential future regrets.

The majority of research examining changes in personal preferences has shown that even adults have difficulty acknowledging potential changes in their future selves, which, in turn, contributes to the likelihood of experiencing negative future outcomes (e.g., poor financial investments, divorce; Quoidbach, Gilbert, & Wilson, 2013). Based on this robust finding, Quoidbach et al. introduced what is known as *the end of history illusion* to describe our tendency to underestimate the extent to which our preferences, attitudes, and so on will change in the future. In a recent study investigating perceptions of changes in future preferences, researchers found that adults not only underestimated the extent to which their current preferences would change in the future but that their own preferences would change to a lesser extent compared to those of a hypothetical same-aged/sex peer (Renoult, Kopp, Davidson, Taler, & Atance, 2016). Although there are a number of studies examining adults'

reasoning about changes in their personal preferences, investigations of this area from a developmental perspective are limited.

In the previously-reviewed, Gopnik and Slaughter (1991) study, 4-year-olds, but not 3-year-olds, correctly acknowledged that their past desire was different from their current desire (i.e., that their desires had changed over time). In another, more recent, study, Bélanger et al. (2014) investigated children's understanding that their own current 'preferences' may change in the future. It should be noted that the terms 'desire' and 'preference' are often used interchangeably in literature about children's desire understanding (e.g., Cassidy et al., 2005) but that the term 'desire' is more often used in ToM research. As noted by Bélanger et al. (2014), the subtle difference of these terms may rely on the simple distinction of liking (i.e., preference) versus wanting (i.e., desire). Consistent with Bélanger et al. (2014), the term 'preference' is used in this dissertation to describe children's partiality toward an object (e.g., which item they "like best").

In Bélanger et al.'s (2014) study, 3-, 4-, and 5-year-olds were asked to choose between child- and adult- preferable items by selecting items they preferred "now" (self-now trials) and would prefer in the future (self-future trials). Five paired child- and adult-preferable items were presented to children in random order including: Kool-Aid/coffee, *Dora the explorer*/cooking videos, picture books/newspapers, sticker books/magazines, and Play-Doh/crossword puzzles. Prior to receiving these item pairs, children were first presented with a photograph of a gender-matched adult along with verbal instructions stating that "...one day, you're going to be all grown up. You're going to be as big as this man/woman..." This verbal information was intended as a prompt to encourage children to adopt the perspective of their future selves during the item selection task. After completing the item selection task, children's selections on the self-now and self-future trials were coded according to whether they selected the appropriate item for the trial. For example, children

were assigned a score of '1' if they selected the Kool-Aid for the self-now trial and a score of '1' if they selected the coffee for the self-future trial. Alternatively, scores of '0' were assigned to incorrect item selections (e.g., Kool-Aid for the self-future trial).

Results revealed that children's understanding that their own preferences may change in the future improves significantly with age. Specifically, a chance analysis revealed that 5-year-olds, but not 4- or 3-year-olds, demonstrated a consistent understanding that their own future, or 'grown-up', preferences (e.g., newspaper) may differ from their current preferences (e.g., picture book). Three-year-olds, in particular, performed significantly below chance on the item selection task, consistently selecting their current preferences for their future self. Four-year-olds, however, performed at chance level for the item selection task, suggesting a possible transitional stage in their cognitive development, during which they are demonstrating some insight that their preferences will change over time. These findings indicate that younger preschoolers do not yet have the capacity to fully appreciate that their future preferences will differ from their current preferences. However, could the forced-choice approach of Bélanger et al.'s (2014) methodology be under-estimating younger preschoolers' ability to contemplate their future preferences?

As briefly discussed by Bélanger et al. (2014), younger preschoolers may have experienced greater difficulty with the item selection task due to the categorical nature of the methodology. That is, children were asked to select the item they would like best as a 'grown-up' but were only given two potential options (e.g., "coffee" or "Kool-Aid"). This forced-choice methodology may have restricted children from expressing the extent to which they might actually prefer a particular item in the future. For example, it is possible that despite choosing "Kool-Aid" rather than "coffee" for their future selves, younger children may have recognized that they would like the Kool-Aid less in the future than they do now and like the coffee more. However, because of the categorical nature of this task, it is not

possible to capture these potential shifts in preferences. Accordingly, a more sensitive measure of children's preferences could provide insight about the extent to which children have an understanding (however rudimentary) that their current and future preferences may differ.

Specifically, a continuous measure of preferences, such as a Likert scale with child-friendly illustrations (a range of happy and sad faces), could help determine if lower-performing preschoolers, especially those performing at chance-level, have some (more subtle) insight about changes in their preferences over time. This approach seems promising given that research in the area of children's affective forecasting, or prediction of their future emotions, has successfully used a rating scale with happy and sad faces to obtain children's reports of their emotions across time (Kopp, Atance, & Pearce, 2017). Additionally, research within the area of children's reasoning about future likelihood (e.g., Lagattuta & Sayfan, 2011) shows that preschoolers can understand and use future-oriented labels by providing verbal (e.g., "probably") and behavioural (i.e., pointing to graduated scale pegs reflecting these same future-likelihood labels) responses when discussing and making predictions about future events. Similarly, Lyons and Ghetti (2011) found that children as young as three can accurately report their level of confidence both verbally (e.g., by stating they are certain/uncertain) and behaviourally (e.g., pointing to the correct corresponding picture depicting either certainty or uncertainty). Thus, previous research supports younger children's understanding and use of scale ratings when considering their own perspectives and, this, within the context of the future.

A further reason for including a continuous measure of preferences is to help clarify whether high-performing preschoolers are indeed reasoning about their future self when responding to the test questions. That is, although older preschoolers in Bélanger et al.'s (2014) study accurately selected the adult-preferable items for their future self, it could be

argued that this performance reflects a reliance on the semantic knowledge system, rather than purely EFT. Specifically, these 5-year-olds may have made their selections based on their general knowledge of what children and adults typically prefer (e.g., grown-ups like coffee and children like Kool-Aid). If so, one might expect, for example, that even though 5-year-olds select "coffee" for their future selves, they may not actually rate this item as particularly desirable (and may, in fact, rate "Kool-Aid" as being more so). In contrast, if an individual is indeed adopting the perspective of/envisioning their future self and, consequently, predicting that the adult item will be preferable in the future, one would expect their preference ratings to reflect this. Including a continuous measure could help distinguish between these two possibilities by enabling a comparison of items selected as 'preferred' (as well as items not selected) and the corresponding preference ratings of these items in high-performing children. In this case, preference ratings should be higher for selected items and lower for items not selected for their future selves. Thus, a continuous measure of preferences could provide insight about high-performing children's engagement in EFT (as measured by their ability to adopt the perspective of their future selves) and whether Bélanger et al.'s (2014) methodology is sufficient for inducing future-oriented MTT.

In sum, including a continuous measure such as a faces rating scale would provide a more sensitive measure of children's reasoning about changes in future preferences while contributing to a broader understanding of children's reasoning about mental states across time. More specifically, it would help clarify whether lower-performing preschoolers have some (more subtle) insight into changes in their future preferences in addition to determining whether high-performing preschoolers are in fact engaging in EFT when considering such changes in future preferences.

Dissertation Objectives

The primary objective of this dissertation is to explore preschoolers' understanding of

their changing preferences within the context of MTT and self-projection more specifically. In Experiments 1 and 2 (Chapter 2), I extend the methodological approach used by Bélanger et al. (2014) to include a continuous measure of preferences reasoning by introducing a faces rating scale used in previous future thinking tasks with preschoolers (Kopp, Atance, & Pearce, 2017; adapted from Wong & Baker, 1988). Including a continuous measure of preferences permitted more sensitive measurement of subtle developments in preschoolers' understanding of changes in their future (Experiment 1) and past (Experiment 2) preferences. In Experiment 2, I develop a new task to examine preschoolers' reasoning about their past preferences, in particular. Cross-experiment comparison is also used to determine similarities (or differences) in the trajectory of preschoolers' future and past preferences reasoning. In a final experiment (Experiment 3; Chapter 3), I explore (1) the relationship between children's reasoning about their future and past preferences, (2) whether future, relative to past, preferences reasoning is more challenging (asymmetry), and (3) whether simulative and cognitive abilities (ToM, EF) contribute to similarities and differences between future and past preferences reasoning.

Chapter 2: Self-Projection in Early Development: Preschoolers' Reasoning About Changes in Their Future and Past Preferences

Leia Kopp, Lojain Hamwi, and Cristina M. Atance

University of Ottawa

This manuscript was published in the *Journal of Cognition and Development* in 2021:

https://doi-org.proxy.bib.uottawa.ca/10.1080/15248372.2021.1874954

Minor changes were made to the published manuscript to address committee comments.

Author Note

Leia Kopp, School of Psychology, University of Ottawa; Cristina M. Atance, School of Psychology, University of Ottawa.

We thank Alex Noble and Bronwyn O'Brien for their help with data collection. Thank you to Dwayne Schindler for statistical consultation and a special thank you to all the children and parents who participated.

Correspondence concerning this article should be addressed to Leia Kopp, School of Psychology, Vanier Hall, Room 6006, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5.

Data availability statement: The data analyzed for the current investigation are available from the corresponding author by reasonable request.

Abstract

Our ability to shift from current to alternative (e.g., past and future) perspectives (i.e., "self-projection") plays a fundamental role in accurate decision-making. We investigated 3-, 4-, and 5-year-olds' ability to shift perspective to reason about their future and past preferences. In Experiment 1 (N = 96), children were presented with pairs of adult- and child-preferable items and asked to select what they preferred "now" and in the future, whereas in Experiment 2 (N = 96), children were presented with pairs of baby- and child-preferable items and asked to select what they preferred "now" and in the past. Children were also asked to rate how much they liked each item using a novel continuous measure of preferences (i.e., faces scale). In Experiment 1, 3-year-olds performed significantly below chance, whereas 4- and 5-year-olds were at chance in selecting the appropriate adult-preferable items for their future self. Four- and 5-year-olds, but not 3-year-olds, demonstrated some understanding of changes in their future preferences by reporting that they will like child-preferable items less and adult-preferable items more in the future than they do now. In Experiment 2, 3- and 4-year-olds were at chance in selecting the appropriate baby-preferable items for their past self, whereas 5-year-olds were significantly above chance. Corresponding preference ratings significantly improved with age. Exploratory cross-experiment analyses revealed that children were more accurate when reasoning about past than future preferences. Our results provide new insights on children's reasoning about preferences and possible differences in their ability to self-project into the future and past.

Keywords: preschoolers; self-projection; episodic future thinking; mental states

Self-Projection in Early Development: Preschoolers' Reasoning About Changes in Their Future and Past Preferences

Thinking about the future and reflecting on the past are related abilities that appear to emerge in parallel during early development (e.g., Quon & Atance, 2010; Suddendorf, 2010). They also share cognitive and neural processes, with memory serving as a system from which we can (re)combine details from past experiences to simulate possible future events (Addis, Wong & Schacter, 2007; Buckner & Carroll, 2007; Okuda et al., 2003; Schacter & Addis, 2007a, 2007b). Buckner and Carroll (2007) use the term "self-projection" to describe the capacity to shift perspectives to contemplate our personal futures (i.e., episodic future thinking; Atance & O'Neill, 2001; Russell, Alexis, & Clayton, 2010; Suddendorf, Nielsen, & von Gehlen, 2011), personal pasts (i.e., episodic memory; Suddendorf, Addis, & Corballis, 2009; Tulving, 1984), and the subjective viewpoint of others (i.e., theory of mind, ToM, Premack & Woodruff, 1978). Self-projection is exercised during everyday events (e.g., deciding whether to cook tonight or order in) but is also relied upon during more serious, life-defining moments (e.g., deciding in which city to settle and start a family). Thus, the capacity to mentally pre-experience the future is critical for success in planning for both our immediate and distant futures, while our ability to re-experience the past allows us to simulate these possible futures while avoiding repeating costly mistakes.

In this paper we focus specifically on young children's capacity to shift from their current perspective to consider alternate perspectives (in this case, 'preferences') they may hold in the future, and potentially held in the past. Although there is a good deal of research about children's episodic memory and episodic future thinking, more broadly, we know little about children's reasoning about *changes* in their past and future mental states, specifically. Understanding

children's reasoning about changes in their own mental states across time is important because it provides insight about the early development of self-projection. Given that early self-projection evolves from seemingly trivial choices (e.g., a young child deciding which toy to spend their allowance on) to consequential decisions made in adulthood (e.g., deciding whom to marry), better understanding its development could contribute to a broader understanding of how decisions involving the self through time are made and, most importantly, how poor decisions with long-term consequences could be avoided. We begin our literature review by focusing on what we know about children's ability to consider their own past and future mental states, followed by children's reasoning about changes in preferences more specifically and, finally, a brief overview of the relationship between future and past thinking more broadly.

Children's Understanding of Changes in Mental States Across Time

Despite the quantity and breadth of research about children's understanding of others' mental states—commonly referred to as theory of mind—few studies have explored children's understanding that their *own* mental states can change over time. A notable exception is a study by Gopnik and Slaughter (1991) in which 3- and 4-year-olds experienced a particular mental state, which was then changed, and were then asked to report their initial, or past, state. For example, children stated their desire for one of two picture books. Children then read their selected book, fulfilling their desire for that item. Children were next asked to state their current desire, to which all children responded with the unchosen picture book. Finally, children were asked to recall which of the two picture books they had initially desired. Four-year-olds, but not 3-year-olds, correctly acknowledged that their past desire (i.e., picture book that was read) was different from their current desire (i.e., unread picture book).

Younger preschoolers also have difficulty appreciating changes in their own past and

future knowledge. For example, Caza, Atance, and Bernstein (2016) examined children's understanding that their own current knowledge differs from their past knowledge (e.g., when they were 6 months old). In this study, 3-, 4-, and 5-year-olds were asked a series of questions about their current general knowledge (e.g., "Do you know that clocks tell time?") and the knowledge they held as babies (e.g., "When you were a baby, did you know that clocks told time?"). Five-year-olds, but not 4- or 3-year-olds, demonstrated an understanding that their past selves knew less than their current selves. Similarly, Atance and Caza (2018) investigated 3-, 4-, and 5-year-olds' understanding that they will know more in the future than they know now by asking them questions about knowledge they would acquire as an adult (e.g., "...will you know what the word *ambiguous* means?"). Three- and 4-year-olds performed at chance, while 5-year-olds were significantly above chance, thus showing a good understanding that their future selves would know more than their current selves.

Overall, these studies demonstrate that 3- and 4-year-olds, but not 5-year-olds, have difficulty understanding that their own current knowledge differs both from their past knowledge and potential future knowledge and that 3-year-olds, but not 4-year-olds, have difficulty recognizing that their desires can change over time. More broadly, these studies indicate that preschoolers' ability to reason about changes in their own mental states improves with age.

Changes in Preferences Across Time

Gopnik and Slaughter's (1991) early work on children's understanding of mental state change suggests that children younger than age four have difficulty recapturing a previously-held desire (or preference). More recent work on children's understanding of preferences, specifically, also suggests that younger preschoolers have difficulty predicting that their current and future preferences may differ (Bélanger, Atance, Varghese, Nguyen, and Vendetti, 2014; Goulding,

Atance, & Friedman, 2019; Lee & Atance, 2016). Bélanger et al. (2014) asked 3-, 4-, and 5-year-olds to choose between child- and adult-preferable items by selecting the item they preferred "now" (self-now trials) and the one they would prefer in the future (self-future trials; e.g., "Which one of these will you like best when you're all grown up…coffee or Kool-Aid?"). A chance-level analysis revealed that only 5-year-olds understood that their future, or 'grown-up', preferences (e.g., coffee, newspaper) would differ from their current preferences (e.g., Kool-Aid, picture book). In contrast, 3-year-olds performed significantly below chance by consistently selecting their current preferences for their future selves, whereas 4-year-olds performed at chance. This chance level responding may indicate a transitional stage in children's understanding that their preferences will change over time. Together, these findings indicate that younger preschoolers do not yet appreciate that their future preferences will differ from their current preferences.

One limitation of Bélanger et al.'s (2014) task is that response options are categorical, thus potentially obscuring children's more nuanced understanding of changes in preferences. This is also true of other studies that have examined children's understanding of their own and others' mental state changes (e.g., Atance & Caza, 2018; Caza et al., 2016; Goulding et al., 2019; Lee & Atance, 2016). Yet, some developmentalists have advocated for the use of continuous measures in place of traditional pass/fail (i.e., categorical) ones (e.g., Ghrear, Fung, Haddock, & Birch, 2020; Sommerville, Bernstein, & Meltzoff, 2013). For example, Sommerville et al. (2013) introduced a continuous measure of false belief reasoning, using a "Sandbox" task. Adapting the standard categorical false belief task to include a continuous measure yielded information about the *extent* to which participants' own knowledge biases their judgments of others' beliefs; information that would not have been gleaned by measuring false beliefs with the standard

categorical task alone.

Similarly, a continuous measure of preferences may yield information about the extent to which children believe their preferences have changed in the past or will change in the future. Such measures have been successfully used in previous research measuring younger preschoolers' predictions about future emotions (Kopp, Atance, & Pearce, 2017; Wong & Baker, 1988), and future-oriented judgement and decision-making abilities (e.g., Lagattuta & Sayfan, 2011). With respect to Bélanger et al.'s (2014) categorical preferences task, even though a child maintains that she will prefer Kool-Aid to coffee in the future (seemingly unaware that her preferences will change), is it nonetheless possible that she recognizes that she will like Kool-Aid less and coffee more? This recognition is important to track because it may form the basis of the more sophisticated understanding that, in the future, certain "grown-up" items and activities (e.g., coffee) will be preferred over "child" ones (e.g., Kool-Aid). It could also be argued that older children's categorical judgments—though correct, could simply reflect semantic knowledge of what adults typically prefer, rather than true self-projection. If so, then older children may correctly select adult-preferable items (because they are what adults "typically" like), but when asked to rate how *much* they, themselves, will like them in the future, their ratings are quite low (perhaps reflecting a more visceral or emotional reaction to the object). In sum, continuous ratings allow both for detecting finer-grained developments in children's understanding and also ruling out alternative interpretations of findings that are impossible using categorical response options alone.

The Past-Future "Connection"

Schacter and Addis' (2007a, 2007b) *Constructive Episodic Simulation Hypothesis* argues for episodic memory as a system that allows individuals to flexibly (re)combine details of past

experiences to simulate novel future events. This hypothesis is supported by neuropsychological and neuroimaging studies that show considerable overlap in the cognitive and neural processes involved in both remembering the past and imagining the future. Similarities between children's (and adults') thinking about past and future events have also been reported (e.g., Harner, 1975; Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Suddendorf & Busby, 2005). Taken together, this research shows that thinking about the future and remembering the past not only share common underlying mechanisms but may also be inter-dependent processes, with the simulation of future events relying on our representation of past episodes. Accordingly, we wondered whether children's reasoning about past preferences would show a similar developmental trajectory to their reasoning about future preferences. We also know little about children's understanding of their *past* mental state changes in particular and so Experiment 2 was intended to fill this gap.

Our objectives for the current investigation were thus to (1) more sensitively track developments in preschoolers' understanding of changes in their future (Experiment 1) and past (Experiment 2) preferences using a continuous measure of preferences, and (2) determine whether there are developmental changes in preschoolers' reasoning about their own past preferences (Experiment 2) and whether these show a similar trajectory to their reasoning about future preferences.

Experiment 1: Future Preferences

We implemented a novel continuous measure of preferences (i.e., faces ratings scale) in addition to the more standard "categorical" response measure used by Bélanger et al. (2014) and other studies examining children's understanding of mental state changes (e.g., Atance & Caza, 2018; Caza et al., 2016; Gopnik and Slaughter, 1991). Consistent with Bélanger et al.'s

procedure, children were asked to choose between child- (e.g., Kool-Aid) and adult- (e.g., coffee) preferable items "now" (self-now trials) and in the future (self-future trials). Importantly, children also indicated how *much* they liked the child- and adult-preferable items now (self-now trials) and how much they would like them in the future (self-future trials) using a faces rating scale ranging from 1 "the worst!" to 9 "the best!" (Kopp et al., 2017; adapted from Wong & Baker, 1988; see Appendix A). This measure thus allowed us to assess the *extent* to which children believed their preferences would change.

Method

Participants

We conducted an a priori power analysis using G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007). Assuming a medium effect size of age (f = .33; this value was considered conservative based on Bélanger et al.'s, 2014, large effect size: η_p^2 = .20) for children's categorical responses, we required 31 children per age group (total sample size of 93) to achieve a power of .80 with alpha set to .05. Further accounting for counterbalancing and equal distribution of boys and girls within age groups, a total of 96 English-speaking 3- to 5-year-olds participated: 32 3-year-olds (M_{age} = 42 months, SD = 3.70; 16 boys), 32 4-year-olds (M_{age} = 53 months, SD = 3.81, 16 boys), and 32 5-year-olds (M_{age} = 65 months, SD = 3.10, 16 boys).

Of the total sample, 33 were tested at a university-based laboratory and 63 were tested at a museum-based laboratory. Children tested at the university were recruited through community events, Internet advertisements, posters, and a developmental database, whereas children tested at the museum were recruited on-site or on a "walk-in" basis. Children were compensated for their participation with stickers and a certificate of completion (museum), or a small toy

(university). Nine additional children were tested but excluded from the final sample (five due to experimenter error, e.g., not following the protocol in a standardized manner, one due to post-test parental disclosure of a developmental disorder, and three due to an inability to complete the protocol).

Children were tested in Ottawa, Canada and were predominantly White (72%) and from middle-class backgrounds (64% had a combined household income >$100,000). All procedures for Experiments 1 and 2 received ethical approval by the University of Ottawa's Office of Research Ethics and Integrity (File #H03-15-05).

Materials and Procedure

Children were tested individually in a 15-20 min long session by a female experimenter. Parents observed in real time either from a computer monitor or tablet in an adjacent room, or from inside the testing room if the child did not want to separate from the parent (n = 1; this parent was seated behind their child and instructed not to interact or react to their child during testing).

Faces rating scale. Once seated, the experimenter showed children a nine-point Likert rating scale depicting happy, neutral, and sad faces (Kopp et al., 2017; adapted from Wong & Baker, 1988). The experimenter then explained to children the emotion associated with each face on the scale beginning with the positive side of the scale and progressing from lowest to highest positive affect (i.e., points 6 to 9; see Appendix A for scale and scale point labels and Appendix B for sample protocol). The experimenter then similarly reviewed the negative side of the scale (i.e., points 4 to 1), finishing with the mid-point (i.e. point 5). Children were then told that they would be asked some questions and that they would need to select their responses from the faces scale. Responses were assigned a "1" if children pointed to the saddest end of the scale, or,

"really don't like something at all; it's the worst!", up to a "9'" if children pointed to the happiest end of the scale, or, "really like something a lot; it's the best!" (i.e., range = 1-9). Responses for all trials were scored in this manner.

Self-now trials. All children received a block of 'self-now' trials followed by a block of 'self-future' trials (i.e., within-subjects design). The purpose of the self-now trials was to establish a baseline of children's current preferences to then compare to their predictions about their future preferences, as measured by the self-future trials. Accordingly, children were first given five trials where they were asked to select which of two paired child- and adult-preferable items (counterbalanced for order of presentation, left/right placement on testing table, and verbal introduction of each item) they liked best "right now". Trials included: Kool-Aid vs coffee, Play-Doh vs crossword puzzle, picture book vs newspaper, sticker book vs magazine, Dora the Explorer DVD vs cooking DVD. After selecting the child- or adult-preferable item for a specific trial, children were asked "How much do you like X (selected item) right now?" The experimenter reminded children of the faces rating scale response options by pointing to the main sections of the scale and stating: "Do you really like (it/them), do you like (it/them) a little, do you think (it's/they're) just okay, do you not like (it/them) a little, or do you not really like (it/them)?" The same question was then asked for the non-selected child- or adult-preferable item. The same format was used for all five trials. Children then engaged in a 3-min drawing break prior to the self-future trials.

Self-future trials. Next, all children were asked about their future preferences for the same five trials. Children were shown a picture of a gender-matched adult (see Appendix C) and told: "Right now, you are (3/4/5) years old. But one day, you're going to be all grown up. You're going to be as big as this (woman/man). (Her/His) name is (Jane/John), and (she/he) is as big as

your (Mommy/Daddy). I'm going to show you some things, and I want you to tell me the things you will like best when you're all grown up." The picture of the gender-matched adult remained on the table during these trials. Children were then presented with the same child- and adult-preferable items used in the self-now trials following the same counterbalanced order. Using the faces rating scale, children were asked how much they would like each child- and adult-preferable item when they are "all grown-up."

Scoring

Categorical responses. As in Bélanger et al. (2014), children's categorical responses were excluded in the self-now and self-future trials if children selected the adult-preferable item (rather than the child-preferable item) for a given self-now trial. Otherwise, it would be impossible to determine whether children's subsequent responses in the self-future trials were based on future self-projection/thinking or simply a re-endorsement of their current preference (e.g., selecting 'coffee' in both the self-now and self-future trials). Also consistent with Bélanger et al., a proportion score ranging from 0 to 1 was created by dividing the number of correct items selected for the self-future trials (adult-preferable items; possible score between 0-5) by the number of correct items selected for the self-now trials (child-preferable items; possible score between 0-5). Whereas a proportion score of "0" indicates that children predicted no change in their current and future preferences (i.e., selected exclusively child items on both the self-now and self-future trials), a proportion score of 1 indicates that children fully differentiated their current and future preferences (i.e., selected exclusively child items for the self-now trials and adult items for the self-future trials).

Continuous Responses. As with children's categorical responses, children's preference ratings (i.e., the options they selected on the faces rating scale) were excluded for both self-now

and self-future trials if children selected an adult item on a self-now trial. For example, if a child selected 'coffee' as their current preference, ratings for this trial along with the corresponding self-future trial were excluded. Means for each child's preference ratings were then calculated to create composite scores for both child- and adult-preferable items now and in the future. This yielded ratings/means for the following four categories: *child items-now* (i.e., how much children liked child-preferable items "now"), *adult items-now* (i.e., how much children liked adult-preferable items "now"), *child items-future* (i.e., how much children predicted they would like child-preferable items in the future), and *adult items-future* (i.e., how much children predicted they would like adult-preferable items in the future).

Results and Discussion

Proportion scores on the Future Preferences task were not significantly affected by testing location [university: $M = 0.54$, $SD = 0.41$; museum: $M = 0.42$, $SD = 0.37$, $F(1, 94) = 2.20$, $p = .141$, partial $\eta^2 = 0.02$], and did not significantly differ by sex, $F(1, 94) = .004$, $p = .949$, partial $\eta^2 = 0.01$, and so data were collapsed across these factors.

Categorical Responses

Children's proportion scores were compared to chance responding (i.e., mean proportion score of 0.5) using one-sample *t*-tests. In what follows, proportion scores that are significantly above chance indicate that children tended to correctly select adult-preferable items on the self-future trials, and thus recognized that their preferences would change in the future. In contrast, proportion scores that are significantly below chance indicate that children tended to select the child-preferable items on the self-future trials, and thus failed to recognize that their current and future preferences would differ. Finally, "at chance" performance indicates that children tended to select child- and adult-preferable items equally/at random in the self-future trials; although

they did not default to their current preferences, they did not consistently predict that their preferences would change in the future.

Our analyses revealed that 3-year-olds performed significantly below chance [M = 0.33, SD = 0.34, $t(31) = -2.90$, $p = .007$], whereas 4- and 5-year-olds performed at chance [M = 0.51, SD = 0.40, $t(31) = 0.10$, $p = .920$; M = 0.54, SD = 0.40, $t(31) = 0.52$, $p = .610$, respectively]. A regression analysis with proportion scores as the criterion variable and age in months as the predictor was significant, $\beta = 0.01$, $t(95) = 2.67$, $p = .009$, and accounted for 7% ($R^2 = .07$) of the variance in proportion scores, suggesting that children's performance tended to improve with age. Reasons for why our 5-year-olds did not perform above chance whereas Bélanger et al.'s (2014) did are unclear, but may be due to cohort differences (e.g., "adult" items such as magazines and crossword puzzles may be less common today than they were when Bélanger et al.'s data were collected) and variability in sampling.

Continuous Responses

A frequency analysis indicated that children used the full range of possible responses (i.e., 1 through 9) on the continuous scale, but tended to more often select the end- (14% and 36% of responses were '1' and '9', respectively) and mid-points (15% of responses were '5') of the scale. Nonetheless, as will become clearer below, children's continuous ratings differed across age and preference rating categories, suggesting that the scale functioned as intended.

We conducted a 3 x 4 split plot ANOVA on children's continuous preference ratings, with age (3, 4, 5) as a between-subjects factor and preference rating category as a within-subjects factor (child items-now, adult items-now, child items-future, adult items-future). Although there was no main effect of age, $F(2, 93) = 1.39$, $p = .254$, partial $\eta^2 = .03$, there was a significant main effect of preference rating category, $F(3, 279) = 44.81$, $p < .001$, partial $\eta^2 = .33$, and a

significant Age x Preference rating category interaction, $F(6, 279) = 4.15$, $p = .001$, partial $\eta^2 = .08$ (see Figure 1). This differential effect of preference rating category across age suggests that an interpretation of the main effect of preference rating category is less important than the interaction.

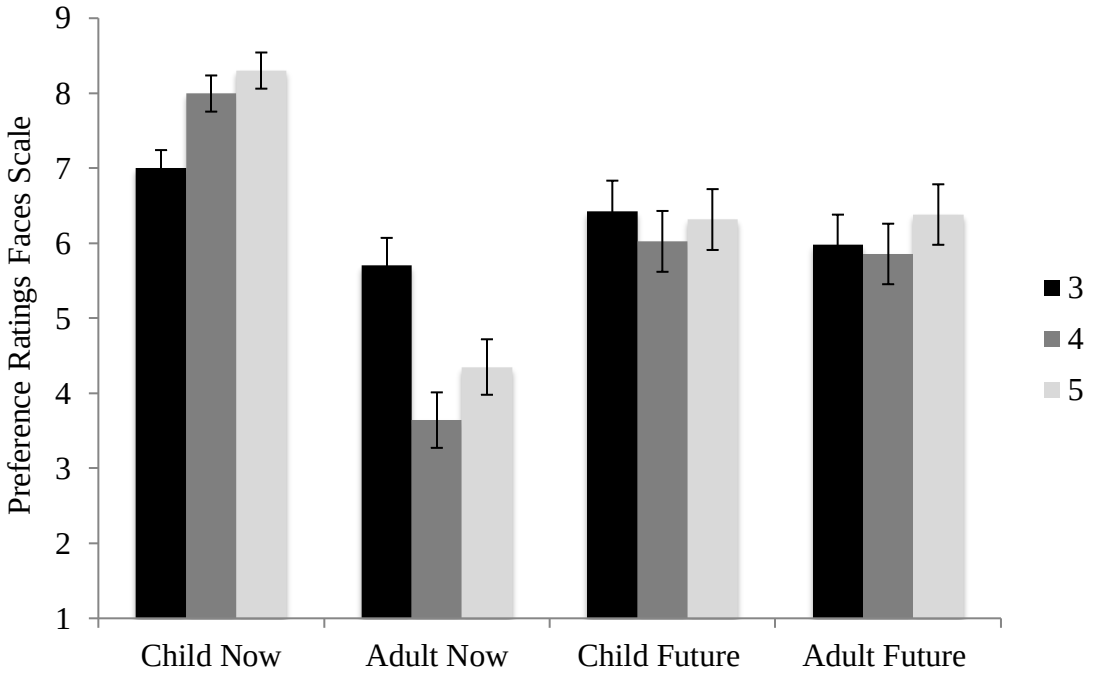


Figure 1. Age by preference rating category (Experiment 1, future preferences). Error bars represent standard error of the mean.

Age x preference rating category interaction. In this section, we explore the Age x Preference rating category interaction by focusing on the following theoretically-relevant simple main effects (and whether they differed) for each of the three age groups: (1) Do children predict that they will like child-preferable items significantly *less* in the future than they do now? (child-future vs child-now); (2) Do children predict that they will like adult-preferable items significantly *more* in the future than they do now? (adult-future vs adult-now); and (3) Do children predict that they will prefer the adult items to the child items in the future? (adult-future

vs child-future). We also checked that children did indeed prefer child to adult items in the present. The results of these comparisons are summarized in Table 1 and outlined next.

Table 1

Simple Main Effects for Age by Preference Rating Category Interaction (Experiment 1, Future Preferences)

Item Judgments	3-year-olds	4-year-olds	5-year-olds
Child-now > Adult-now	*	**	**
Child-future < Child-now	X	**	**
Adult-future > Adult-now	X	**	**
Adult-future > Child-future	X	X	X

Note. X = no significant difference; * = $p < .00874$; ** = $p < .001$

Child-now > Adult-now = "Do children like the child-preferable items significantly more now than adult-preferable items?"

Child-future < Child-now = "Do children predict that they will like child-preferable items significantly less in the future than they do now?"

Adult-future > Adult-now = "Do children predict that they will like adult-preferable items significantly more in the future than they do now?"

Adult-future > Child-future = "Do children predict that they will like the adult-preferable items significantly more than the child-preferable items in the future?"

To explore our simple main effects of interest, we conducted a series of repeated-measures ANOVAs, with each test conducted at an alpha level of .00874 (Sidak-Bonferroni correction factor of $1-.90^{(1/12)}$). All three age groups reported that they preferred child to adult items "now" (3-year-olds, $p = .007$; 4-year-olds, $p < .001$, 5-year-olds, $p < .001$). For comparison (1), only 4- and 5-year-olds predicted that they will like child-preferable items significantly *less* in the future than they do now (3-year-olds, $p = .127$; 4-year-olds, $p < .001$; 5-year-olds, $p < .001$). Similarly, only 4- and 5-year-olds predicted that they will like adult-preferable items

significantly *more* in the future than they do now [i.e., comparison (2); 3-year-olds, $p = .553$; 4-year-olds, $p < .001$; 5-year-olds, $p < .001$]. Finally, none of the three age groups predicted that they will prefer the adult items to the child items in the future [i.e., comparison (3); 3-year-olds, $p = .304$; 4-year-olds, $p = .822$; 5-year-olds, $p = .924$].

The picture that emerged from children's continuous preference ratings was more nuanced and informative than considering their categorical responses alone. As expected, all children reported that they currently preferred child to adult items. However, 3-year-olds failed to recognize any potential shifts in their future preferences, reporting a continued endorsement of child items in the future. In contrast, despite their chance-level performance on the categorical ratings, 4- and 5-year-olds' preference ratings reflected an understanding that they will like child items *less* and adult items *more* in the future than they do now (i.e., comparisons 1 and 2). However, neither 4- nor 5-year-olds predicted our final and, arguably, most cognitively complex contrast of interest: that they will prefer the adult items over and above the child items in the future. Thus, 4- and 5-year-olds demonstrated some (more subtle) understanding that their preferences will change, yet still experienced difficulty acknowledging a 'final' shift in preference from child to predominately adult items in the future.

Experiment 2: Past Preferences

To examine whether there exist developmental changes in preschoolers' reasoning about their past preferences and whether these show a similar trajectory to their reasoning about future preferences, we designed a new task that required preschoolers to identify the preferences they held as babies. Notably, we focus on children's *reasoning* about their own past to present changes in preferences as opposed to their specific memory of these changes, per se (which would, of course, be impossible). Similar to Experiment 1, successfully reasoning about changes

in one's own past preferences requires shifting (or self-projecting) from one's current perspective to one's past, or 'baby', perspective.

The findings from Experiment 2 can also provide insight about a possible source of difficulty that children experience when reasoning about their future preferences. Both Bélanger et al. (2014) and Goulding et al. (2019) argue that conflict between children's present and future desires may hinder their ability to identify their future preferences. That is, because adult items are inherently less desirable than child items, children may find it particularly difficult to inhibit their current preference for child items in favor of adult ones. Goulding et al. provided support for this account by showing that 3-year-olds were better able to predict that they would own vs prefer adult items (e.g., wallet, newspaper) in the future, and also that a generic adult would be more likely to own than prefer adult items now. Their interpretation is that judging that one will *own* adult rather than child items in the future places less executive demands on children than judging that they will *prefer* adult to child items in the future.

Similarly, one could argue that reasoning about past preferences places less executive/inhibitory demands on children because baby items, unlike adult items, may still be somewhat desirable thus resulting in less conflict between currently-preferred items (e.g., Play-Doh) and baby items (e.g., rattle)—this as compared to currently-preferred items and adult items (e.g., crossword puzzles). Comparing children's continuous ratings for the adult (Experiment 1) and baby (Experiment 2) items (e.g., Do children report liking adult items less "now" than baby items?) can inform us about this possibility. For this reason—and to parallel our approach in Experiment 1—we also asked children to provide preference ratings using the faces rating scale.

We also wondered whether children with younger siblings would find it easier to reason about past preferences based on recent and direct experience (i.e., having a baby sibling). This

possibility is consistent with research showing that having siblings facilitates children's understanding of other related aspects of cognitive development, including theory of mind (e.g., Jenkins & Astington, 1996; Peterson, 2000).

Method

Participants

Our power analysis for Experiment 2 was identical to Experiment 1 and resulted in 96 3-, 4-, and 5-year-olds (who had not participated in Experiment 1). Children were tested at either a university (n = 28) or museum (n = 68) laboratory and included 32 3-year-olds (M_{age} = 42 months, SD = 3.06; 16 boys), 32 4-year-olds (M_{age} = 53 months, SD = 3.60, 16 boys), and 32 5-year-olds (M_{age} = 65 months, SD = 3.44, 16 boys). Recruitment methods, participant characteristics, length of testing, and participant remuneration were the same as in Experiment 1. Ten children were tested but excluded from the final sample (four due to experimenter error, and six due to their inability to complete the protocol). Two of the children tested had their parent present in the room during the session; however, as in Experiment 1, the parent was seated behind their child and instructed not to interact or react to their child during testing.

Children were tested in Ottawa, Canada and were predominantly White (58%) and from middle-class backgrounds (66% combined household income >$100,000). As part of a demographic form, parents were also asked to indicate if their child had siblings and, if so, to include their ages. This yielded two comparative categories: (1) has at least one younger sibling (n = 49) and (2) has no younger sibling or has only older siblings (n = 41). Six participants were not included in this categorization because parents had declined to complete the demographic form.

Materials and Procedure

Self-now trials. As in Experiment 1, all children received a block of self-now trials followed by a block of 'self-past' trials (i.e., within-subjects design; see Appendix D for sample protocol). The purpose of the self-now trials was to establish a baseline of children's current preferences to compare to their judgments of baby preferences measured by the 'self-past' trials. Children were first given five trials in which they were asked to select one of two paired child- and baby-preferable items (counterbalanced for order of presentation, left/right placement on testing table, and verbal introduction of each item) they liked best "right now." Trials included: juice box/bottle of milk, Play-Doh/rattle, sticker-book/picture book, Goldfish crackers/baby food in a jar (note, however, that we said "food in a jar" not "baby food" to children), and action figure/"blankie". After selecting the child- or baby-preferable item for a specific trial, children were asked, "How much do you like X (selected item) right now?" using the same faces scale as in Experiment 1. The same question was then asked for the non-selected child- or baby-preferable item, and always followed the child's initial item choice. Children then engaged in a 3-min drawing break.

Self-past trials. Next, all children were asked about their past preferences. Similar to the self-future trials in Experiment 1, children were shown a photograph of a gender-neutral baby (see Appendix E) after which the experimenter stated: "Right now, you're 3/4/5 years old. But you used to be a baby. You were as small as this baby and her/his name is Tiffany/Tommy. I'm going to show you some things, and I want you to tell me the things you used to like best when you were a baby." As with the self-future trials from Experiment 1, the picture of the baby remained on the testing table during the series of trials. Children were then presented with the same child- and baby-preferable items as the self-now trials. Children were also asked "how

much" they liked the child- and baby-preferable items when they were a baby.

Scoring

Scoring was identical to Experiment 1 for both categorical responses and continuous preferences ratings. Proportion scores were created for children's categorical responses by dividing the number of correct (i.e., baby-preferable) items selected for the self-past trials (possible score between 0-5) by the number of correct (i.e., child-preferable) items selected for the self-now trials (possible score between 0-5). This yielded a proportion score ranging from 0 to 1. Similar to Experiment 1, this proportion score represents children's ability to engage in past self-projection and, specifically, the extent to which they understand that their past preferences likely differed from their current preferences. Whereas a proportion score of "0" indicates that children reported no change in their past preferences (i.e., selected exclusively child items on both the self-now and self-past trials), a proportion score of 1 indicates that children fully differentiated their past and current preferences (i.e., selected exclusively child items for the self-now trials and baby items for the self-past trials).

Means for each child's continuous preference ratings were calculated to create composite scores for both child- and baby-preferable items now and in the past, yielding the following four categories: *child items-now* (i.e., how much children liked child-preferable items "now"), *baby items-now* (i.e., how much children liked baby-preferable items "now"), *child items-past* (i.e., how much children reported liking child-preferable items in the past), *baby items-past* (i.e., how much children reported liking baby-preferable items in the past).

Results and Discussion

Proportion scores were not significantly affected by testing location [university: M = 0.74, SD = 0.26; museum: M = 0.61, SD = 0.35, $F(1, 94) = 2.94$, $p = .090$, partial $\eta^2 = .03$], and

so data were collapsed across this factor. Proportion scores also did not differ depending on whether or not the participant had a younger sibling (at least one younger sibling vs no or only older siblings), $F(1, 88) = 0.23$, $p = .630$, partial $\eta^2 = .00$, so we did not consider this variable further.

However, proportion scores significantly differed as a function of sex, $F(1, 94) = 5.19$, $p = .025$, partial $\eta^2 = 0.05$, with girls ($M = 0.72$, $SD = 0.31$) selecting the correct items for their past, or "baby", selves significantly more often than boys ($M = 0.57$, $SD = 0.33$). This difference may be due to girls being more socialized than boys to be aware of and interested in babies (and possibly their likes and dislikes) thus making it easier for them to reason about their own preferences as babies. Because sex did not interact with age on children's proportion scores, $F(2, 90) = .99$, $p = .375$, partial $\eta^2 = .02$, and because we had no a priori reasons to expect that children's performance would differ as a function of sex, we collapsed across this variable for subsequent analyses.

Categorical Responses

As in Experiment 1, children's proportion scores were compared to chance (i.e., mean proportion score of 0.5) using one-sample *t*-tests. In what follows, proportion scores that are significantly above chance indicate that children tended to correctly select baby-preferable items on the self-past trials, and thus recognized that their preferences differed in the past. In contrast, proportion scores that are significantly below chance indicate that children tended to select the child-preferable items on the self-past trials, and thus failed to recognize that their current and past preferences differed. Finally, "at chance" performance indicates that children tended to select child- and baby-preferable items equally/at random in the self-past trials; although they did not default to their current preferences, they did not consistently predict that their preferences

differed in the past.

These analyses revealed that 3- and 4-year-olds performed at chance [M = 0.49, SD = 0.34, $t(31) = -.175$, $p = .862$; M = 0.62, SD = 0.34, $t(31) = 1.89$, $p = .068$, respectively], whereas 5-year-olds performed significantly above chance [M = 0.84, SD = 0.18, $t(31) = 10.80$, $p < .001$]. A regression analysis revealed that age in months was a significant predictor of proportion scores, $\beta = 0.02$, $t(95) = 5.08$, $p < .001$, and accounted for 22% ($R^2 = .22$) of the variance in these scores [a finding that also held when sex was entered as a covariate, $\beta = 0.02$, $t(95) = 5.29$, $p < .001$, ($R^2 = .27$)].

These results suggest that children's ability to appreciate that their past preferences differed from their current ones improved with age, with only the performance of the 5-year-olds being significantly above chance. One possible explanation for younger preschoolers' at chance performance could be their motivation to be perceived as a "big boy" or "big girl". Specifically, parents often encourage their young children to be more "grown up" and independent which may lead to these children distinguishing their current selves from babies by assuming a 'big kid' status—and one that never included an interest in baby-preferable items. Disentangling whether younger children's poorer performance is in part due to this possibility versus a genuine difficulty reasoning about past preferences is impossible to determine based on our data, but is an intriguing question to address in future research.

Continuous Responses

A frequency analysis indicated that children used the full range of possible responses (i.e., 1 through 9) on the continuous scale but, as in Experiment 1, tended to more often select the end- (11% and 38% of responses were '1' and '9', respectively) and mid-points (11% of responses were '5') of the scale.

We conducted a 3 x 4 split plot ANOVA on children's continuous preference ratings, with age (3, 4, 5) as a between-subjects factor and preference rating category as a within-subjects factor (child items-now, baby items-now, child items-past, baby items-past). There were significant main effects of age, $F(2, 93) = 5.64$, $p = .005$, partial $\eta^2 = .11$, preference rating category, $F(3, 279) = 72.60$, $p < .001$, partial $\eta^2 = .44$, and a significant Age x Preference rating category interaction, $F(6, 279) = 9.76$, $p < .001$, partial $\eta^2 = .17$ (see Figure 2). Similar to Experiment 1, we do not interpret main effects given that these were qualified by a significant interaction.

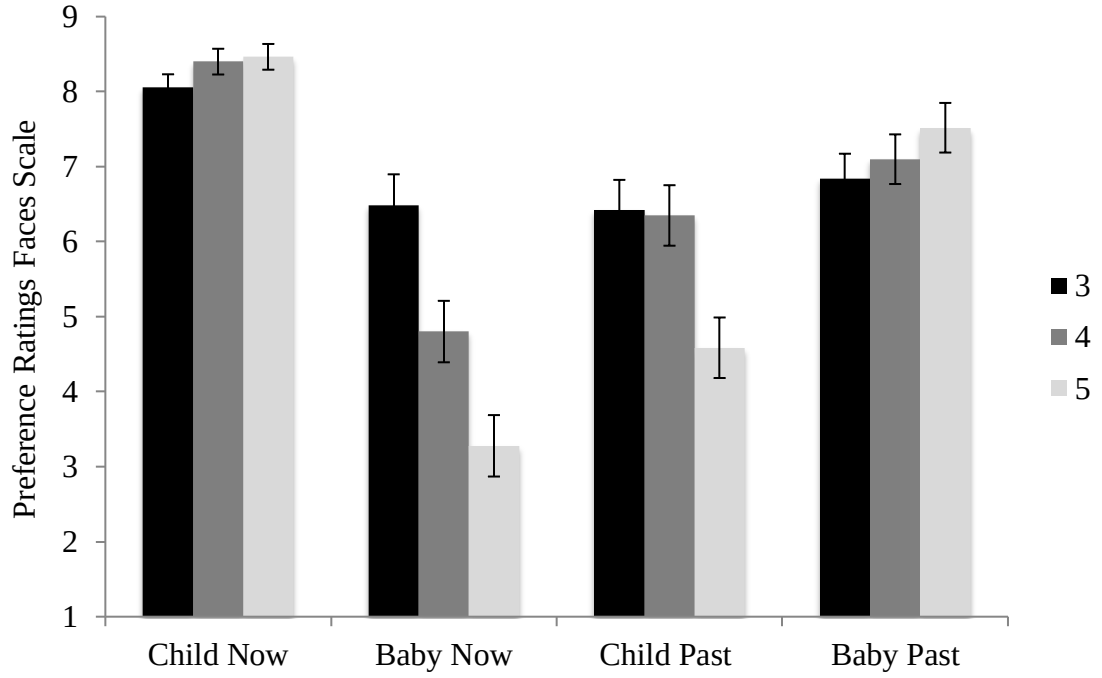


Figure 2. Age by preference rating category (Experiment 2, past preferences). Error bars represent standard error of the mean.

Age x preference rating category interaction. As in Experiment 1, we examined the most theoretically relevant simple main effects of preference rating category for each of the three age groups: (1) Do children report having liked the child-preferable items significantly less in the

past than they do now? (child-past vs child-now); (2) Do children report having liked baby-preferable items significantly more in the past than they do now? (baby-past vs baby-now); and (3) Do children report that they preferred the baby items to the child items in the past? (baby-past vs child-past). We also checked that children preferred child to baby items in the present. The results of these comparisons are summarized in Table 2 and outlined below.

Table 2

Simple Main Effects for Age by Preference Rating Category Interaction (Experiment 2, Past Preferences)

Item Judgments	3-year-olds	4-year-olds	5-year-olds
Child-now > Baby-now	**	**	**
Child-past < Child-now	**	**	**
Baby-past > Baby-now	X	**	**
Baby-past > Child-past	X	X	**

Note. X = no significant difference; * = $p < .00874$; ** = $p < .001$

Child-now > Baby-now = "Do children like the child-preferable items significantly more now than baby-preferable items?"

Child-past < Child-now = "Do children report having liked child-preferable items significantly less in the past than they do now?"

Baby-past > Baby-now = "Do children report having liked baby-preferable items significantly more in the past than they do now?"

Baby-past > Child-past = "Do children report having liked baby-preferable items significantly more than child-preferable items in the past?"

To explore our simple main effects of interest, we conducted a series of repeated-measures ANOVAs, with each test conducted at an alpha level of .00874 (Sidak-Bonferroni correction factor of $1-.90^{(1/12)}$). All three age groups indicated that they preferred child to baby items "now" (3-year-olds, $p = .001$; 4-year-olds, $p < .001$; 5-year-olds, $p < .001$). For comparison (1), 3-, 4-, and 5-year-olds all reported having liked child-preferable items significantly *less* in

the past than they do now (all *p*s < .001). Both 4- and 5-year-olds (but not 3-year-olds) reported that they liked baby-preferable items significantly more in the past than they do now [i.e., comparison (2); 3-year-olds, $p = .489$; 4-year-olds, $p < .001$; 5-year-olds, $p < .001$]. Finally, only 5-year-olds reported that, in the past, they liked baby-preferable items significantly more than child-preferable items [i.e., comparison (3); 3-year-olds, $p = .210$; 4-year-olds, $p = .169$; 5-year-olds, $p < .001$].

As in Experiment 1, children's preference ratings (i.e., continuous measure) shed further light on their understanding. Despite their chance-level performance on the categorical selections, 3-year-olds correctly endorsed our first contrast of interest, reporting that they liked child-preferable items less in the past than they do now. Four-year-olds made a step further in understanding changes in their past to current preferences by reporting that they liked baby-preferable items more in the past than they do now. Notably, this difference in 3- and 4-year-olds' reasoning was only detectable with the continuous ratings. Five-year-olds also correctly endorsed our first two contrasts of interest; however, unlike 3- and 4-year-olds, 5-year-olds also endorsed our final contrast of interest: that they preferred baby- to child-preferable items in the past. Thus, 5-year-olds demonstrated a robust understanding of changes in their past preferences, even successfully reasoning about a more cognitively complex pattern of preference for baby items over and above child items for their past self.

Cross-experiment Comparisons

We conducted exploratory cross-experiment analyses to determine whether children's reasoning about past preferences shows a similar developmental trajectory to their reasoning about future preferences. To do so, we compared children's categorical responses (i.e., proportion scores) for both Future and Past Preferences tasks. Children's proportion scores on

the Future Preferences task (M = 0.46, SD = 0.39; Experiment 1) was significantly lower than their performance on the Past Preferences task (M = 0.65, SD = 0.33; Experiment 2), $t(190) = -3.71$, $p < .001$. Moreover, this pattern held when we restricted our analyses to the three item pairs that were either identical or highly similar across both experiments: "drinks" [future trial: coffee/Kool-Aid vs past trial: milk in a bottle/juice; future trial M = 0.39 vs past trial M = 0.81, t(169) = -6.24, p < .001], "play" [future trial: crossword puzzle/Play-Doh vs past trial: rattle/Play-Doh; future trial M = 0.53 vs past trial M = 0.80, t(158) = -3.73, p < .001], and "read" [future trial: magazine/sticker book vs past trial: picture book/sticker book; future trial M = 0.43, vs past trial M = 0.68, t(165) = -3.40, p = .001]. Together, these analyses suggest that children find it easier to reason about their past preferences than their future ones.

Based on this difference in performance, we tested a possible source of heightened difficulty when children reason about their future preferences (i.e., "inhibitory account" proposed by Bélanger et al., 2014, and Goulding et al., 2019). Specifically, we wondered whether it might be more difficult for children to inhibit their current preferences for the more desirable child items in favor of the less desirable adult items. If so, children's preference ratings should indicate that they found the baby-preferable items (Experiment 2) more desirable "now" than the adult-preferable items (Experiment 1). This was not the case: Children's stated preferences for the baby- (M = 4.86, SD = 2.64) and adult-preferable (M = 4.56, SD = 2.24) items did not significantly differ, $t(190) = -0.82$, $p = .412$. Although one must be cautious when comparing across experiments conducted with different groups of children (though both samples in the current investigation were demographically very similar), these results suggest that a purely "inhibitory" account cannot explain children's difficulty reasoning about future preferences.

General Discussion

In two experiments, we examined preschoolers' reasoning about changes in their future and past preferences. In addition to asking children to select the items that they would prefer as adults and those that they preferred as babies (i.e., categorical measure), we explored the *extent* to which children believed their preferences would change in the future and differed in the past, thus adding to the more standard categorical response options used in previous research about children's understanding of their own mental state changes (e.g., Atance & Caza, 2018; Bélanger et al., 2014; Caza et al., 2016; Goulding et al., 2019; Lee & Atance, 2016). We also examined whether children's reasoning about future and past preferences followed similar developmental trajectories.

Our results revealed that preschoolers' ability to successfully reason about changes in their own preferences generally improved with age. However, consistent with other research advocating for continuous over categorical measures (e.g., Sommerville et al., 2013), a more detailed and nuanced picture of children's reasoning was obtained using continuous preference ratings. More specifically, though 4- and 5-year-olds' categorical responses indicated chance level performance in Experiment 1, our continuous measure indicated that around age 4, children demonstrated some understanding that their future preferences will differ from their current ones. In Experiment 2, our continuous preferences measure also revealed that children's reasoning about their past preferences is graded in nature, becoming increasingly complex and nuanced with age. For example, although 3-year-olds performed at chance level on our categorical measure, their continuous preferences ratings reflected an understanding that they preferred child items less as babies than they did now. As in Experiment 1, this additional insight about children's reasoning could not have been gleaned using our categorical measure alone.

Although most developmentalists do not characterize concept formation/reasoning as emerging in an "all-or-none" fashion, it is methodologically challenging to determine how to capture more "graded" forms of knowledge. This seems especially important because compared to more "objective" states such as knowledge (i.e., one either knows something or not), preferences hold a more continuous quality. We may like something a little or a lot and these more nuanced judgements are difficult to capture using only categorical (e.g., "either/or") judgements. Given that children in the current investigation tended to use mid- and end-points of the preferences scale, future research might explore more streamlined versions (e.g., 5-point) of our scale. Nevertheless, we believe that our approach is an important step in the direction of measuring developmental nuances and, like Sommerville et al.'s (2013) Sandbox "false belief" task, for example, may provide a more ecological approach to measuring developmental shifts in children's cognition.

Although there were similarities in children's reasoning about future and past preferences, cross-experiment analyses revealed that children reasoned more accurately about their past preferences. Notably, whereas 3-year-olds showed no insight that their current and future preferences would differ, in the realm of past preferences, they acknowledged that they liked child-preferable items significantly less in the past than they do now. Older children's reasoning about future and past preferences also differed from one another. Specifically, 5-year-olds were more successful in selecting the appropriate items (i.e., categorical responses) for their baby self, and also demonstrated a more complete and complex understanding of the changing nature of past preferences, as compared to future preferences. Thus, in addition to reporting liking child items less in the past than they do now and liking baby items more, 5-year-olds recognized that, as babies, they preferred baby over child items.

Why might children find reasoning about past preferences easier than reasoning about future ones? Although past and future thinking are related during early development (Busby & Suddendorf, 2005; Richmond & Pan, 2013), there is also evidence that children's ability to think episodically about the past develops more rapidly than their ability to imagine the future (Coughlin, Lyons, & Ghetti, 2014; Gott & Lah, 2014). This asymmetry in past and future thinking has been found for children's temporal reasoning (e.g., Friedman, 2004; McCormack & Hanley, 2011), understanding of temporal terms (e.g., "yesterday" and "tomorrow"; Zhang & Hundson, 2018), sequencing of temporal events (e.g., McColgan & McCormack, 2008), and parent-child conversations about the past and future (e.g., Nelson & Fivush, 2004; Hudson, 2006). Some researchers cite the increased cognitive complexity and demands of future-oriented thinking to account for these differences (e.g., Zhang & Hudson; McCormack & Hanley, 2011), while others suggest that younger children are simply not as proficient at imagining the future as they are at thinking about the past (Atance, 2015; Hudson, Mayhew, & Prabhakar, 2011; Prabhakar & Ghetti, 2020).

Ease of mental representations of past and future may also provide insight about differences in children's reasoning about past and future preferences. Friedman (2000, 2004) proposes that children may more easily think about past events because they can rely on previous experiences to construct mental representations of the past, whereas, the same mental references and experiences are not available when thinking about the future. Consistent with this claim, preschoolers are more successful in sequencing representational images of past compared to future events (e.g., Benson, 1997; Friedman, 2000). Children in our study may have found it easier to reason about changes in their past preferences because mental representations of their past/'baby' self may have been easier to construct than those of their future or 'grown-up' self.

Results from our continuous preferences measure also speak to a hypothesis about why reasoning about future preferences may be difficult for young children. Both Bélanger et al. (2014) and Goulding et al. (2019) argue that children find it particularly challenging to reason about their future preferences because they have difficulty inhibiting their current desires when identifying the preferences of their adult self. In the current study, we argued that were this the case, then reasoning about past preferences may pose less of a challenge given that baby items may be somewhat more desirable to preschoolers than adult items. In other words, the level of desirability of the baby items may reduce the amount of conflict (between child and baby items) experienced by children, thus making it easier for them to reason about potential changes in their own past preferences compared to their future ones.

Although we found that reasoning about past preferences was easier for children than reasoning about future preferences, this did not appear to stem from the fact that children judged baby items as inherently more desirable than adult ones. In fact, the data from children's continuous preference ratings indicated that children viewed both adult and baby items as equally (un)desirable. Although this does not rule out the possibility that "conflict" per se contributes to children's reasoning about future (and past) preferences, it does not appear to fully account for the increased difficulty of reasoning about future preferences. Nonetheless, to better clarify the contribution of conflict and inhibitory control, future work should include actual measures of inhibitory control (e.g., Day/Night Stroop-like task; e.g., Gerstadt, Hong, & Diamond, 1994) alongside the Preferences tasks, and/or manipulate level of desirability of child and adult items within the Preferences tasks themselves. For example, might children perform better overall on the Future Preferences task if the desirability of the future/adult items (e.g., a Smartphone) is increased?

We also acknowledge that our comparisons between future and past preferences were conducted across experiments and hence across two different samples of children. Although these samples were demographically similar, it is important to replicate our findings using a within-subject design whereby children are simultaneously asked about their past, present, and future preferences within the same trials. This would also serve to equate the level of desirability of the child-preferable "now" items. Although these items were identical for two of our five trials, they differed slightly for the remaining three. Another limitation of our comparison is that the past that we asked children about (i.e., being a baby) was temporally nearer than the future (i.e., being a grown-up). Although this difference in temporal proximity is important, it is arguable that, for a young child, being a "baby" (which 3-year-olds adamantly argue they are not!) is just as temporally distant as being a "grown-up." Nonetheless, matching our two tasks on temporal distance is an important direction for future research, as would administering Future and Past Preferences tasks with more nuanced time points (e.g., several years in the past/several years in the future; "when you were a baby"/ "when you will be a big kid", etc.) and within the same group of children. Testing older children (e.g., 6- and 7-year-olds) on our continuous measure would also shed further light on the graded development of preferences reasoning with age, as well as whether differences in reasoning about future and past preferences maintains throughout development. Finally, it is worth noting that children's understanding of temporal terms and concepts could further explain age-related differences in children's performance on our Preferences tasks. Although Busby-Grant and Suddendorf (2011) report that even 3-year-olds have a good grasp of the wording "when I was little/a baby" and "when I get bigger/grow up" (which parallel the wording used in our tasks), there are nonetheless important developmental differences in children's understanding of other temporal concepts that could also

have played a role in their understanding of our task instructions.

Contributions and Applications

Our findings contribute to the growing body of research on children's understanding of their own mental state changes across time and provide new data about children's reasoning about changes in their *past* preferences, specifically. The addition of our continuous preferences measure provides novel insights about developmental shifts and differences not gleaned by categorical measures alone. Results from the continuous preferences measure reveal that children's understanding of changes in their preferences is a graded process and that children may develop a better sense of what has changed in the past before they can imagine possible changes in their future. Recall that in their Constructive Episodic Simulation Hypothesis (2007a, 2007b), Schacter and Addis argue that simulation of future events relies on the mental (re)combination of aspects from past episodes. Together with our findings, this suggests that parenting strategies could be developed to bolster the development of children's self-projection skills while targeting reasoning about future preferences in particular. These strategies could include parent-assisted discussions with children to revisit past changes in preferences in an effort to help them better simulate possible changes in their future preferences. In scaffolding the development of self-projection in their children, parents can better equip them to make more accurate and successful decisions throughout childhood.

References

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

Atance, C. M. (2015). Young children's thinking about the future. *Child Development Perspectives, 9,* 178-182. doi:10.1111/cdep.12128

Atance, C. M., & Caza, J. S. (2017). "Will I know more in the future than I know now?" Preschoolers' judgments about changes in general knowledge. *Developmental Psychology*. doi:10.1037/dev0000480

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

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, 85,* 2419-2431. doi:10.1111/cdev.12282

Benson, J. B. (1997). The development of planning: It's about time. In S. L. Friedman & E. K. Scholnick (Eds.), *The developmental psychology of planning: Why,how, and when do we plan?* (pp. 43-75). doi:10.4324/9781315806495

Birch, S. A. J., & Bloom, P. (2007). The curse of knowledge in reasoning about false beliefs. *Psychological Science, 18,* 382-386. doi:10.1111/j.1467-9280.2007.01909.x

Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Sciences, 11,* 49–57. doi:10.1016/j.tics.2006.11.004

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

Busby-Grant, J., & Suddendorf, T. (2011). Production of temporal terms by 3-, 4-, and 5-year-old children. *Early Childood Research Quarterly, 26*, 87-95. doi:10.1016/j.ecresq.2010.05.002

Caza, J. S., Atance, C. M., & Bernstein, D. M. (2016). Older (but not younger) preschoolers understand that knowledge differs between people and across time. *British Journal of Developmental Psychology, 34*, 313-324. doi:10.1111/bjdp.12130

Coughlin, C., Lyons, K. E., & Ghetti, S. (2014). Remembering the past to envision the future in middle childhood: Developmental linkages between prospection and episodic memory. *Cognitive Development, 30*, 96-110. doi:10.1016/j.cogdev.2014.02.001

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*, 1149-1160. doi:10.3758/BRM.41.4.1149

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191. doi:10.3758/BF03193146

Friedman, W. J. (2000). The development of children's knowledge of the times of future events. *Child Development, 71*, 913-932. doi:10.1111/1467-8624.00199

Friedman, W. J. (2004). The development of a differentiated sense of the past and the future. *Advances in Child Development and Behavior, 31*, 229-269. doi:10.1016/S0065-2407(03)31006-7

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3 1/2-7 years old on a stroop-like day-night test. *Cognition, 53*, 129-153. doi:10.1016/0010-0277(94)90068-X

Ghrear, S., Fung, K., Haddock, T., & Birch, S. A. J. (2020). Only familiar information is a "curse": Children's ability to predict what their peers know. *Child Development*. doi:10.1111/cdev.13437

Gopnik, A., & Slaughter, V. (1991). Young children's understanding of changes in their mental states. *Child Development, 62*, 98-110. doi:10.1111/j.1467-8624.1991.tb01517.x

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

Goulding, B. W., Atance, C. M., & Friedman, O. (2019). An advantage for ownership over preferences in children's future thinking. *Developmental Psychology, 55*, 1702-1708. doi:10.1037/dev0000759

Harner, L. (1975). Yesterday and tomorrow: Development of early understanding of the terms. *Developmental Psychology, 11*, 854-865. doi:10.1037/0012-1649.11.6.864

Hayne, H., Gross, J., McNamee, S., Fitzgibbon, O., & Tustin, K. (2011). Episodic memory and episodic foresight in 3- and 5-year-old children. *Cognitive Development, 26*, 343–355. doi:10.1016/j.cogdev.2011.09.006

Hudson, J. A. (2006). The development of future time concepts through mother-child conversation. *Merrill-Palmer Quarterly, 52*, 70-95. doi:10.1353/mpq.2006.0005

Hudson, J. A., Mayhew, E. M., & Prabhakar, J. (2011). The development of episodic foresight: Emerging concepts and methods. *Advances in Child Development and Behavior, 40*, 95-137. doi: 10.1016/B978-0-12-386491-8.00003-7

Jenkins, J. M., & Astington, J. W. (1996). Cognitive factors and family structure associated with theory of mind development in young children. *Developmental Psychology, 32,* 70 78. doi:10.1037/0012-1649.32.1.70

Kopp, L., Atance, C. M., & Pearce, S. (2017). “Things aren’t so bad!”: Preschoolers overpredict the emotional intensity of future outcomes. *British Journal of Developmental Psychology, 35*, 623-627. doi:10.1111/bjdp.12210

Lagattuta, K. H., & Sayfan, L. (2011). Developmental changes in children’s understanding of future likelihood and uncertainty. *Cognitive Development, 26*, 315-330. doi:10.1016/j.cogdev.2011.09.004

Lee, W. S. C., & Atance, C. M. (2016). The effect of psychological distance on children’s reasoning about future preferences. *PLOS ONE, 11*, 1-18. doi:10.1371/journal.pone.0164382

McColgan, K. L., & McCormack, T. (2008). Searching and planning: Young children’s reasoning about past and future event sequences. *Child Development, 79*, 1477-1497. doi:10.1111/j.1467-8624.2008.01200.x

McCormack, T., & Hanley, M. (2011). Children’s reasoning about the temporal order of past and future events. *Cognitive Development, 26*, 299-314. doi:10.1016/j.cogdev.2011.10.001

Nelson, K., & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review, 111*, 486-511. doi:10.1037/0033-295X.111.2.486

Okuda, J., Fujii, T., Ohtake, H., Tsukiura, T., Tanji, K., Suzuki, K., . . . Yamadori, A. (2003). Thinking about the future and the past: The roles of the frontal pole and the medial temporal lobes. *Neuroimage, 19*, 1369-1380. doi:10.1016/S1053-8119(03)00179-4

Peterson, C. C. (2000). Kindred spirits: Influences of siblings’ perspectives on theory of mind. *Cognitive Development, 15*, 435-455. doi:10.1016/S0885-2014(01)00040-5

Prabhakar, J., & Ghetti, S. (2020). Connecting the dots between past and future: Constraints in episodic future thinking in early childhood. *Child Development, 91*, 315-330. doi:10.1111/cdev.13212

Premack, D. & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioural and Brain Sciences, 1,* 515-526. doi:10.1017/S0140525X00076512

Quon, E., & Atance, C. M. (2010). A comparison of preschoolers' memory, knowledge, and anticipation of events. *Journal of Cognition and Development, 11*, 37-60. doi:10.1080/15248370903453576

Richmond, J. L., & Pan, R. (2013). Thinking about the future early in life: The role of relational memory. *Journal of Experimental Child Psychology, 114*, 510-521. doi:10.1016/j.jecp.2012.11.002

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*, 56–71. doi:10.1016/j.cognition.2009.08.013

Schacter, D. L., & Addis, D. R. (2007a). The cognitive neuroscience of constructive memory: Remembering the past and imagining the future. *Philosophical Transactions of the Royal Society of London: Biological Sciences*, 362, 773-786. doi:10.1098/rstb.2007.2087

Schacter, D. L., & Addis, D. R. (2007b). The ghosts of past and future. *Nature, 445*, 27. doi: 10.1038/445027a

Sommerville, J. A., Bernstein, D. M., & Meltzoff, A. N. (2013). Measuring beliefs in centimeters: Private knowledge biases preschoolers' and adults' representation of others' beliefs. *Child Development, 84*, 1846-1854. doi:10.1111/cdev.12110

Suddendorf, T. (2010). Episodic memory versus episodic foresight: Similarities and differences. *Wiley Interdisciplinary Reviews: Cognitive Science, 1*, 99-107. doi:10.1002/wcs.23

Suddendorf, T., Addis, D. R., & Corballis, M. (2009). Mental time travel and the shaping of the human mind. *Philosophical Transactions of the Royal Society, 364*, 1317-1324. doi: 10.1098/rstb.2008.0301

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

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

Tulving, E. (1984). Precis of elements of episodic memory. *Behavioral and Brain Sciences, 7*, 223-268. doi:10.1017/S0140525X0004440X

Wong, D. L., & Baker, C. M. (1988). Pain in children: Comparison of assessment scales, *Pediatric Nursing, 14*, 9-17. Retrieved from wongbakerfaces.org

Zhang, M., & Hudson, J. A. (2018). Children's understanding of yesterday and tomorrow. *Journal of Experimental Child Psychology, 170*, 107-133. doi:10.1016/j.jecp.2018.01.010

Chapter 3: Relations Between Self-Projection, Theory of Mind, and Executive Function Abilities in Early Development

Leia Kopp, Lojain Hamwi, and Cristina M. Atance

University of Ottawa

Author Note

Leia Kopp, School of Psychology, University of Ottawa; Cristina M. Atance, School of Psychology, University of Ottawa.

We thank Danielle Ovtsyn for help with data collection and Ronan Sampson for reliability coding. Thank you to Dwayne Schindler for statistical consultation. A special thank you to all the children and parents who participated.

Correspondence concerning this article should be addressed to Leia Kopp, School of Psychology, Vanier Hall, Room 6006, University of Ottawa, Ottawa, Ontario, Canada K1N 6N5.

Data availability statement: The data analyzed for the current investigation are available from the corresponding author by reasonable request.

Abstract

We investigated both the relation and possible asymmetry between preschoolers' reasoning about their future and past preferences, and whether these forms of reasoning relate to theoretically-relevant simulative [Theory of Mind (ToM)] and cognitive [executive function (EF)] abilities. Adapting Kopp, Hamwi, and Atance's (2021) Preferences tasks to include a within-subjects design, children (N = 93, M_{age} = 49 months) completed counterbalanced Future and Past Preferences tasks by selecting what they preferred "now" (child-preferable items), in the future (adult-preferable items), and in the past (baby-preferable items). Children also completed EF [Dimensional Change Card Sort (DCCS), Sun/Moon], ToM [Contents False Belief – Self/Other (CFB-S, CFB-O), Change in Location (CiL), conflicting desires], and language (WPPSI: Receptive Vocabulary, Picture Naming) measures. Children's Future and Past Preferences scores were significantly correlated – but not after controlling for their receptive language ability. There was no significant difference (asymmetry) between Preferences task scores. Children's ability to reason about their future and past preferences was also not related to or predicted by their performance on the ToM and EF tasks after controlling for age, language ability, and sex. These results help clarify the developmental trajectory of two important forms of self-projection and reveal new insights about factors theoretically argued to underlie children's future and past preferences reasoning.

Keywords: self-projection, preferences, theory of mind, executive function, mental states

Relations Between Self-Projection, Theory of Mind, and Executive Function Abilities in Early Development

Mentally projecting from our current perspective to contemplate our futures and re-experience our pasts or, what has been termed future and past "self-projection" (Buckner & Carroll, 2007; Kopp, Hamwi, & Atance, 2021), emerge and decline in tandem (Addis, Wong, & Schacter, 2008; Suddendorf, 2010a) and have parallel developmental trajectories (e.g., Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Busby & Suddendorf, 2005). Yet, despite developmental work showing important links between "future" and "past" forms of self-projection, there is also research to suggest that thinking and reasoning about the future may be more difficult for children than thinking and reasoning about the past (Coughlin, Lyons, & Ghetti, 2014; McCormack, Burns, O'Connor, Jaroslawska, & Caruso, 2019; Prabhakar & Ghetti, 2019; Wang, Capous, Koh & Hou, 2014). We explore these links and asymmetries in the current paper by focusing on two important aspects of self-projection; namely, children's capacity to reason about their future and past mental states— "preferences", in particular. Children's ability to reason about the changing nature of their own mental states—including preferences—is important for successful decision making across the lifespan. For example, important choices in adulthood (e.g., buying a family sedan or the flashy sports car) may evolve from lower risk decisions made in childhood (e.g., deciding which toy to choose from the "prize drawer" at the end of your dentist visit).

In the current experiment, we explore preschoolers' reasoning about changes in their own future and past preferences. Our goals are to determine whether preschoolers' reasoning about their future and past preferences are related and, whether, despite this relation, children find it more difficult to reason about the former than the latter. In addition, we explore whether possible

asymmetries (and similarities) in reasoning about past and future mental states might be explained by other theoretically-relevant simulative and cognitive abilities—most notably, theory of mind (ToM) and executive function (EF). Doing so may shed light on why certain forms of future self-projection may be more cognitively challenging for children than past self-projection. We begin with a literature review focused on developmental research that links future and past self-projection abilities, followed by research about linkages between future and past mental state reasoning, including preferences, more specifically and, finally, an overview of the relations between children's reasoning about future and past preferences and their ToM and EF.

Linking Future and Past Self-Projection in Development

Self-projection, including thinking about the future and remembering the past [broadly conceptualized as "episodic future thinking" (EFT); Atance & Mahy, 2016; Atance & O'Neill, 2001, and "episodic memory"; Tulving, 2002, respectively], is an important focus of developmental research. With respect to EFT in particular, around age four, children begin to accurately describe possible personal future events and experiences (e.g., Busby-Grant & Suddendorf, 2011), engage in planning and saving behaviours to meet a future need (e.g., Atance, Metcalf, & Thiessen, 2017; Suddendorf, Nielsen, & von Gehlen, 2011), and delay gratification in favour of a larger future reward (e.g., Mischel & Mischel, 1987). It is also around age four that children begin to encode and recall personal memories (e.g., Perner & Ruffman, 1995; Suddendorf & Corballis, 1997), accurately report personally experienced events from their past (Busby & Suddendorf, 2005), and demonstrate an enduring cognitive representation of the self in time (Nelson, 2001; Povinelli, 2001; but also see Bauer, 2007, Nelson & Fivush, 2004, and Reese, 2002, for the argument that episodic memory develops more gradually in early development).

Developmental work has also shown significant relations between future and past self-projection abilities across both verbal (i.e., language-based) and behavioural (i.e., item-selection or choice-based) methodologies. For example, using a verbal methodology, Suddendorf (2010b) asked 3- and 4-year-olds to report what they did "yesterday" and what they planned to do "tomorrow". Preschoolers who successfully reported a past event were also more likely to report a possible future event (and vice versa), even when controlling for children's ability to answer similar questions that did not include temporal or episodic qualities. Using a more "behavioural" methodology, Ünal and Hohenberger (2017) found that 3-, 4-, and 5-year-olds who performed well on an episodic memory task requiring them to describe the "what, where, and when" of a toy hiding game also performed well on an episodic future thinking task asking them to predict items necessary to play a "desktop football" game the next day. Despite these similarities between young children's ability to reason about the future and past, there is work to suggest that self-projecting into the future is more difficult than self-projecting into the past.

Research examining children's event representations (e.g., Busby-Grant & Suddendorf, 2009), temporal reasoning, language, and sequencing (Friedman, 2003; McColgan & McCormack, 2008; McCormack & Hanley, 2011; Zhang & Hudson, 2018), and language comprehension and production (Harner, 1975; Hudson, 2006; Nelson & Fivush, 2004) shows that children understand, reason, and communicate more successfully about the past than the future. For example, Prabhakar and Ghetti (2019) asked 3- and 4-year-olds to remember spatiotemporal information (a sequence of movements involving characters on a tablet) to achieve a future goal (to view a video of a character dancing to a song). Children were asked to demonstrate the movement sequence in a past (recall) task ("Can you show me how you played the video before?") and in a future task ("When you come back tomorrow, can you show me how

you will play the video?"). Although performance on the past and future tasks was significantly correlated and age-related improvements were found on both, children had more difficulty in the future task compared to the past task. Thus, as a whole, the research that directly compares children's reasoning about the past and future supports the claim that children tend to have greater difficulty self-projecting into the future than into the past. Broadly-speaking, researchers argue that future-oriented reasoning and self-projection place increased cognitive demands on children (e.g., Zhang & Hudson, 2018) while others argue that younger children simply lack proficiency in imagining the future compared to thinking about the past (e.g., Atance, 2015).

Children's Reasoning about Future and Past Mental States

Self-projection allows us to "step out" of the present to imagine future and past mental states. Mental state reasoning, or inferring beliefs, desires, and intentions (Mitchell & Riggs, 2000), has been well studied with regard to children's inferences about the mental states of others (i.e., ToM; Premack & Woodruff, 1978); yet, little is known about the development of children's understanding and inferences about their *own* mental states and, more specifically, their *changing* nature over time. Children's understanding about changes in their future and past mental states is critical for successful decision making in adulthood. We may think about knowledge we will gain in the future or preferences we held in the past, for example, to inform our decisions in the present. Developmentalists have begun to study these capacities in young children by assessing whether they can differentiate future and past mental states from their current ones. For example, preschoolers' understanding that they will know more in the future (e.g., "When you're all grown up. . .will you know what the animal called a *tamarin* looks like?"; Atance & Caza, 2018) and knew less in the past (e.g., "When you were a baby. . .did you know that this animal was called an *elephant*?"; Caza, Atance, & Bernstein, 2016) improves with

age. Similarly, research in the area of children's understanding of knowledge loss (i.e., the understanding that we may lose some of our current knowledge over time) shows that, as early as age four, children appreciate that they may lose some of their current knowledge in the future (Fitneva, 2020).

Additional work in the area of future and past mental state reasoning has also started to explore children's understanding of changes in their desires and preferences; an area of self-projection that is especially relevant to the development of successful decision making. In an early study, Gopnik and Slaughter (1991) showed that 4-year-olds understood that their current desire (i.e., new, unread picture book) can differ from their previous desire (e.g., picture book initially chosen but since read). Research specific to children's understanding of changes in their preferences further shows age-related improvement in preschoolers' ability to predict that their future or "grown up" preferences (e.g., coffee) may differ from their current preferences (e.g., Kool-Aid; Bélanger, Atance, Varghese, Nguyen, & Vendetti, 2014). In recent work, Kopp, Hamwi, and Atance (2021) adapted Bélanger et al.'s item-selection methodology to examine preschoolers' reasoning about changes in their future and past preferences with the goal of determining whether both show similar age-related changes between 3 and 5 years.

In two experiments, Kopp et al. (2021) gave 3-, 4-, and 5-year-olds a Future Preferences task that included pairs of child- (e.g., Play-Doh) and adult-preferable (e.g., crossword puzzle; Experiment 1) items, and a Past Preferences task that included pairs of child- (e.g., Play-Doh) and baby-preferable (e.g., rattle; Experiment 2) items. In Experiment 1, children were asked to choose the items they preferred "now" and those that they would prefer in the future, whereas in Experiment 2, they were asked to choose the items they preferred "now" and those they had preferred in the past. Although children's performance improved with age in both experiments,

cross-experiment analyses revealed that children were more accurate in reasoning about their past than future preferences. Although these findings are consistent with previous research showing both similarities and differences in children's future and past self-projection abilities, further investigation is necessary as Kopp et al.'s finding of asymmetry is based on exploratory analyses across separate samples of children.

Accordingly, in the current experiment, we sought to clarify both the relation and possible asymmetry between preschoolers' reasoning about their future and past preferences. We thus implemented a within-subjects design in which children received both Kopp et al.'s (2021) Future and Past Preferences tasks (adapted from Bélanger et al., 2014). A strength of this approach is that we use the same task format to measure children's reasoning about future preferences in one case, and past preferences in the other, allowing for direct comparison of children's future and past self-projection abilities.

Relations Between Past and Future Self-Projection and ToM and EF

Theory of mind (ToM) entails our understanding that the mental states of others—including their beliefs, desires, intentions, and knowledge—can differ from our own and from reality (Premack & Woodruff, 1978). Relevantly, children's ability to infer *desires*, including those that may conflict with their own (i.e., conflicting desires), is an important aspect of ToM development (Wright-Cassidy et al., 2005). In fact, ToM is often considered another form of self-projection, alongside EFT and episodic memory (e.g., Buckner & Carroll, 2007). Moreover, executive functioning (EF) has been proposed as an important cognitive ability underlying EFT and episodic memory (Suddendorf & Corballis, 2007; Ünal & Hohenberger, 2017). EF refers to a set of higher order cognitive abilities involved in the self-regulation of thought and action (Carlson, 2005) including inhibitory control (i.e., the capacity to regulate an automatic action),

and cognitive flexibility (i.e., the ability to shift one's perspective when new information challenges prior beliefs). Theoretically, both ToM and EF require a shift in perspective similar to the shift required when someone adopts the perspective of their future or past selves during self-projection (e.g., Hanson, Atance, & Paluck, 2014). That is, future and past self-projection require a shift in perspective from the current self to the future and past self, respectively, whereas ToM and EF require a shift in one's own perspective to that of another person or conflicting position, respectively. Neurophysiological research in adults has shown that particular brain regions become activated during both future and past self-projection and when taking the perspective of another person (e.g., Buckner & Carroll, 2007; Spreng & Grady, 2010; Viard et al, 2011). ToM impairments have also been found in populations with compromised episodic memory (e.g., depression, Bora & Berk, 2015; dementia, Synn et al., 2018) and in populations with concurrent deficits in future and past self-projection (e.g., Autism Spectrum Disorder; Lind & Bowler, 2008).

Developmental research has also explored the relation between self-projection and ToM and EF. In addition to having 3-, 4-, and 5-year-olds complete an episodic memory task and an EFT task, Ünal and Hohenberger (2017) had them complete an EF task (Day-Night Stroop task; Gerstadt, Hong, & Diamond, 1994). Regression analyses revealed that children's performance on the episodic memory task, but not the EFT task, was positively predicted by their performance on the EF task when controlling for age. Hanson et al. (2014) also failed to find intercorrelations between their EFT tasks [Sequencing (Busby-Grant & Suddendorf, 2009); Picture Book (Atance & Meltzoff, 2005); Grocery/Beach (Hudson, Shapiro, & Sosa, 1995); Tomorrow (Busby & Suddendorf, 2005); Zoo (McColgan & McCormack, 2008)] and EF tasks [Black/White (Simpson & Riggs, 2005); DCCS (Zelazo, 2006); Tower of Hanoi (Carlson et al., 2004); Truck Loading

(Carlson et al., 2004), Fluency (Turner, 1999); Backward Digit Span (Carlson, 2005); Count/Label (Carlson, 2005)] in preschoolers. Their EFT tasks were also not significantly related to their ToM measures [Diverse Desires, Diverse Beliefs, Knowledge Access, Contents False Belief (Wellman & Liu, 2004); Change in Location (Carlson & Moses, 2001)]. Hanson et al. explain this lack of relation as possibly due to differences in the kind of "perspective shift" required by the EFT, EF, and ToM tasks. More specifically, they argued that their EFT tasks—unlike the EF and ToM tasks—did not require children to shift from a current perspective that *conflicted* with a future perspective. As such, it is possible that tasks that require children to consider *conflicting* past and future perspectives—as in the Future and Past Preferences tasks in Kopp et al. (2021) —may both relate to and be predicted by children's broader capacity to shift between conflicting perspectives as assessed by both EF and ToM tasks (including both conflicting beliefs and desires). That is, children may need to actively inhibit the urge to endorse their current preferences to successfully reason from the perspective of their past or future selves.

Overview and Objectives of the Current Experiment

We sought to further clarify the relation – and possible asymmetry – between preschoolers' reasoning about their past and future preferences. To do so, we adapted Kopp et al.'s (2021) Future and Past Preferences tasks to directly compare preschoolers' performance on each. We hypothesized that children's abilities to reason about their future and past preferences would be significantly related. However, we also predicted that children would be more accurate when reasoning about their past, as compared to their future, preferences thus demonstrating an asymmetry in their self-projection abilities. To shed further light on mechanisms that might underlie both similarities and differences in children's self-projection, we included ToM (false belief and conflicting desires tasks) and EF (inhibitory control and cognitive flexibility tasks).

Unlike previous methodologies (e.g., Hanson et al., 2014), our self-projection tasks require a shift in perspective consistent with that required during successful ToM and EF reasoning. Thus, we predicted that children's ability to reason about their future and past preferences would be related to and predicted by their performance on the ToM and EF tasks—this after controlling for language ability, age, and sex. We further predicted that this relation would be strongest amongst ToM, EF, and future preferences, specifically. This is because thinking about the future is argued to require stronger imaginative capacities and cognitive demands than thinking about the past.

Method

Participants

Using G*Power 3.1 (Faul, Erdfelder, Buchner, & Lang, 2009; Faul, Erdfelder, Lang, & Buchner, 2007), we conducted a preliminary power analysis for a multiple linear regression including six tested predictors [two ToM false belief tasks (with one task yielding two separate scores for a total of three ToM scores), two EF tasks, and one conflicting desires task[1])] and three additional (control) predictors (age in months, language composite, and sex) for a total of nine predictors with Future Preferences and Past Preferences task scores entered in separate regression analyses as dependent variables. This analysis indicated a total sample size of 98 to achieve a power of .80 with alpha set to .05 and a medium effect size of .15. Due to difficulties with recruitment of 5-year-olds throughout the testing phase of this experiment, we made the experiment available to all available preschoolers between 3 and 5 years of age (as opposed to recruiting equal numbers of 3-, 4-, and 5-year-olds). Then, due to the COVID-19 pandemic restrictions, in-person data collection was suspended in March, 2020. At this point, 93 English-

[1] The Conflicting Desires task is a measure of ToM, however, we consider this task separately from the other ToM tasks, which are measures of false belief.

speaking 3- to 5-year-olds (M_{age} = 49 months, SD = 8.25) had participated. Our final sample included: 46 3-year-olds (M_{age} = 42 months, SD = 2.56; 29 boys), 35 4-year-olds (M_{age} = 53 months, SD = 3.74, 15 boys), and 12 5-year-olds (M_{age} = 63 months, SD = 3.11, 3 boys). A subsequent power analysis for multiple linear regression revealed that 8% variance accounted for by any given predictor variable (R^2 change = .079) could be achieved with a total sample size of 93, power of .80, and alpha set to .05).

Children were recruited through community events, Internet advertisements, posters, and a developmental database and were tested at a University laboratory and compensated with a small toy. Seven additional children were tested but excluded from the final sample (three due to parental interference during testing, including prompting their child's responses, three due to inability to complete the protocol, and one child who had viewed their sibling's testing session prior to their own). Children were tested in Ottawa, Canada and were predominantly White (76%) and from middle-class backgrounds (63% had a combined household income >$100,000). All procedures received ethical approval by the University of Ottawa's Office of Research Ethics and Integrity (File #H03-15-05).

Materials and Procedure

Children were tested individually in one 40-50 minute long session by a female experimenter. Parents observed the testing session in real time from a computer in an adjacent room. Children were randomly assigned to begin with either the Future (self-now trials + self-future trials) or Past Preferences (self-now trials + self-past trials) task, yielding two primary protocol versions (see Table 1 and Appendix F for sample protocol).

Table 1

Task Block Orders

Order	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth
V1,V2	PPT-N	EF	PPT-P	ToM	FPT-N	CD	FPT-F	Language
V3,V4	FPT-N	EF	FPT-F	ToM	PPT-N	CD	PPT-P	Language

Note. V1, V2, V3, V4 = Protocol versions 1, 2, 3, & 4 (further described in Table 2), PPT-N = Past Preferences task – self now trials, EF = Executive function tasks, PPT-P = Past Preferences task – self past trials, ToM = Theory of mind tasks, FPT-N = Future Preferences task – self now trials, CD = Conflicting desires task, FPT-F = Future Preferences task – self future trials, Language = language subtests of the WPPSI-III.

Child-, adult-, and baby-preferable items from the self-now, self-future and self-past trials were counterbalanced for order of presentation, left-right placement on testing table, and verbal introduction of each item, resulting in two different versions of the two primary protocols for the Future and Past Preferences tasks, for a total of four protocol versions. Children always completed the self-now trials of either the Future or Past Preferences tasks first, followed by two EF tasks (Dimensional Change Card Sort, Sun/Moon), the self-future trials (Future Preferences task before Past Preferences task) or self-past trials (Past Preferences task before Future Preferences task), and two ToM tasks (Contents False Belief, Change in Location False Belief). Children were then administered the self-now trials of the Preferences task (i.e., Future or Past) they had not yet completed, followed by a conflicting desires task, either the self-future or self-past trials, and, finally, two language tasks (Receptive Vocabulary and Picture Naming subtests of the Wechsler Preschool & Primary Scale of Intelligence, third edition; WPPSI-III; Wechsler, 2002). Other than the Future and Past Preferences tasks, task order remained fixed as this allowed for approximately the same amount of time to elapse between Preferences Task trials.

Future Preferences Task

All children completed a Future Preferences task that included five 'self-now' trials and five 'self-future' trials (see Table 2).

Table 2

Trial Item Counterbalancing by Protocol Version

Protocol	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
V1					
PPT-N & P	MB(R) vs JB	GC(R) vs MF	R(L) vs PD	SB(L) vs PB	AF(L) vs B
FPT-N & F	M(L) vs SB	W(R) vs AF	NP(R) vs PD	GC(L) vs SF	JB(L) vs C
V2					
PPT-N & P	R(R) vs PD	AF(L) vs B	MB(L) vs JB	PB(R) vs SB	GC(L) vs MF
FPT-N & F	SB(R) vs M	JB(L) vs C	SF(R) vs GC	NP(R) vs PD	W(L) vs AF
V3					
FPT-N & F	M(L) vs SB	W(R) vs AF	NP(R) vs PD	GC(L) vs SF	JB(L) vs C
PPT-N & P	MB(R) vs JB	GC(R) vs MF	R(L) vs PD	SB(L) vs PB	AF(L) vs B
V4					
FPT-N & F	SB(R) vs M	JB(L) vs C	SF(R) vs GC	NP(R) vs PD	W(L) vs AF
PPT-N & P	R(R) vs PD	AF(L) vs B	MB(L) vs JB	PB(R) vs SB	GC(L) vs MF

Note. V1, V2, V3, V4 = Protocol versions 1, 2, 3, & 4, PPT-N = Past Preferences task – self now trials, PPT-P = Past Preferences task – self past trials, FPT-N = Future Preferences task – self now trials, FPT-F = Future Preferences task – self future trials, MB = milk in a bottle, JB = juice box, GC = Goldfish Crackers, MF = mashed food, R = rattle, PD = Play-Doh, SB = sticker book, PB = picture book, AF = action figure, B = Blankie, M = magazine, W = wallet, NP = number puzzle, SF = stir fry, C = coffee, (L) = placement of item on table on experimenter's left, (R) = placement of item on table on experimenter's right. Items with left or right placement in parentheses announced first by experimenter.

Self-now trials. Children completed five trials where they were asked to select one of two paired child- and adult-preferable items they liked best "right now". Trials included: juice box/coffee, Play-Doh/number puzzle, sticker book/magazine, Goldfish crackers/vegetable stir-fry, and action figure/wallet. Children completed the self-now trials first so as to establish a baseline of their current preferences. This baseline was then used to compare against children's predictions about their future preferences (as measured by the self-future trials; see below).

Self-future trials. All children were asked about their future preferences for the same five item pairs used in the self-now trials following the same counterbalanced order. In the self-future trials, children were first shown a photograph of a gender-matched adult and told: "Right now, you are (3/4/5) years old. But one day, you're going to be all grown up. You're going to be as big as this (woman/man). (Her/His) name is (Jane/John), and (she/he) is as big as your (Mommy/Daddy). I'm going to show you some things, and I want you to tell me the things you will like best when you're all grown up." The photograph of the gender-matched adult remained on the table during these trials.

Scoring. Children's responses in the Future Preferences task were excluded for both the self-now and self-future trials if children selected the adult-preferable item as their current preference in any given self-now trial. Otherwise, it would be impossible to determine whether children's subsequent selection of an adult-preferable item in a given self-future trial reflected future "self-projection" or a continued endorsement of their current preference (e.g., selecting 'wallet' in both the self-now and self-future trials). A proportion score ranging from 0 to 1 was created for each child by dividing the number of correct items selected for the self-future trials (adult-preferable items; possible score: 0-5) by the number of correct items selected for the self-now trials (child-preferable items; possible score: 0-5). Using this scoring system, a proportion

score of "0" reflects a child who predicted no change from their current to future preferences (i.e., only child items were selected for all usable self-now and self-future trials), whereas a proportion score of 1 reflects a child who predicted that all of their current preferences would change in the future (i.e., all child items selected for usable self-now trials and all adult items for usable self-future trials).

Past Preferences Task

All children completed a Past Preferences task that included five 'self-now' trials and five 'self-past' trials (see Table 2).

Self-now trials. Children completed five trials where they were asked to select one of two paired child- and baby-preferable items they liked best "right now." Trials included: juice box/milk in a bottle, Play-Doh/rattle, sticker-book/picture book, Goldfish crackers/baby food in a jar (note, however, that we said "mashed food" not "baby food" to children), and action figure/"blankie". As with the Future Preferences task, children were first administered the self-now trials so as to establish a baseline of their current preferences from which to compare perceived changes in preferences from when they were babies (measured by the self-past trials; see below).

Self-past trials. All children were asked about their past preferences using the same five item pairs as in the self-now trials following the same counterbalanced order. In the self-past trials, children were shown a photograph of a gender-neutral baby and told: "Right now, you're 3/4/5 years old. But you used to be a baby. You were as small as this baby and her/his name is Tiffany/Tommy. I'm going to show you some things, and I want you to tell me the things you used to like best when you were a baby." The photograph of the gender-neutral baby remained on the table during these trials.

Scoring. As with the scoring procedure in the Future Preferences task, children's responses for both the self-now and self-past trials were excluded if children selected the baby-preferable item as their current preference in any given self-now trial. Following the same scoring procedure as the Future Preferences task, a proportion score ranging from 0 to 1 was created by dividing the number of correct (i.e., baby-preferable) items selected for the self-past trials (possible score: 0-5) by the number of correct (i.e., child-preferable) items selected for the self-now trials (possible score: 0-5). This score represents children's past self-projection, or their ability to reason about likely changes in their current preferences since they were a baby. Thus, using this scoring system, a proportion score of "0" reflects a child who reported no change in their past preferences (i.e., only child items selected for all usable self-now and self-past trials), whereas a proportion score of 1 reflects a child who recognized that all of their current preferences had since changed from the time they were a baby (i.e., all child items selected for usable self-now trials and all baby items for usable self-past trials).

Executive Function Tasks

Dimensional Change Card Sort (DCCS: Standard Version). In this task (Zelazo, 2006), children were presented with two boxes: one with a picture of a blue star and the other with a red truck. To begin, the experimenter explained to children that they would be playing a card game called the "colour game". To play, children were told that they needed to sort the cards by colour. The experimenter first demonstrated sorting a blue card into the blue star box or red card into the red truck box. Children were then asked to sort an alternate coloured card to the first demonstrated card and were either praised for a correct answer or provided with corrective feedback for an incorrect answer. Children then sorted up to six cards, with the experimenter ensuring the cards were placed face down into the boxes with each sort. After each sort, and

regardless of performance, the experimenter re-stated the rules of the game: “So remember, if it’s blue it goes here, but if it’s red it goes there. Here’s a blue/red one. Where does it go?”. Next, the experimenter introduced the post-switch trials, stating that “Now, we are going to play a new game. We’re not going to play the colour game anymore. We’re going to play the shape game”. Children were then asked to sort the next six cards according to a different rule (by shape). After each sort, children were reminded of the rules for the shape game regardless of performance: “Remember, if it’s a star it goes here, but if it’s a truck it goes there. Here’s a star/truck. Where does it go?”. Children’s scores corresponded to the number of correct sorts during the post-switch trials (range: 0-6). Two independent coders recorded and tallied children’s DCCS post-switch sorts with one coder coding all responses and the other coding a sub-set of responses (38.7%)[2]. Inter-rater reliability indicated an intraclass correlation coefficient = .946, $p < .001$. The primary investigator resolved any discrepancies between coders.

Sun/Moon. In this task (inhibitory control; Simpson & Riggs, 2005; derived from Gerstadt et al., 1994), children were presented with a card with an illustration of a sun. The experimenter then stated: “This card is sun, right? When you see this card, I don’t want you to say ‘sun’. No, I want you to say ‘moon’.” Children were then presented with a card depicting a moon and asked to say ‘sun’ instead of ‘moon’ following the same instructions as the sun card. Children were given a maximum of three practice trials with feedback and then completed 21 test cards with no rule reminders. The cards were presented in a fixed, pseudorandom order. Using a scoring procedure implemented by Mahy, Mazachowsky, and Pagobo (2018), children

[2] Due to on-campus COVID-19 restrictions around the time of coding, our second coder was only able to score a sub-sample of the DCCS post-switch responses. However, this amount (roughly 40%) is within the range of data that typically undergoes reliability coding in developmental studies.

received a score of 2 for each trial in which they correctly said the opposite of the image on the card, a score of 1 for each trial in which they self-corrected from the image on the card to the opposite, and a score of 0 for each trial in which they incorrectly said the image on the card (total range 0-42). Two independent coders recorded and tallied all children's responses for the Sun/Moon task. Inter-rater reliability coding resulted in an intraclass correlation coefficient = .994, $p < .001$. The primary investigator resolved any discrepancies between coders.

Theory of Mind/False Belief Tasks

Contents False Belief. In this task (Wellman & Liu, 2004; derived from Perner, Leekam, & Wimmer, 1987), children were shown a Band-Aids box and asked what they thought was inside. The experimenter then opened the box to reveal unexpected contents: a toy dog. After placing the toy dog back inside the Band-Aids box, the experimenter asked children the control question: "Okay, what is in the Band-Aids box?" (correct answer: "toy dog/dog"). Children were then asked the (self) target belief question: "When you first saw this box, before we opened it, what did you think was inside?" (correct answer: "Band-Aids"). The experimenter then presented a stuffed toy of the Muppet, "Elmo" and stated: "Now here comes Elmo. Elmo has never ever seen inside this Band-Aids box." The (other) target belief question was then asked: "So, what does Elmo think is inside the box?" (correct answer: "Band-Aids"). Finally, children were asked a memory control question: "Did Elmo see inside this box?" (correct answer: "no"). Children received separate "self" and "other" scores for this task. Children received a score of '1' for false belief "self" if they answered the control and target self belief questions correctly and a '0' if they answered either incorrectly. Children received a score of '1' for false belief "other" if they answered the control, target other belief, and memory questions correctly and a '0' if they answered any incorrectly (total score range of 0-1 for both false belief "self" and

"other" scores).

Change in Location False Belief. In this task (Carlson & Moses, 2001; derived from Wimmer & Perner, 1983), children were presented with two boxes (green and orange) and two Muppet figurines (Bert and Ernie). The experimenter demonstrated that Ernie was playing with a toy pig and then showed him putting the toy into one of the boxes. Ernie was then removed from the testing table and the child was told that Ernie was going to "play outside". Next, Bert was presented and was shown finding the toy pig where Ernie had left it. Bert then put the toy pig into the other box before being removed from the testing table. Upon Ernie's return, children were asked the false belief question: "Where does Ernie think the pig is?" (correct answer: green box). Children were also asked two control questions: "Where did Ernie put the pig?" (correct answer: green box) and "Where is the pig really?" (correct answer: orange box). Children received a score of '1' if they answered the false belief and control questions correctly, otherwise, they received a score of 0 (total score range of 0-1).

Conflicting Desires Task

In this task (adapted from Wright-Cassidy et al., 2005), all children received two conflict trials, which each included four pictured activities; one of these activities was desirable, whereas the remaining three were undesirable. In Trial 1, going to the zoo was the desirable activity, whereas getting a haircut, going to the grocery store, and going for a long car ride were undesirable. In Trial 2, eating candy was the desirable activity, whereas taking a nap, cleaning their bedroom, and brushing their hair were undesirable. After children were presented with the four activities, they were asked to point to the activity they "really, really like to do" and the activity they "really, really don't like to do" from the four presented options. The experimenter then restated the child's selected activities by saying: "Okay, so you really like to do this one

(pointing to selected activity and stating aloud), and you really don't like this one (again, pointing and stating activity aloud)". The experimenter then removed the four pictures from the table and read the child a story. Each of the two stories depicted a gender-matched child character (Sam/Sarah; photo placed on testing table) whose desired activity conflicted with the child participant's. For example, if a child selected eating candy as their desired activity and taking a nap as their undesired activity, then that particular child was read a story whereby the character enjoys taking a nap and dislikes eating candy. Then, children were asked what Sam/Sarah would choose to do from the four activities. Children received a score of '1' for each correctly selected desired activity of the story character and a score of '0'otherwise (total score range of 0-2).

Language Measures

Children's receptive (Receptive Vocabulary subtest) and expressive (Picture Naming subtest) language abilities were measured using the Wechsler Preschool and Primary Scale of Intelligence – Third Edition: Canadian (WPPSI-III CDN; Wechsler, 2002). In the Receptive Vocabulary subtest, children were presented with a series of four pictures and asked to select the one stated aloud by the experimenter (e.g., painting). In the Picture Naming subtest, children were shown a series of individual pictures and asked to provide the name of the object shown (e.g., broom). Children received a score of '1' for each correct response up to a score of 38 for Receptive Vocabulary and a score of 30 for Picture Naming. Children's scores on these subtests were averaged together to create a composite score after converting individual raw scores into z-scores. This composite score was used as a control variable (linguistic ability) during regression analyses.

Results

Preliminary Analyses

The multiple imputation module in SPSS - IBM 28.0.1 was used to conduct a missing values analysis. Across all variables, 2.151% of the data were missing. Based on this small percentage of missing data, a data imputation was not performed[3]. Variables were screened for univariate outliers exceeding the cut-off of z +/- 2.58. Identified univariate outliers were brought closer to the mean (at z +/- 2.58). A composite language score was created by examining Pearson product-moment correlations between the two WPPSI-III language measures (Receptive Vocabulary and Picture Naming). The two language measures were significantly correlated, $r(88) = .61$, $p < .001$, and so a language composite score was calculated by averaging the Receptive Vocabulary and Picture Naming standardized scores. Children's Future (future first: $M = .56$, $SD = .39$; past first: $M = .50$, $SD = .41$) and Past Preferences (future first: $M = .51$, $SD = .42$; past first: $M = .64$, $SD = .33$) task scores did not differ as a function of the order children received/completed the Preferences tasks, $F(1, 91) = .46$, $p = .500$, partial $\eta^2 = .01$ (Future Preferences task scores); $F(1, 90) = 2.91$, $p = .091$, partial $\eta^2 = .03$ (Past Preferences task scores). See Table 3 for descriptive statistics for all study variables.

[3]In the interest of increased power, an exploratory missing values analysis was conducted using the multiple imputation module of SPSS IBM 28.0.1. Based on the percentage of missing data (2.151%), occurring randomly (Little's MCAR $p = .443$), a single imputation was performed [i.e., Expectation-Maximization (EM) covariance matrix] to estimate and replace missing values (see Tabachnick & Fidell, 2007). Differences in statistical outcomes are referenced in subsequent footnotes.

Table 3

Mean Scores on All Tasks

Task	Mean	Standard Deviation
Preferences Tasks		
PPT (range = 0-1)	.57	.38
FPT(range = 0-1)	.53	.40
EF Tasks		
DCCS (range = 0-6)	3.97	2.62
S/M (range = 0-42)	21.53	15.94
ToM Tasks		
CFB-S (range = 0-1)	.39	.49
CFB-O (range = 0-1)	.25	.44
CiL (range = 0-1)	.36	.48
CD (range = 0-2)	.56	.66
Language Measure (WPPSI-III)		
LComp (*z*-scores)	.01	.88
RV (raw scores out of 38)	22.69	4.84
PN (raw scores out of 30)	18.50	4.20

Note. PPT = Past Preferences task, FPT = Future Preferences task, DCCS = Dimensional Change Card Sort, S/M = Sun/Moon, CFB-S = Contents False Belief - Self, CFB-O = Contents False Belief - Other, CiL = Change in Location, CD = Conflicting Desires, LComp = Language Composite, RV = Receptive Vocabulary, PN = Picture Naming.

Relations and Asymmetries Between Future and Past Preferences Task Performance

To examine the extent to which future and past self-projection are related abilities in preschoolers, a Pearson product-moment correlation was conducted between children's proportion scores on the Future and Past Preferences tasks. This correlation was significant, $r(90) = .33$, $p = .001$, and held when independently controlling for age in months, $r(87) = .25$, $p = .018$, and sex, $r(87) = .33$, $p = .002$, but not language, $r(84) = .19$, $p = .075$. Interestingly, the significant correlation between task scores held when controlling for expressive language ability

(WPPSI-III Picture Naming) $r(84) = .26$, $p = .016$, but not receptive language ability (WPPSI-III Receptive Vocabulary), $r(86) = .19$, $p = .071$.

To determine whether there exists an asymmetry between children's future and past self-projection abilities, we conducted a paired-samples *t*-test. This analysis revealed no significant difference between Future ($M = 0.53$, $SD = 0.40$) and Past ($M = 0.57$, $SD = 0.39$) Preferences task scores, $t(91) = .879$, $p = .382$. To further explore a possible asymmetry, we conducted a series of paired-samples *t*-tests comparing the five comparable item pairs across Future and Past Preferences tasks (Play-Doh/number puzzle vs Play-Doh/rattle; action figure/wallet vs action figure/blankie; juice box/coffee vs juice box/milk in a bottle; sticker book/magazine vs sticker book/picture book; Goldfish crackers/vegetable stir-fry vs Goldfish crackers/baby food in a jar, respectively). The only significant difference that emerged was between the action figure/wallet (future trial: $M = 0.44$, $SD = 0.50$) and action figure/blankie (past trial: $M = 0.60$, $SD = 0.49$) pairing, $t(90) = 2.70$, $p = .008$.

Do ToM and EF Predict Performance on Future and Past Preferences Tasks?

Correlational Analyses. We first conducted a series of Pearson product-moment correlations between all main task variables (i.e., Future Preferences, Past Preferences, ToM, EF, Conflicting desires). Correlations were computed both with and without age in months, language, and sex as control variables. As can be seen in Table 4, the Future Preferences task was significantly correlated with two of the three ToM tasks (CFB-Self, CFB-Other), both EF tasks (DCCS, Sun/Moon), and Conflicting desires. The Past Preferences task was significantly correlated with one of the ToM tasks (CFB-Other) and both EF tasks (DCCS, Sun/Moon). However, when controlling for age in months, language, and sex, Future and Past Preferences tasks were no longer significantly correlated with any of the ToM, EF, or conflicting desires

tasks[4]. Although the Past Preferences task was now significantly *negatively* correlated with one of the three ToM tasks (CiL) after including our control variables, this result is difficult to interpret due to a lack of theoretical explanation and may be the result of sampling error (i.e., Type 1 error, given the number of predictors).

[4]Exploratory analysis of the data using a single missing values imputation (see footnote 3 for procedure) yielded a significant partial correlation between children's Future Preferences Task scores and the Sun/Moon task, $r(86) = .23$, $p = .031$, after controlling for age in months, language, and sex.

Table 4

Correlations Between All Study Variables

Task	2	3	4	5	6	7	8	9	10	11
1. Age	.36**	.30**	.29**	.22*	.35**	.58**	.50**	.25*	.41**	.28**
2. LComp	-	.01	.32**	.39**	.41**	.36**	.44**	.20	.43**	.43**
3. Sex		-	.11	.30**	.11	.28**	.21	.04	.26*	.06
4. CFB-S			-	.16 (.02)	.16 (-.07)	.41** (.29**)	.26* (.02)	.17 (.04)	.18 (-.01)	.21* (.08)
5. CFB-O				-	.33** (.17)	.22* (.03)	.27** (.00)	-.08 (-.24*)	.26* (-.05)	.31** (.07)
6. CiL					-	.31** (.08)	.40** (.13)	.05 (-.13)	.08 (-.27*)	.16 (-.11)
7. DCCS						-	.32** (-.02)	.14 (.09)	.34** (-.11)	.34** (.14)
8. S/M							-	.26* (.06)	.27** (-.10)	.40** (.11)
9. CD								-	.09 (-.10)	.21* (.13)
10. PPT									-	.33** (.01)
11. FPT										-

Note. Partial correlations controlling for age in months, language, and sex shown in parentheses. * $p < .05$, ** $p < .01$. Age = Age in months, LComp = Language Composite, CFB-S = Contents False Belief - Self, CFB-O = Contents False Belief - Other, CiL = Change in Location, DCCS = Dimensional Change Card Sort, S/M = Sun/Moon, CD = Conflicting Desires, PPT = Past Preferences task, FPT = Future Preferences task.

Multiple Regression Analyses. Next, we conducted two separate hierarchical multiple regression analyses. In the first, we predicted Future Preferences task scores from the ToM

(CFB-Self, CFB-Other, CiL) and EF (DCCS, Sun/Moon) variables, while controlling for age in months, language, and sex, which were entered in the first block. Conflicting desires task scores were entered as an exploratory variable in a final third block (see Table 5). The overall regression model was significant and predicted approximately 32% of the variance in Future Preferences task scores, $R^2 = .32$, $F(9,65) = 3.41$, $p = .002$. However, the control variables accounted for 27% of the overall variance in these scores (R^2 change = .267, Model 1), whereas our predictor variables accounted for 4% (R^2 change = .044, Model 2) and 1% (R^2 change = .010, Model 3), respectively. None of the individual variables were significant predictors of Future Preferences task scores. Of the control variables, language was significant, however, age in months and sex were not. Based on this outcome and in the interest of increased power, the regression model was run again without controlling for age in months and sex. The overall regression model remained significant and predicted approximately 32% of the variance in Future Preferences task scores, $R^2 = .32$, $F(7,67) = 4.40$, $p < .001$. Notably, all individual predictor variables remained unchanged[5].

[5]Exploratory analysis of the data using a single missing values imputation (see footnote 3 for procedure) yielded CFB-Other (partial $r = .22$) and Sun/Moon (partial $r = .23$) as significant predictors of Future Preferences task scores.

Table 5

Regression Analysis Predicting Future Preferences Task Scores From Study Variables

	Future Preferences Task Scores								
	Step 1			Step 2			Step 3		
	B (*SE*)	β	*p*	B (*SE*)	β	*p*	B (*SE*)	β	*p*
Constant	.474 (.261)		.074	.580 (.274)		.038	.579 (.274)		.038
Age	<.001 (.005)	-.008	.949	-.004 (.006)	-.091	.515	-.005 (.006)	-.101	.467
LComp	.233 (.050)	.517	<.001	.201 (.062)	.447	.002	.185 (.064)	.412	.005
Sex	.054 (.085)	.069	.526	.001 (.093)	.001	.994	-.003 (.094)	-.003	.977
CFB-S				.014 (.092)	.018	.878	.013 (.092)	.017	.885
CFB-O				.080 (.104)	.093	.444	.103 (.107)	.120	.337
CiL				-.117 (.104)	-.146	.223	-.107 (.095)	-.134	.268
DCCS				.025 (.022)	.155	.254	.023 (.022)	.142	.297
S/M				.004 (.003)	.141	.264	.003 (.003)	.132	.297
CD							.066 (.069)	.109	.341
R^2	.267			.311			.321		
F	8.63		<.001	3.73		.001	3.41		.002
ΔR^2				.044			.010		
ΔF				.841		.525	.919		.341

Note. Age = Age in months, LComp = Language Composite, CFB-S = Contents False Belief - Self, CFB-O = Contents False Belief - Other, CiL = Change in Location, DCCS = Dimensional Change Card Sort, S/M = Sun/Moon, CD = Conflicting Desires.

In a second hierarchical multiple regression analysis, we predicted Past Preferences task scores from the ToM (CFB-Self, CFB-Other, CiL) and EF (DCCS, Sun/Moon) variables with age in months, sex, and language again entered as control variables in the first block. Conflicting desires was then entered into the regression in a final third block (see Table 6). The overall regression model was significant and predicted approximately 36% of variance in Past Preferences task scores, $R^2 = .36$, $F(9,65) = 4.04$, $p < .001$. The control variables accounted for 29% of the overall variance in these scores (R^2 change = .287, Model 1), whereas our predictor variables accounted for 6% (R^2 change = .060, Model 2) and 1% (R^2 change = .012, Model 3), respectively. Of the predictors investigated, only CiL appeared to add unique variance to the Past Preferences task scores. Again, however, CiL scores negatively predicted Past Preferences task

scores likely due to sampling error. The remaining variables including CFB-Self, CFB-Other, DCCS, Sun/Moon, and Conflicting desires were not significant predictors of Past Preferences task scores. Of the control variables, language and sex were both significant, however, age in months was not. Reanalysis of the regression model without age in months entered as a control variable did not yield differences in statistical outcomes/conclusions[6].

Table 6

Regression Analysis Predicting Past Preferences Task Scores From Study Variables

	Past Preferences Task Scores								
	Step 1			Step 2			Step 3		
	B (*SE*)	β	*p*	B (*SE*)	β	*p*	B (*SE*)	β	*p*
Constant	.109 (.246)		.658	.027 (.254)		.915	.028 (.254)		.913
Age	.004 (.005)	.229	.435	.009 (.006)	.192	.158	.009 (.006)	.204	.135
LComp	.181 (.047)	.421	<.001	.237 (.058)	.552	<.001	.254 (.060)	.591	<.001
Sex	.188 (.080)	.251	.021	.207 (.087)	.276	.020	.210 (.087)	.281	.018
CFB-S				-.001 (.086)	-.001	.991	<.001 (.085)	<.001	.999
CFB-O				<.001 (.097)	.001	.998	-.025 (.099)	-.030	.803
CiL				-.182 (.088)	-.238	.043	-.193 (.088)	-.252	.033
DCCS				-.015 (.020)	-.096	.464	-.013 (.020)	-.082	.533
S/M				-.002 (.003)	-.068	.580	-.001 (.003)	-.058	.636
CD							-.071 (.064)	-.122	.273
R^2	.287			.347			.359		
F	9.55		<.001	4.38		<.001	4.04		<.001
ΔR^2				.060			.012		
ΔF				1.20		.318	1.22		.273

Note. Age = Age in months, LComp = Language Composite, CFB-S = Contents False Belief - Self, CFB-O = Contents False Belief - Other, CiL = Change in Location, DCCS = Dimensional Change Card Sort, S/M = Sun/Moon, CD = Conflicting Desires.

Discussion

In the current experiment, we strove to further clarify the relation and possible

[6]Exploratory analysis of the data using a single missing values imputation yielded CiL (partial *r* = -.23) as a significant predictor of Past Preferences task scores; however, this may be due to sampling error as previously noted.

asymmetry between preschoolers' reasoning about changes in their future and past preferences. We also explored the extent to which ToM and EF predicted these two forms of self-projection in an effort to explain why future self-projection may be more challenging for children than past self-projection.

Summary of Results

Our results show that preschoolers' ability to think and reason about changes in their past and future preferences is related; that is, children who successfully reasoned about their past preferences also tended to successfully reason about their future preferences. Despite this relation depending, at least in part, on children's language, the correlation between Past and Future Preferences task performance remained close to significance even after controlling for children's receptive vocabulary ability, specifically. Unexpectedly, we did not find support for asymmetry in children's self-projection abilities – children did not find it more difficult to reason about their future as compared to their past preferences. We detected some first-order correlations between children's performance on the Future and Past Preferences tasks and ToM, EF, and Conflicting desires tasks. With respect to future self-projection, significant first-order correlations were found between the Future Preferences task and ToM (CFB-Self, CFB-Other), EF (DCCS, Sun/Moon), and the Conflicting desires tasks. Regarding past self-projection, significant first-order correlations were found between the Past Preferences task and ToM (CFB-O) and EF (DCCS, Sun/Moon). Importantly, however, these relations were no longer significant after controlling for age, language, and sex. Our hierarchical multiple regression analyses further showed that ToM, EF, and Conflicting desires tasks were not significant predictors of children's performance on the Future or Past Preferences tasks.

Relation Between Reasoning About Past and Future Preferences

Consistent with developmental research in the areas of self-projection more broadly (e.g., Suddendorf, 2010b; Ünal & Hohenberger, 2017), and preferences in particular (e.g., Kopp et al., 2021), our results provide convergent evidence that preschoolers' reasoning about their future and past preferences are related abilities. Interestingly, however, this relation was found to depend on children's language abilities and receptive vocabulary, specifically. It is perhaps not surprising that children's reasoning about their future and past mental states may be, in part, explained by their language ability given significant parallels and overlap in the development of language and self-projection skills (e.g., episodic memory and future simulation) during early development. Specifically, rapid development in language acquisition, comprehension, and production—including the use and understanding of verb tense and temporal terms and relations—occurs during the preschool years (McCormack & Hanley, 2011). It is also during this time that children develop "temporal decentering", or the ability to consider temporal perspectives (i.e., points in time) that differ from one's current temporal experience (i.e., the present). Thus, much development in language and self-projection (amongst other cognitive abilities) occurs and is integrated during early development.

The importance of language in the development of children's self-projection abilities has also been explored through adult-child conversations. For example, improvement in preschoolers' EFT has been shown to occur following self-referential future- and past-oriented conversations with adults (Chernyak, Leech, & Rowe, 2017; Leech, Leimgruber, Warneken, & Rowe, 2019). Moreover, Atance, Metcalf, and Thiessen (2017) found that even very brief verbal prompts that pertain to the future self (e.g., alerting children of their option to save in the present for a larger future reward) improve children's EFT abilities. Similarly, in their *Social Cultural*

Developmental Theory, Nelson and Fivush (2004) argue that the role of language is fundamental to the development of autobiographical memory (i.e., memory of the self in the past), further identifying autobiographical memory as a system of integrated skills including language and narrative ability, temporal understanding, consciousness of self and other, and mental states.

Asymmetry in Reasoning About Future and Past Preferences

Although we predicted that children would experience greater difficulty reasoning about changes in their future, as compared to past, preferences, this is not what we found. This finding is inconsistent with the developmental work on this topic generally (e.g., Busby-Grant & Suddendorf, 2009; Prabhakar & Ghetti, 2019), including most notably Kopp et al. (2021) who, using a cross-experiment analysis, showed that reasoning about future, relative to past, preferences is more challenging for preschoolers. However, there are several aspects of our experimental design that we believe led to a more stringent comparison between past and future. First, we implemented a more powerful within-subjects design that allowed us to directly compare differences in the same children's reasoning between past and future preferences. Second, we were better able to match future and past items and were consistent in using the same child-preferable items across our two Preferences tasks. In contrast, only three of five of Kopp et al.'s item trials were of the same general category ("drinks", "play", "read") across their Future (Experiment 1) and Past (Experiment 2) Preferences tasks, and only two of their five trials retained the same present, or child-preferable, items (Play-Doh, sticker book). By contrast, four of our five trials shared the same category ("drinks", "play", "read", "food") across tasks and, as noted, all child-preferable items were identical across our Preferences tasks. Given our more stringent experimental design and attention to consistency in items across Preferences tasks, we would argue that a true difference in difficulty should have been detected had it existed.

Nonetheless, it is somewhat surprising that we did not find that children's reasoning about their future preferences was more difficult than their reasoning about past preferences. This is because the future "adult" preferences that children in our experiment needed to reason about were more temporally distant than the corresponding past "baby" preferences. Temporal events that are perceived as nearer (whether in the past or future) tend to be easier for both children in middle childhood and adults to think about than events perceived as more temporally distant (Coughlin et al., 2014; D'Argembeau & Van der Linden, 2004). Had this pattern emerged in the current experiment it would have resulted in our predicted asymmetry given that being a 'baby' is temporally closer for preschoolers than being a 'grown-up'. Yet, perhaps "baby-hood" and adulthood are perceived as temporally equidistant to preschoolers, given that both are distinct life stages that likely feel quite removed from one's current self. If so, this raises the interesting question about whether/how very young children perceive temporal distance and the extent to which it affects their reasoning. Although, as noted earlier, there is some work to suggest that starting around middle childhood children's reasoning is affected by temporal distance, preliminary work from our lab suggests that young children are relatively "insensitive" to this dimension (O'Brien, Greenspon, Hamwi, Castro, & Atance, 2021).

Relations between Self-Projection and ToM and EF

We also considered theoretically-relevant simulative (ToM) and cognitive (EF) abilities as potential mechanisms underlying children's future and past self-projection abilities. Part of the reason for exploring these relations was to determine whether reasoning about future preferences – which we predicted would be more difficult than reasoning about past preferences – might more strongly recruit ToM and EF abilities. Although first-order correlations provided some insight about relations between Future and Past Preferences task scores and ToM and EF, we did

not detect any significant asymmetry in children's self-projection, as we had predicted. Consistent with the relation between Future and Past Preferences Task scores, relations between children's future and past self-projection abilities and ToM and EF depended largely on children's age and language ability. Thus, our data suggest that, unsurprisingly, as children age and develop stronger language abilities, their capacities to engage in future and past self-projection, simulation, and cognition, also improve. The nuance of how all of these variables interact is unclear; however, what is clear is that language, past and future self-projection, ToM, and EF are interrelated abilities that appear to share a common variance with language, which may act as a mediating variable.

Yet, it was still somewhat unexpected that relations between future and past self-projection and ToM and EF did not remain significant beyond first-order correlations given theoretical support for these links. For example, inhibitory control is argued to be an important factor underlying future thinking ability (Atance & Jackson, 2009; Suddendorf & Corballis, 2007) and is the primary EF skill measured in the Sun/Moon task. To successfully project into the future to reason about one's preferences, it may be especially important to inhibit one's current or "default" preferences. Similarly, children experience anticipatory, or future-oriented, conflict during Sun/Moon when presented with successive cards that require active inhibitory control. That is, children must inhibit their automatic response to label the cards at face value (e.g., incorrectly labeling a sun card as "sun") in favor of the opposite label (correctly labeling a sun card as "moon"). This future-oriented *conflict* that both tasks share suggests a likely relation between self-projecting into the future and inhibitory control, although our findings – as well as those of previous studies (e.g., Hanson et al., 2014; Ünal & Hohenberger, 2017) – do not conclusively support this relation.

Interestingly, exploratory analysis of our data, including a missing values imputation (see footnote 3), yielded a significant relation between children's Future Preferences task performance and Sun/Moon scores, even after controlling for age, language ability, and sex. This finding suggests that factors such as increased power could have provided a clearer picture of possible relations amongst tasks. Further, if our experimental design had reliably yielded a significant relation between inhibitory control and future-oriented reasoning, this finding would have suggested that the two relate insofar as both require bridging a current perspective that conflicts with a future one. Our exploratory analysis further showed that children's future preferences reasoning was predicted by their ToM abilities (CFB-Other, with Conflicting desires approaching significance). This result is consistent with developmental research (e.g., Adornetti et al., 2021) that finds relations between ToM and EFT in middle childhood, but also contrasts with work that does not find a relation in younger children (e.g., Hanson et al., 2014; Ünal & Hohenberger, 2017). Like the conflicting shift in perspective that *may* unite inhibitory control and future preferences reasoning, the CFB-Other and Conflicting desires tasks involve actively shifting from one's current mental state to that of another, including beliefs and desires that may differ from one's own. In the current investigation, children were required to inhibit their own perspective in favour of inferring a character's beliefs (Elmo's belief about what would be in a Band-Aids box, despite children's knowledge of the unexpected contents) and desires (Sam/Sarah whose desired activity was opposite to that of our child participants) that conflicted with their own. As ToM is considered another form of self-projection alongside EFT and episodic memory (Buckner & Carroll, 2007), it would not be surprising to find a relation between our Future Preferences task and ToM. Yet, it is important to note that the current investigation did not conclusively support a relation between children's future and past self-

projection, and ToM and EF abilities.

Limitations and Future Directions

Although the current investigation included a more stringent experimental design (within-subjects) and attention to consistency in items across Preferences tasks relative to Kopp et al. (2021), some limitations remain. Despite the advantages of implementing a within-subjects design, it is possible that repeated exposure to some of the Preference Task items (i.e., child-preferable items) may have impacted children's subsequent item selection. Although we did not find any differences in performance across order of past or future block completion (past versus future first and vice versa), completion of both Preferences Tasks could have resulted in differences in performance relative to those children in Experiments 1 and 2 who only completed one of the Preferences tasks. Although possible, these differences are nevertheless difficult to detect. However, one notable drawback of a within-subjects design, relative to Experiments 1 and 2, regards length of testing session. This was an observable obstacle for some of our youngest Experiment 3 participants.

As previously noted, our Preferences tasks were not matched on temporal distance. That is, children's 'baby' self is much closer temporally relative to their 'adult' self. Thus, more research on how temporal distance might or might not affect children's reasoning about preferences is warranted. To explore this, preschoolers' perceived temporal distance could be manipulated and prompted according to current, near, and distant reference points in both past and future directions. For example, timepoints spanning baby, toddler, preschooler, "big kid", middle schooler, teenager/high schooler, young adult/university student, adult, and older adult/grandparent could be considered alongside temporally referential milestones (e.g., potty training during toddlerhood and marriage during adulthood).

One could also consider a wider age range of child participants to detect developmental differences in preferences reasoning with greater sensitivity. Related to this point, another limitation of the current investigation is that our sample was skewed toward younger preschoolers. Given the important cognitive developments occurring during the preschool period (i.e., ages 3-5), including a more balanced range of younger and older preschoolers could reveal clearer patterns and relations between past and future preferences reasoning exclusively and in relation to simulative (ToM) and cognitive (EF) abilities. Given the mean age of our sample (M_{age} = 49 months, SD = 8.25) was younger than Kopp et al.'s combined cross-experiment sample (M_{age} = 54 months, SD = 9.91), future research including our Preferences task methodology should implement a within-subjects design with a wider age range. Further, given that exploratory analysis of our data using a missing values imputation yielded a relation between children's future self-projection and ToM and EF abilities, future studies with increased power and greater efforts toward task reliability (e.g., Brosseau-Liard, 2022) might uncover clearer support for this link.

With the concurrent developments in future- and past-oriented reasoning and language during early development, the role of language in self-projection remains an area for continued clarification and investigation. Further investigating the role of language and, specifically, receptive vocabulary, could help clarify the relation between preschoolers' reasoning about their future and past preferences. To investigate this relation further, one could manipulate language alongside our Future and Past Preferences tasks. Accordingly, task introduction and instructions for our Preferences tasks could be manipulated to prime and bolster children's self-projection abilities by including/excluding explicit discussion of children's adult or baby self. Another possible route is to encourage children to think and talk about the future (e.g., imagining

themselves in different future scenarios) and the past (e.g., remembering different past events) prior to asking them to reason about their future and past preferences. This suggested approach is based on the research by Chernyak et al. (2017) and Leech et al. (2019) discussed earlier in our Discussion showing that preschoolers' EFT improved following brief adult-child conversations involving the future and past self.

Conclusion

Implementing a more powerful experimental design (within-subjects) and greater attention to methodological detail (Preferences task item consistency) relative to previous preferences research (Kopp et al. 2021) provides new insights and conclusions about children's future and past preferences reasoning. Most notably, our findings suggest an important role of language in the relation between future and past preferences reasoning while showing that, unexpectedly, the challenge of reasoning about future and past preferences in early childhood appears to be equivalent. Finally, our data suggests the need to further explore possible relations among children's future and past preferences reasoning and their ToM and EF abilities.

References

Addis, D. R., Wong, A. T., and Schacter, D. L. (2008). Age-related changes in the episodic simulation of future events. *Psychological Science, 19*, 33-41. doi:10.1111/j.1467-9280.2008.02043.x

Adornetti, I., Chiera, A., Altavilla, D., Deriu, V., Marini, A., Valeri, G., . . . Ferretti, F. (2021). Self-projection in middle childhood: A study on the relationship between theory of mind and episodic future thinking. *Cognitive Processing, 22*, 321-332. doi:10.1007/s10339-021-01013-w

Atance, C. M. (2015). Young children's thinking about the future. *Child Development Perspectives, 9*, 178-182. doi:10.1111/cdep.12128

Atance, C. M., & Caza, J. S. (2018). "Will I know more in the future than I know now?" Preschoolers' judgments about changes in general knowledge. *Developmental Psychology*. doi:10.1037/dev0000480

Atance, C. M., & Mahy, C. E. V. (2016). Episodic future thinking in children: Methodological and theoretical approaches. In K. Michaelian, S. B. Klein, & K. K. Szpunar (Eds.), *Seeing the future: Theoretical perspectives on future-oriented mental time travel.* Oxford:Oxford University Press.

Atance, C. M., & Jackson, L. K. (2009). The development and coherence of future-oriented behaviors during the preschool years. *Journal of Experimental Child Psychology, 102*, 379-391. doi:10.1016/j.jecp.2009.01.001

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

Atance, C. M., Metcalf, J. L., & Thiessen, A. (2017). How can we help children save? Tell them they can (if They Want to). *Cognitive Development, 43*, 67-79. doi: 10.1016/j.cogdev.2017.02.009

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

Bauer, P. J. (2007). *Remembering the times of our lives: Memories in infancy and beyond*. Mahwah, NJ : Lawrence Erlbaum Associates.

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, 85*, 2419-2431. doi:10.1111/cdev.12282

Bora, E. & Berk, M. (2015). Theory of mind in major depressive disorder: A meta-analysis. *Journal of Affective Disorders, 191*, 49-55. doi:10.1016/j.jad.2015.11.023

Brosseau-Liard, P. E. (2022). Reliable developmental research: Not only for infancy. *Infant and Child Development*, 1-5. doi:10.1002/icd.2320

Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Sciences, 11*, 49–57. doi:10.1016/j.tics.2006.11.004

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

Busby-Grant, J., & Suddendorf, T. (2009). Preschoolers begin to differentiate the times of events from throughout the lifespan. *European Journal of Developmental Psychology, 6*, 746 762. doi:10.1080/17405620802102947

Busby-Grant, J., & Suddendorf, T. (2011). Production of temporal terms by 3-, 4-, and 5-year-old children. *Early Childhood Research Quarterly, 26*, 87-95. doi:

10.1016/j.ecresq.2010.05.002

Carlson, S. M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology, 28*, 595-616. doi:10.1207/s15326942dn2802_3

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development, 72*, 1032-1053. doi:10.1111/1467-8624.00333

Carlson, S. M., Moses, L. J., & Claxton, L. J. (2004). Individual differences in executive functioning and theory of mind: An investigation of inhibitory control and planning ability. *Jounral of Experimental Child Psychology, 87*, 299-319. doi:10.1016/j.jecp.2004.01.002

Caza, J. S., Atance, C. M., & Bernstein, D. M. (2016). Older (but not younger) preschoolers understand that knowledge differs between people and across time. *British Journal of Developmental Psychology, 34*, 313-324. doi:10.1111/bjdp.12130

Chernyak, N. Leech, K. A., & Rowe, M. L. (2017). Training preschoolers' prospective abilities through conversation about the extended self. *Developmental Psychology, 53*, 652-661. doi:10.1037/dev0000283

Coughlin, C., Lyons, K. E., & Ghetti, S. (2014). Remembering the past to envision the future in middle childhood: Developmental linkages between prospection and episodic memory. *Cognitive Development, 30*, 96-110. doi:10.1016/j.cogdev.2014.02.001

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*, 844-858. doi:10.1016/j.concog.2004.07.007

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*, 1149-1160. doi:10.3758/BRM.41.4.1149

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*, 175-191. doi:10.3758/BF03193146

Fitneva, S. A. (2020). Children's epistemic forecasting: The case of knowledge loss. *Journal of Experimental Child Psychology, 199*, 104926. doi:10.1016/j/jecp.2020.104926

Friedman, W. J. (2003). The development of a differentiated sense of the past and the future. *Advances in Child Development and Behavior, 31*, 229-269. doi:10.1016/S0065-2407(03)31006-7

Gerstadt, C. L., Hong, Y. J., & Diamond, A. (1994). The relationship between cognition and action: Performance of children 3 ½-7 years old on a stroop-like day-night test. *Cognition, 53*, 129-153. doi:10.1016/0010-0277(94)90068-X

Ghrear, S., Fung, K., Haddock, T., & Birch, S. A. J. (2020). Only familiar information is a "curse": Children's ability to predict what their peers know. *Child Development*. doi:10.1111/cdev.13437

Gopnik, A., & Slaughter, V. (1991). Young children's understanding of changes in their mental states. *Child Development, 62*, 98-110. doi:10.1111/j.1467-8624.1991.tb01517.x

Goulding, B. W., Atance, C. M., & Friedman, O. (2019). An advantage for ownership over preferences in children's future thinking. *Developmental Psychology, 55*, 1702-1708. doi:10.1037/dev0000759

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. doi:10.1016/j.jecp.2014.07.006

Harner, L. (1975). Yesterday and tomorrow: Development of early understanding of the terms. *Developmental Psychology, 11*, 854-865. doi:10.1037/0012-1649.11.6.864

Hayne, H., Gross, J., McNamee, S., Fitzgibbon, O., & Tustin, K. (2011). Episodic memory and episodic foresight in 3- and 5-year-old children. *Cognitive Development, 26*, 343–355. doi:10.1016/j.cogdev.2011.09.006

Hudson, J. A. (2006). The development of future time concepts through mother-child conversation. *Merrill-Palmer Quarterly, 52,* 70-95. doi:10.1353/mpq.2006.0005

Hudson, J. A., Shapiro, L. R., & Sosa, B. B. (1995). Planning in the real world: Preschool children's scripts and plans for familiar events. *Child Development, 66,* 984. doi:10.2307/1131793

Kopp, L., Hamwi, L., & Atance, C. M. (2021). Self-projection in early development: Preschoolers' reasoning about changes in their future and past preferences. *Journal of Cognition and Development, 1*, 1-21. doi:10.1080/15248372.2021.1874954

Lee, W. S. C., & Atance, C. M. (2016). The effect of psychological distance on children's reasoning about future preferences. *PLOS ONE, 11*, 1-18. doi:10.1371/journal.pone.0164382

Leech, K. A., Leimgruber, K., Warneken, F., & Rowe, M. L. (2019). Conversation about the future self improves preschoolers' prospection abilities. *Journal of Experimental Child Psychology, 181*, 110-120. doi:10.1016/j.jecp.2018.12.008

Lind, S., & Bowler, D. (2008). Episodic memory and autonoetic consciousness in autism spectrum disorders: The roles of self-awareness, representational abilities, and temporal

cognition. In J. M. Boucher, D. M. Bowler (Eds.), *Memory in autism: Theory and evidence.* Cambridge University Press: Cambridge UK.

Mahy, C. E. V., Mazachowsky, T. R., & Pagobo, J. R. (2018). Do verbal reminders improve preschoolers' prospective memory performance? It depends on age and individual differences. *Cognitive Development, 47,* 158-167. doi:10.1016/j.cogdev.2018.06.004

McColgan, K. L., & McCormack, T. (2008). Searching and planning: Young children's reasoning about past and future event sequences. *Child Development, 79*, 1477-1497. doi:10.1111/j.1467-8624.2008.01200.x

McCormack, T., Burns, P., O'Connor, P., Jaroslawska, A., & Caruso, E. M. (2019). Do children and adolescents have a future-oriented bias? A developmental study of spontaneous and cued past and future thinking. *Psychological Research, 83,* 774-787. doi:10.1007/s00426-018-1077-5

McCormack, T., & Hanley, M. (2011). Children's reasoning about the temporal order of past and future events. *Cognitive Development, 26,* 299-314. doi: 10.1016/j.cogdev.2011.10.001

Mischel, H. N., & Mischel, W. (1987). The development of children's knowledge of self-control strategies. In F. Halisch & J. Kuhl (Eds.), *Motivation, intention, and volition* (pp. 321-336). Berlin: Springer-Verlag.

Mitchell, P., & Riggs, K. J. (Eds.) (2000). *Children's reasoning and the mind.* Hove, East Sussex England: Psychology Press.

Nelson, K. (2001). Language and the self: From the ‘‘experiencing I’’ to the ‘‘continuing me’’. In C. Moore & K. Lemmon (Eds.), *The self in time: Developmental perspectives.* Mahwah, NJ: Erlbaum.

Nelson, K., & Fivush, R. (2004). The emergence of autobiographical memory: A social cultural developmental theory. *Psychological Review, 111,* 486-511. doi:10.1037/0033 295X.111.2.486

O'Brien, B., Greenspon, M., Hamwi, L., Castro, A. W., & Atance, C. M. (2021, April). *Do temporal distance and event frequency influence children's future event representations?* Poster session presented at the Society for Research in Developmental Psychology 2021 Biennial Meeting. https://srcd21biennial.ipostersessions.com/Default.aspx?s=C9-29-0F-87-72-3A-E9-1B-9A-FE-D2-99-F8-68-EF-AE

Perner, J., Kloo, D., & Gornik, E. (2007). Episodic memory development: Theory of mind is part of re-experiencing experienced events. *Infant and Child Development, 16,* 471-490. doi:10.1002/icd.517

Perner, J., Leekam, S. R., & Wimmer, H. (1987). Three-year-olds' difficulty with false-belief: The case for a conceptual deficit. *British Journal of Developmental Psychology, 5,* 125-137. doi:10.1111/j.2044-835X.1987.tb01048.x

Perner, J., & Ruffman, T. (1995). Episodic memory and autonoetic consciousness: Developmental evidence and a theory of childhood amnesia. *Journal of Experimental Child Psychology, 59,* 516–548. doi:10.1006/jecp.1995.1024

Povinelli, D. J. (2001). The self: Elevated in consciousness and extended in time. In C. Moore, & K. Lemmon (Eds.). *The self in time: Developmental perspectives*. Lawrence Erlbaum.

Prabhakar, J. & Ghetti, S. (2019). Connecting the dots between past and future: Constraints in episodic future thinking in early childhood. *Child Development, 91,* 315-330. doi:10.111/cdev.13212

Premack, D. & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioural and Brain Sciences, 1,* 515-526. doi:10.1017/S0140525X00076512

Reese, E. (2002). A model of the origins of autobiographical memory. In J. W. Fagen & H. Hayne (Eds.), *Progress in infancy research* (Vol. 2, pp. 215-260). Mahwah, NJ: Lawrence Erlbaum Associates.

Simpson, A., & Riggs, K. J. (2005). Inhibitory and working memory demands of the day-night task in children. *Journal of Cross-Cultural Psychology, 45*, 555-568. doi:10.1177/0022022113513921

Sommerville, J. A., Bernstein, D. M., & Meltzoff, A. N. (2013). Measuring beliefs in centimeters: Private knowledge biases preschoolers' and adults' representation of others' beliefs. *Child Development, 84*, 1846-1854. doi:10.1111/cdev.12110

Spreng, R. N., & Grady, C. L. (2010). Patterns of brain activity supporting autobiographical memory, prospection, theory of mind, and their relationship to the default mode network. *Journal of Cognitive Neuroscience, 22*, 1112-1123. doi:10.1162/jocn.2009.21282

Suddendorf, T. (2010a). Episodic memory versus episodic foresight: Similarities and differences. *Wiley Interdisciplinary Reviews: Cognitive Science, 1*, 99-107. doi:10.1002/wcs.23

Suddendorf, T. (2010b). Linking yesterday and tomorrow: Preschoolers' ability to report temporally displaced events. *British Journal of Developmental Psychology, 28*, 491-498. doi:10.1348/026151009X479169

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

Suddendorf, T. & Corballis, M. (2007). The evolution of foresight: What is mental time travel,

and is it unique to humans? *Behavioral and Brain Sciences, 30,* 299-351. doi: 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. *Developmental Science, 14,* 26-33. doi:10.1111/j.1467-7687.2010.00950.x

Synn, A., Mothakunnel, A, Kumfor, F., Chen, Y., Piguet, O., Hodges, J. R., & Irish, M. (2018). Mental states in moving shapes: Distinct cortical and subcortical contributions to theory of mind impairments in dementia. *Journal of Alzheimer's Disease, 61,* 521-535. doi:10.3233/JAD-170809

Tabachnick, B. G., & Fidell, L. S. (2007). *Using multivariate statistics (Fifth ed.).* Boston, MA: Pearson Education, Inc.

Tulving, E. (2002). Episodic memory: From mind to brain. *Annual Review of Psychology, 53I,* 1-25. doi:10.1146/annurev.psych.53.100901.135114

Turner, M. A. (1999). Generating novel ideas: Fluency performance in high-functioning and learning disabled individuals with autism. *Jounral of Child Psychology and Psychiatry, 40,* 189-201. doi:10.1111/1469-7610.00432

Ünal, G., & Hohenberger, A. (2017). The cognitive bases of the development of past and future episodic cognition in preschoolers. *Journal of Experimental Child Psychology, 162,* 242-258. doi :10.1016/j.jecp.2017.05.014

Viard, A., Chételat, G., Lebreton, K., Desgranges, B., Landeau, B., de La Sayette, V., Eustache, F., & Piolino, P. (2011). Mental time travel into the past and the future in healthy aged adults: An fMRI study. *Brain and Cognition, 75,* 1-9. doi:10.1016/j.bandc.2010.10.009

Wang, Q., Capous, D., Koh, J. B. K., & Hou, Y. (2014). Past and future episodic thinking in

middle childhood. *Journal of Cognition and Development, 15*, 625–643. doi: 10.1080/15248372.2013.784977

Wechsler, D. (2002). *Wechsler Preschool and Primary Scale of Intelligence, Third Edition* (WPPSI-III). San Antonio, TX: Psychological Corporation.

Wellman, H. M., & Liu, D. (2004). Scaling theory-of-mind tasks. *Child Development, 75,* 523-541. doi: 10.1111/j.1467-8624.2004.00691.x

Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13,* 103-128. doi:10.1016/0010-0277(83)90004-5

Wright-Cassidy, K., Cosetti, M., Jones, R., Kelton, E., Meier-Rafal, V., Richman, L., & Stanhaus, H. (2005). Preschool children's understanding of conflicting desires. *Journal of Cognition and Development, 6,* 427-454. doi:10.1207/s15327647jcd0603_6

Zelazo, P. D. (2006). The dimensional change card sort (DCCS): A method of assessing executive function in children. *Nature Protocols, 1,* 297-301. doi:10.1038/nprot.2006.46

Zhang, M., & Hudson, J. A. (2018). Children's understanding of yesterday and tomorrow. *Journal of Experimental Child Psychology, 170,* 107-133. doi:10.1016/j.jecp.2018.01.010

Chapter 4: General Discussion

Summary of Findings

This dissertation explored preschoolers' reasoning about changes in their future and past preferences and, more specifically, their understanding that the preferences they may hold in the future, and likely held in the past, differ from their current preferences. First, we implemented a novel continuous measure of preferences (faces rating scale) in combination with standard categorical response options (selection of preference from paired items). We found that children's future and past preferences reasoning had similar trajectories; that is, preschoolers' success in reasoning about their future and past preferences generally improved between ages 3 and 5. Results further revealed subtleties in the development of preschoolers' preferences reasoning with our continuous preferences measure showing that, around age 4, children demonstrate some understanding that their future preferences will differ from their current ones, despite performing at chance level in selecting the appropriate adult-preferable items for their future self. Specifically, 4- and 5-year-olds reported that they will like child-preferable items less and adult-preferable items more in the future than they do now. Similarly, although 3-year-olds performed at chance level in selecting the appropriate baby-preferable items for their past self, continuous preferences ratings revealed an understanding that they indeed preferred child-preferable items less as babies than they did now. Cross-experiment comparison of categorical response patterns further revealed asymmetry in preschoolers' preferences reasoning; reasoning about changes in their past preferences was easier for children relative to their future preferences.

A comparison of children's performance on future and past preferences tasks was further addressed in our final experiment. Here, we included a more rigorous within-subjects design to directly compare children's future and past preferences reasoning abilities while also exploring

possible mechanisms (ToM, EF) underlying the relation between future and past self-projection. Results confirmed that preschoolers' ability to think and reason about changes in their past and future preferences is related (but largely dependent on language), however, asymmetry in children's self-projection abilities was not found. That is, unlike our exploratory cross-experiment analysis (Experiments 1 and 2; Chapter 2), children who completed both future and past preferences tasks (Experiment 3; Chapter 3) did not find reasoning about their past preferences easier than their future preferences. Finally, after controlling for age, language, and sex, correlational and regression patterns did not support a relation between children's future and past preferences reasoning and their simulative (ToM) and cognitive (EF) abilities.

Contributions to Research About the Development of Self-Projection

Continuous Preferences Rating Scale & Preferences Tasks

In Experiments 1 and 2 (Kopp, Hamwi, & Atance, 2021), we introduced a continuous measure of children's preferences (faces rating scale; Kopp, Atance, & Pearce, 2017; adapted from Wong & Baker, 1988) to explore the *extent* to which children understand that their preferences will change in the future and have changed from the past. Pairing our continuous preferences measure with the more standard categorical item selection task used by Bélanger, Atance, Varghese, Nguyen, and Vendetti (2014) – which we also adapted – yielded evidence to support developmentalists' call for use of continuous over categorical measures with children (e.g., Ghrear, Fung, Haddock, & Birch, 2020; Sommerville, Bernstein, & Meltzoff, 2013). Specifically, our continuous preferences measure gleaned information about children's self-projection development that would not have been revealed with categorical measures alone. From our continuous preferences measure, we uncovered subtle shifts in children's understanding of changes in their future (e.g., emerging around age 4; Experiment 1) and past

(e.g., emerging around age 3; Experiment 2) preferences. Overall, introducing a continuous measure of preferences was an important step toward detecting more graded developmental shifts in cognition during early development.

We also designed a new task to measure children's understanding of changes in their *past* preferences: our Past Preferences task (Experiment 2). Our initial objective with the Past Preferences task was to investigate developmental changes in preschoolers' reasoning about changes in their past preferences and to determine whether there exist similarities to the trajectory of preschoolers' future preferences reasoning. To our knowledge, the Past Preferences task is the first "mental state change" task specifically developed to measure children's reasoning about changes in their past preferences. Another strength and contribution of the Past Preferences task is its methodological similarity (e.g., consistency across adult, baby, and child items) relative to our Future Preferences task, which was further adapted in our third and final experiment. This methodological similarity in turn permitted a more valid within-subjects comparison of children's preferences reasoning and, thus, greater confidence in our conclusions (Experiment 3).

Convergent and Divergent Findings

Consistent with developmental literature and research about children's MTT more broadly, and preferences specifically, results from this dissertation confirm a graded developmental trajectory of future and past self-projection and, more pointedly, preferences reasoning (Experiments 1 & 2). Similarities (i.e., relation) and differences (asymmetry) between future and past self-projection abilities were also clarified (Experiment 3). Although results from our cross-experiment analysis (Experiments 1 & 2) suggested asymmetry in children's future versus past preferences reasoning (i.e., past preferences reasoning being easier than future

preferences reasoning), this finding was not replicated with our more powerful within-subjects design (Experiment 3). Also inconsistent with our predictions, we did not find evidence to suggest that children's future and past preferences reasoning is related to or predicted by simulative (ToM) or cognitive (EF) abilities.

Remaining Questions, Limitations, and Future Directions

Episodic versus Semantic Distinction

Recall from Tulving's influential work (1972; 1984; 1985a; 1985b; 2001) that the distinction between semantic and episodic memory (and future-thinking; Atance & O'Neill, 2001; Busby & Suddendorf, 2005) systems reflects our ability to *know* versus *remember* (or *imagine*). Both systems are fundamental components in our ability to engage in mentally re-experiencing and pre-experiencing the self through time (Suddendorf, 2010; Quon & Atance, 2010). While the current investigation sought to explore children's *episodic* future and past self-projection regarding changes in their personal preferences, semantic knowledge (e.g., what a 'baby' or 'grown up' typically prefers) is nevertheless also required for success on our Future and Past Preferences tasks. Although, intuitively, children could achieve the greatest success on our Preferences tasks by simply relying on semantic knowledge when selecting items for their past ('baby') and future (adult) selves, children in our studies did not use this approach.

One reason for this may be that it is too difficult for children to override the influence of their own preferences, or maybe the difficulty lies in the ability to think about the passage of time where, one day, they will be an adult (or were, in fact, a 'baby'). Interestingly, Bélanger et al. (2014) not only confirmed that children as young as 3-years-old demonstrate good semantic knowledge of adults' preferences but also found that younger children's reasoning about future preferences is easier when selecting for a same-aged peer relative to themselves. From this, it is

clear that children's difficulty in self-projection is just that - it is difficult to project when the subject is *you* even when you know what a typical adult, for example, prefers. Future experimental directions including future self-focused prompts (e.g., an age-morphed photograph of the child as an adult) or engaging children in imaginative play (e.g., play dress-up as their 'grown-up' self) may help children to improve their capacity to self-project.

Past Over Future Performance Asymmetry

While it is tempting to conclude, based on our final experiment, that there is no asymmetry in children's reasoning about changes in their future and past preferences, we are careful to consider areas for further investigation. Notably, some developmental research reveals a more complicated picture of children's development of past and future thinking and reasoning. For example, cognitively, children demonstrate future over past asymmetry (i.e., future easier than past) during temporal reasoning (e.g., "before" and "after" questions) yet, linguistically (and in sequential reasoning generally), show past over future asymmetry in understanding "yesterday" relative to "tomorrow" (Zhang & Hudson, 2018). Furthermore, variability in the developmental sequence of children's event representations (i.e., the ability to construct mental representations of past and future events) has been noted throughout early childhood to late middle childhood. Generally, children demonstrate more success in past than future judgments with this pattern weakening by the start of middle childhood whereby children demonstrate developmental gains in future over past judgments; despite this apparent shift, however, both past- and future-oriented judgments show substantial development throughout early to late middle childhood (see Friedman, 2003, for a review). Taken together, this research demonstrates that asymmetry in children's future and past thinking and reasoning can vary depending on methodological approach (i.e., cognitive- versus language-based tasks) with both showing

variability in development throughout childhood.

From this, it is important to consider factors that make it difficult to compare the findings from Chapter 2 (Experiments 1 & 2) and Chapter 3 (Experiment 3) and, therefore, also make it difficult to conclude the presence or absence of performance asymmetry in children's preferences reasoning. Although we are more confident in our comparison of children's future and past preferences reasoning based on Experiment 3's more rigorous within-subjects design, differences in demographics (older versus younger mean age in months), procedure (preferences ratings versus no preferences ratings), and methodology [less common items by today's standards (e.g., newspaper, DVD, Kool-Aid "Jammer") versus items less reliant on contemporary relevance (e.g., number puzzle, wallet, generic juice box)] between Experiments 1 and 2 on the one hand and Experiment 3 on the other exist. Although our Experiment 3 methodology permitted strengths in comparison between Preferences Tasks within the same group of children, it is important to note the possible disadvantages of using a within-subjects design. Most notably, repeated exposure to task items (particularly the child-preferable items) may have impacted children's subsequent item selections. Further, length of testing sessions also doubled with the use of our within-subjects design relative to Experiments 1 and 2, which may have resulted in an additional challenge for some of the younger children in Experiment 3. Not only do these differences complicate our conclusion about children's performance asymmetry in preferences reasoning but also suggest the possibility that these differences (i.e., extraneous variables) could have contributed to performance asymmetry in Experiments 1 and 2.

Beyond replicating our Experiment 3 findings, continuing to strengthen our Future and Past Preferences tasks while exploring variables such as language (e.g., receptive vocabulary; Experiment 3) may provide additional insight regarding factors affecting children's preferences

reasoning. To further bolster children's self-projection performance and to explore the influence of language, future investigations could include imaginative dress-up (e.g., blazer and tie for business attire) and play (e.g., pretending to 'work' at an office while interacting with props), parent-child discussion ("when I/you grow up…" prompts), and use of visuals (e.g., picture of the child as an 'adult' in place of adult, "John", from Experiments 1 & 3). Furthermore, use of our continuous preferences rating scale with our Future and Past Preferences tasks in a within-subjects design could also reveal possible subtleties (i.e., asymmetries) in preferences reasoning performance within the same sample of children. These adaptations in conjunction with testing a wider age range (e.g., early through late childhood) and larger sample to bolster power could help clarify asymmetries and relevant factors in children's preferences reasoning.

Finally, task reliability and validity are an important consideration regarding both our methodology and within the field of developmental research as a whole. For example, inconsistent findings noted in developmental work exploring relations between children's self-projection, ToM, and EF (e.g., Hanson et al., 2014; Ünal & Hohenberger, 2017) may reflect issues of reliable and valid measurement of task constructs rather than a lack of relation amongst variables per se. That is, although these constructs may be related, the way in which they are measured may lead developmentalists to conclude that they are not (due to poor task reliability and validity). This may also be the case in our Experiment 3; our Preferences Tasks design may have contributed to inconsistencies in relations between self-projection, ToM, and EF due to our task design possibly better capturing age differences relative to individual variability. In other words, our Experiment 3 constructs may be related, however, our tasks may not have been able to capture these relations despite our best design efforts. Regarding the (lack of) findings in our Experiment 3, Brosseau-Liard (2022) notes that forced-choice tasks are unreliable measures of

individual differences due to statistical “noise” resulting from children sometimes guessing between two choices. Specific to validity, it is further possible that task relations are lost after controlling for language in our Experiment 3 because, fundamentally, these tasks assess language ability or at least as much as they assess our constructs of interest. In an effort to address the possible downfalls of task reliability and validity in our Experiment 3 (and within developmental psychology as a whole), Brosseau-Liard suggests maximizing statistical power by increasing sample size, using more sophisticated analytical approaches (e.g., multilevel binary or multinomial logistic regression) when appropriate, and bolstering task reliability through additional task items and trials. With this in mind, larger sample sizes and additional Preferences Task items and trials could provide clearer conclusions about possible relations between future and past preferences reasoning and possible mechanisms underlying these abilities in preschoolers (i.e., ToM, EF).

Temporal Distance

A main limitation of this dissertation regards imbalance of temporal distance in our Preferences tasks between children’s nearer past (‘baby’) and more distant future (‘adult’) selves. Although some research finds that children’s reasoning is impacted by temporal distance during middle childhood (e.g., Coughlin, Lyons, & Ghetti, 2014), younger children may be relatively insensitive to differences in temporal distance (e.g., O’Brien, Greenspon, Hamwi, Castro, & Atance, 2021), however, this later area of research is, currently, not well understood. Regardless, it remains important to investigate whether manipulating temporal distance has any impact on children’s preferences reasoning. If temporal distance indeed impacts children’s preferences reasoning, then teasing its impact apart from our general findings could be important for the conclusions made thus far in our and other investigations of children’s preferences reasoning.

The development of new Preferences tasks to include temporal differences according to developmental stages and milestones (e.g., babyhood, toddlerhood, early/middle childhood, adolescence, young/middle/older adulthood, old age) would help clarify the relevance of temporal distance in children's preferences reasoning.

Conflict and Inhibitory Control

Consistent with manipulation of temporal distance, varying the desirability of Preferences task items could better target the possible role of conflict in children's preferences reasoning. Both of our Preferences tasks inherently involve conflicting shifts in perspective from children's current perspective to their 'adult' and 'baby' selves. Although we did not find that children's preferences reasoning was related to or predicted by our EF tasks, it is possible that alternative methods of capturing inhibitory control and conflict could. For example, manipulating the desirability of Preferences task items could reveal additional insight about underlying mechanisms recruited during preferences reasoning while also helping to clarify possible differences that may contribute to asymmetries in performance. Specifically, future research could have children rank the desirability of a variety of baby-, child-, and adult-preferable items to be used in a new Preferences task. Then, conditions including matched (most/most, least/least) and asymmetric (most/least, least/most) desirability of items across Past and Future Preferences tasks (within-subjects design) could be implemented. In theory, the less desirable the baby- and adult-preferable items are in a given Preferences task, the more difficult (more conflict, thus, greater recruitment of EF) reasoning should be, thus decreasing task performance. Overall, varying and/or holding desirability of Preferences task items constant could yield important information about how to improve (or impede) children's preferences reasoning performance. If this is the case, then factors (i.e., desirability) influencing asymmetry could also be identified.

Conclusion

This dissertation meaningfully contributes to research about children's reasoning about the past and the future and, more specifically, their capacity to self-project out of their current perspective to consider their past and future preferences. In Chapter 2, we provide a more ecological approach to measuring developmental shifts in children's preferences reasoning with the introduction of our continuous preferences rating scale (Experiment 1). We also offer a new task to measure children's reasoning about changes in their *past* preferences: our Past Preferences task (Experiment 2). With these additions, we showed that children's reasoning about their future and past preferences generally improves with age. Results discussed in Chapter 2 also suggest possible differences (performance asymmetry) in children's preferences reasoning with exploratory cross-experiment analyses; children appeared to be more successful in reasoning about changes in their past than future preferences. Finally, in Chapter 3 (Experiment 3), we clarify the relation, address differences, and explore underlying mechanisms in children's future and past preferences reasoning. Correlational and regression analyses revealed that children's future and past preferences reasoning are unrelated after controlling for children's age, language ability, and sex. Additionally, asymmetry in self-projection performance noted in Chapter 2 was not replicated using a more rigorous experimental design (within-subjects). Taken together, applications of these findings to improve self-projection in early development might include engaging preschoolers in future- and past-oriented talk/discussions and in cognitive activities similar to the item selection and preferences ratings components of our Preferences tasks. Encouraging children to consider seemingly trivial changes in their past and future preferences throughout development could lead to important improvements in their decision making with impacts for both everyday events and more serious, life-defining moments.

References for General Introduction and General Discussion

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

Adornetti, I., Chiera, A., Altavilla, D., Deriu, V., Marini, A., Valeri, G., . . . Ferretti, F. (2021). Self-projection in middle childhood: A study on the relationship between theory of mind and episodic future thinking. *Cognitive Processing, 22*, 321-332. doi:10.1007/s10339-021-01013-w

Atance, C. M., Bélanger, M., & Meltzoff, A. N. (2010). Preschoolers' Understanding of Others' Desires: Fulfilling Mine Enhances My Understanding of Yours. *Developmental Psychology*, *46*, 1505-1513. doi:10.1037/a002037

Atance, C. M., & Caza, J. S. (2017). "Will I know more in the future than I know now?" Preschoolers' judgments about changes in general knowledge. *Developmental Psychology*. doi:10.1037/dev0000480

Atance, C. M., & Jackson, L. K. (2009). The development and coherence of future-oriented behaviors during the preschool years. *Journal of Experimental Child Psychology*, *102*, 379-391. doi: 10.1016/j.jecp.2009.01.001

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. doi:10.1016/j.jecp.2014.09.001

Atance, C. M., Metcalf, J. L., & Thiessen, A. (2017). Helping Children Save: Tell Them They Can (if They Want to). *Cognitive Development, 43*, 67-79. doi: 10.1016/j.cogdev.2017.02.009

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

Atance, C. M., & O'Neill, D. K. (2005). The emergence of episodic future thinking in humans. *Learning and Motivation, 36,* 126-144. doi:10.1016/j.lmot.2005.02.003

Atance, C. M., & O'Neill, D. K. (2005). Preschoolers' talk about future situations. *First Language, 25,* 5–18. doi:10.1177/0142723705045678

Barragan-Jason, G., Atance, C., Kopp, L., & Hopfensitz, A. (2018). Two facets of patience in young children: Waiting with and without an explicit reward. *Journal of Experimental Child Psychology, 171,* 14-30. doi:10.1016/j.jecp.2018.01.018

Baron-Cohen, S., Leslie, A. M., & Frith, U. (1985). Does the autistic child have a "theory of mind"? *Cognition, 21,* 37-46. doi:10.1016/0010-0277%2885%2990022-8

Bartsch, K., Horvath, K., & Estes, D. (2003). Young children's talk about learning events. *Cognitive Development, 18,* 177-193. doi:10.1016/S0885-2014(03)00019-4

Bauer, P. J. (2007). Remembering the times of our lives: Memory in infancy and beyond. Mahwah, NJ: Lawrence Erlbaum Associates.

Bauer, P. J., Hertsgaard, L. A., & Dow, G. A. (1994). After 8 months have passed: Long-term recall of events by 1- to 2-year-old children. *Memory, 2,* 353–382. doi: 10.1080/09658219408258955

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, 85,* 2419-2431. doi:10.1111/cdev.12282

Brosseau-Liard, P. E. (2022). Reliable developmental research: Not only for infancy. *Infant and Child Development,* 1-5. doi:10.1002/icd.2320

Buckner, R. L., & Carroll, D. C. (2007). Self-projection and the brain. *Trends in Cognitive Sciences, 11*, 49–57. doi:10.1016/j.tics.2006.11.004

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

Busby-Grant, J., & Suddendorf, T. (2011). Production of temporal terms by 3-, 4-, and 5-year-old children. *Early Childhood Research Quarterly, 26*, 87-95. doi:10.1016/j.ecresq.2010.05.002

Carlson, S. M., Moses, L. J., & Claxton, L. J. (2004). Individual differences in executive functioning and theory of mind: An investigation of inhibitory control and planning ability. *Experimental Child Psychology, 87*, 299-319. doi:10.1016/j.jecp.2004.01.002

Cassidy, K. W., Cosetti, M., Jones, R., Kelton, E., Rafal, V. M., Richman, L., & Stanhaus, H. (2005). Preschool children's understanding of conflicting desires. *Journal of Cognition and Development, 6*, 427-454. doi:10.1207/s15327647jcd0603_6

Caza, J. S., Atance, C. M., & Bernstein, D. M. (2016). Older (but not younger) preschoolers understand that knowledge differs between people and across time. *British Journal of Developmental Psychology, 34*, 313-324. doi:10.1111/bjdp.12130

Colombo, M. & Hayne, H. (2010). Episodic memory: Comparative and developmental issues. In M. S. Blumberg, J. H. Freeman, & S. R. Robinson (Eds.), *Oxford handbook of developmental behavioral neuroscience*. Oxford: Oxford University Press.

Coughlin, C., Lyons, K. E., & Ghetti, S. (2014). Remembering the past to envision the future in middle childhood: Developmental linkages between prospection and episodic memory. *Cognitive Development, 30*, 96–110. doi:10.1016/j.cogdev.2014.02.001

D'Argembeau. A., Raffard, S. & Van der Linden, M. (2008). Remembering the past and

imagining the future in schizophrenia. *Journal of Abnormal Psychology, 117*, 247-251. doi:10.1037/0021-843X.117.1.247

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*, 844-858. doi: 10.1016/j.concog.2004.07.007

D'Argembeau, A., & Van der Linden, M. (2006). Individual differences in the phenomenology of mental time travel: The effect of vivid imagery and emotion regulation strategies. *Consciousness and Cognition, 15*, 342-350. doi:10.1016/j.concog.2005.09.001

DeCasper, A. J. & Spence, M. J. (1986). Prenatal maternal speech influences newborns' perception of speech sound. *Infant Behavior & Development, 9*, 133–150. doi:10.1016/0163-6383(86)90025-1

Eisenberg, A. R. (1985). Learning to describe past experience in conversation. *Discourse Processes, 8*, 177–204. doi:10.1080/01638538509544613

Fivush, R., Haden, C., & Adam, S. (1995). Structure and coherence of preschoolers' personal narratives over time: Implications for childhood amnesia. *Journal of Experimental Child Psychology, 60*, 32–56. doi:10.1006/jecp.1995.1030

Fivush, R., & Hamond, N. R. (1990). Autobiographical memory across the preschool years: Toward reconceptualizing childhood amnesia. In R. Fivush & J. A. Hudson (Eds.). *Knowing and remembering in young children*. New York: Cambridge University Press.

Flavell, J. H., Botkin, P. T., Fry, C. L., Wright, J. W., & Jarvis, P. E. (1968). *The development of role-taking and communication skills in children*. New York: Wiley.

Friedman, W. J. (2000). The development of children's knowledge of the times of future events.

Child Development, 71, 913-932. doi:10.1111/1467-8624.00199

Friedman, W. J. (2003). The development of a differentiated sense of the past and the future. *Advances in Child Development and Behavior, 31*, 229–269. doi:10.1016/S0065 2407(03)31006-7

Friedman, W. J. (2004). The development of a differentiated sense of the past and the future. *Advances in Child Development and Behavior, 31*, 229-269. doi:10.1016/S0065-2407(03)31006-7

Friedman, W. J. & Kemp, S. (1998). The effects of elapsed time and retrieval on young children's judgments of the temporal distances of past events. *Cognitive Development, 13*, 335–367. doi:10.1016/S0885-2014(98)90015-6

Ghrear, S., Fung, K., Haddock, T., & Birch, S. A. J. (2020). Only familiar information is a "curse": Children's ability to predict what their peers know. *Child Development.* doi:10.1111/cdev.13437

Gilbert, D. T. (2006). *Stumbling on happiness*. New York: Knopf.

Gopnik, A., & Graf, P. (1988). Knowing how you know: Young children's ability to identify and remember the sources of their beliefs. *Child Development, 59*, 1366–1371. doi: 10.1111/1467-8624.ep8589535

Gopnik, A., & Slaughter, V. (1991). Young children's understanding of changes in their mental states. *Child Development, 62*, 98-110. doi:10.1111/j.1467-8624.1991.tb01517.x

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. doi:10.1016/j.jecp.2014.07.006

Harner, L. (1975). Yesterday and tomorrow: Development of early understanding of the terms.

Developmental Psychology, 11, 864–865. doi:10.1037/0012-1649.11.6.864

Hayne, H. (2004). Infant memory development: Implications for childhood amnesia. *Developmental Review, 24*, 33–73. doi:10.1016/j.dr.2003.09.007

Hayne, H. (2007). Infant memory development: New questions, new answers. In L. Oakes, & P. Bauer (Eds.), *Short- and long-term memory in infancy and early childhood: Taking the first steps toward remembering*. New York: Oxford University Press.

Hayne, H., Gross, J., McNamee, S., Fitzgibbon, O., & Tustin, K. (2011). Episodic memory and episodic foresight in 3- and 5-year-old children. *Cognitive Development, 26*, 343–355. doi:10.1016/j.cogdev.2011.09.006

Ingvar, D. H. (1979). "Hyperfrontal" distribution of the cerebral grey matter flow in resting wakefulness: On the functional anatomy of the conscious state. *Acta Neurologica Scandinavica, 60*, 12-25. doi:10.1111/j.1600-0404.1979.tb02947.x

Ingvar, D. H. (1985). "Memory of the future": An essay on the temporal organization of conscious awareness. *Human Neurobiology, 4*, 127-136. Retrieved from: https://www.prospectivepsych.org/sites/default/files/pictures/Ingvar_Memory-of-future-1985.pdf

Kopp, L., Atance, C. M., & Pearce, S. (2017). "Things aren't so bad!": Preschoolers overpredict the emotional intensity of future outcomes. *British Journal of Developmental Psychology, 35*, 623-627. doi:10.1111/bjdp.12210

Kopp, L., Hamwi, L., & Atance, C. M. (2021). Self-projection in early development: Preschoolers' reasoning about changes in their future and past preferences. *Journal of Cognition and Development, 1*, 1-21. doi:10.1080/15248372.2021.1874954

Lagattuta, K. H., & Sayfan, L. (2011). Developmental changes in children's understanding of

future likelihood and uncertainty. *Cognitive Development, 26*, 315-330. doi:10.1016/j.cogdev.2011.09.004

Levine, B. (2004). Autobiographical memory and the self in time: Brain lesion effects, functional neuroanatomy, and lifespan development. *Brain and Cognition, 55*, 54-68. doi: 10.1016/S0278-2626(03)00280-X

Lyons, K. E., & Ghetti, S. (2011). The development of uncertainty monitoring in early childhood. *Child Development, 82*, 1778-1787. doi:10.1111/j.1467-8624.2011.01649.x

Martin-Ordas, G., Atance, C. M., & Louw, A. (2012). The role of episodic and semantic memory in episodic foresight. *Learning and Motivation, 43*, 209-219. doi:10.1016/j.lmot.2012.05.011

McColgan, K. L., & McCormack, T. (2008). Searching and planning: Young children's reasoning about past and future event sequences. *Child Development, 79*, 1477-1497. doi: 10.1111/j.1467-8624.2008.01200.x

Metcalf, J. L., & Atance, C. M. (2011). Do preschoolers save to benefit their future selves? *Cognitive Development, 26*, 371-382. doi:10.1016/j.cogdev.2011.09.003

Mischel, W., Shoda, Y., & Rodriguez, M. L. (1989). Delay of gratification in children. *Science, 244*, 933–938. doi:10.1126/science.2658056

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

Moore, C., Jarrold, C., Russell, J., Lumb, A., Sapp, F., & MacCallum, F. (1995). Conflicting desire and the child's theory of mind. *Cognitive Development, 10*, 467-482. doi: 10.1016/0885-2014%2895%2990023-3

Nelson, K. (2001). Language and the self: From the ‘‘experiencing I’’ to the ‘‘continuing me’’.

In C. Moore & K. Lemmon (Eds.), *The self in time: Developmental perspectives.* Mahwah, NJ: Erlbaum.

Nelson, K., & Fivush, R. (2004). The emergence of autobiographical memory: A social-cultural developmental theory. *Psychological Review, 111,* 486–511. doi:10.12691/education-4 11-7

O'Brien, B., Greenspon, M., Hamwi, L., Castro, A. W., & Atance, C. M. (2021, April). *Do temporal distance and event frequency influence children's future event representations?* Poster session presented at the Society for Research in Developmental Psychology 2021 Biennial Meeting. https://srcd21biennial.ipostersessions.com/Default.aspx?s=C9-29-0F-87-72-3A-E9-1B-9A-FE-D2-99-F8-68-EF-AE

Okuda, J., Fujii, T., Ohtake, H., Tsukiura, T., Tanji, K., Suzuki, K., . . . Yamadori, A. (2003). Thinking about the future and the past: The roles of the frontal pole and the medial temporal lobes. *Neuroimage, 19,* 1369-1380. doi:10.1016/S1053-8119(03)00179-4

O'Neill, D. K., & Atance, C. M. (2000). "Maybe my daddy give me a big piano:" the development of children's use of modals to express uncertainty. *First Language, 20,* 29 52. doi:10.1177/014272370002005802

O'Neill, D. K., & Gopnik, A. (1991). Young children's ability to identify the sources of their beliefs. *Developmental Psychology, 27,* 390–397. doi:10.1037/0012-1649.27.3.390

O'Neill, D. K., & Chong, S. C. F. (2001). Preschool children's difficulty understanding the types of information obtained through the five senses. *Child Development, 72,* 803–815. doi: 10.1111/1467-8624.00316

O'Neill, D. K., Astington, J. W., & Flavell, J. H. (1992). Young children's understanding of the role that sensory experiences play in knowledge acquisition. *Child Development, 63,*

474–490. doi:10.1111/j.1467-8624.1992.tb01641.x

Pascalis, O., de Schonen, S., Morton, J., Deruelle, C. & Fabre-Grenet, M. (1995). Mother's face recognition by neonates: A replication and an extension. *Infant Behavior & Development, 18*, 79–85. doi:10.1016/0163-6383(95)90009-8

Perner, J. (2001). Episodic memory: Essential distinction and developmental implications. In C. Moore, & K. Lemmon (Eds.). *The self in time: Developmental perspectives*. Lawrence Erlbaum.

Perner, J., & Ruffman, T. (1995). Episodic memory and autonoetic consciousness: Developmental evidence and a theory of childhood amnesia. *Journal of Experimental Child Psychology, 59*, 516–548. doi:10.1006/jecp.1995.1024

Povinelli, D. J. (2001). The self: Elevated in consciousness and extended in time. In C. Moore, & K. Lemmon (Eds.). *The self in time: Developmental perspectives*. Lawrence Erlbaum.

Povinelli, D. J., Landau, K. R., & Perilloux, H. K. (1996). Self-recognition in young children using delayed versus live feedback: Evidence of a developmental asynchrony. *Child Development, 67*, 1540-1554. doi:10.1111/j.1467-8624.1996.tb01813.x

Povinelli, D. J., Landry, A. M., Theall, L. A., Clark, B. R., & CastilleC. M. (1999). Development of young children's understanding that the recent past is causally bound to the present. *Developmental Psychology, 35*, 1426-1439. doi:10.1037/0012-1649.35.6.1426

Premack, D. & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioural and Brain Sciences, 1,* 515-526. doi:10.1017/S0140525X00076512

Prencipe, A., & Zelazo, P. D. (2005). Development of affective decision making for self and other: Evidence for the integration of first- and third-person perspectives. *Psychological*

Science, 16, 501-505. doi:10.1111/j.0956-7976.2005.01564.x

Quoidbach, J., Gilbert, D. T., & Wilson, T. D. (2013). The end of history illusion. *Science, 339,* 96-98. doi:10.1126/science.1229294

Quon, E., & Atance, C. M. (2010). A comparison of preschoolers' memory, knowledge, and anticipation of events. *Journal of Cognition and Development, 11,* 37-60. doi: 10.1080/15248370903453576

Race, E., Keane, M. M., & Verfaellie, M. (2011). Medial temporal lobe damage causes deficits in episodic memory and episodic future thinking not attributable to deficits in narrative construction. *The Journal of Neuroscience, 31,* 10262-10269. doi: 10.1523%2FJNEUROSCI.1145-11.2011

Rakoczy, H., Warnecken, F., & Tomasello, M. (2007). "This way!", "No! That way!" – 3-year olds know that two people can have mutually incompatible desires. *Cognitive Development, 22,* 47-68. doi:10.1016/j.cogdev.2006.08.002

Renoult, L., Kopp, L., Davidson, P. S. R., Taler, V., & Atance, C. M. (2016). You'll change more that I will: Adults' predictions about their own and others' future preferences. *Quarterly Journal of Experimental Psychology, 69,* 299-309. doi:10.1080/17470218.2015.1046463

Rosenbaum, R. S., Kohler, S., Schacter, D. L., Moscovitch, M., Westmacott, R., Black, S. E., . . . Tulving, E. (2005). The case of K.C.: Contribution of a memory-impaired person to memory theory. *Neuropsychologia, 43,* 989-1021. doi:10.1016/j.neuropsychologia.2004.10.007

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, 56–71. doi:10.1016/j.cognition.2009.08.013

Sachs, J. (1983). Talking about the there and then: The emergence of displaced reference in parent–child discourse. In K. Nelson (Ed.). *Children's language*. Hillsdale, NJ: Erlbaum.

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,* 125-132. doi: 10.1002/dev.21004

Schacter, D. L., & Addis, D. R. (2007). Constructive memory: The ghosts of past and future. *Nature, 445,* 27–27. doi:10.1038/445027a

Schacter, D. L., Addis, D. R., & Buckner, R. L. (2007). Remembering the past to imagine the future: The prospective brain. *Nature Reviews Neuroscience, 8*, 657-661. doi:10.1038/nrn2213

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

Schacter, D. L., Addis, D. R., Hassabis, D., Martin, V. C., Spreng, R. N., & Szpunar, K. K. (2012). The future of memory: Remembering, imagining, and the brain. *Neuron, 76,* 677-694. doi:10.1016/j.neuron.2012.11.001

Schacter, D. L., Benoit, R. G., & Szpunar, K. K. (2017). Episodic future thinking: Mechanisms and functions. *Currents Opinion in Behavior Science, 17,* 41–50. doi: 10.1016/j.cobeha.2017.06.002

Sommerville, J. A., Bernstein, D. M., & Meltzoff, A. N. (2013). Measuring beliefs in centimeters: Private knowledge biases preschoolers' and adults' representation of others' beliefs. *Child Development, 84,* 1846-1854. doi:10.1111/cdev.12110

Spreng, R. N., & Grady, C. L. (2010). Patterns of brain activity supporting autobiographical memory, prospection, theory of mind, and their relationship to the default mode network. *Journal of Cognitive Neuroscience, 22*, 1112-1123. doi:10.1162/jocn.2009.21282

Stawarzyck, D., & D'Argembeau, A. (2015). Neural correlates of personal goal processing during episodic future thinking and mindwandering: an ALE meta-analysis. *Human Brain Mapping, 36*, 2929-2947. doi:10.1002/hbm.22818

Suddendorf, T. (2010). Episodic memory versus episodic foresight: Similarities and differences. *Wiley Interdisciplinary Reviews: Cognitive Science, 1*, 99-107. doi:10.1002/wcs.23

Suddendorf, T., Addis, D. R., & Corballis, M. (2009). Mental time travel and the shaping of the human mind. *Philosophical Transactions of the Royal Society, 364*, 1317-1324. doi: 10.1098/rstb.2008.0301

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. doi:10.1016/j.lmot.2005.02.010

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

Suddendorf, T. & Corballis, M. (2007). The evolution of foresight: What is mental time travel, and is it unique to humans? *Behavioral and Brain Sciences, 30*, 299-351. doi: 10.1017/S0140525X07001975

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

Suddendorf, T., & Moore, C. (2011). Introduction to the special issue: The development of

episodic foresight. *Cognitive Development, 26*, 295-298. doi:10.1016/j.cogdev.2011.09.001

Szpunar, K. K., Watson, J. M., and McDermott, K. B. (2007). Neural substrates of envisioning the future. *National Academy of Sciences, 104*, 642–647. doi: 10.1073/pnas.0610082104

Thompson, C., Barresi, J. & Moore, C. (1997) The development of future-oriented prudence and altruism in preschoolers. *Cognitive Development 12*, 199–212. doi: 10.1016/S0885-2014(97)90013-7

Tulving, E. (1972). Episodic and semantic memory. In E. Tulving (Ed.), *Organization of memory.* New York, NY: Academic Press.

Tulving, E. (1984). Precis of elements of episodic memory. *Behavioral and Brain Sciences, 7*, 223-268. doi:10.1017/S0140525X0004440X

Tulving, E. (1985a). How many memory systems are there?. *American Psychologist, 40*, 385 398. doi:10.1037/0003-066X.40.4.385

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

Tulving, E. (2001). Origin of autonoesis in episodic memory. In H. L. Roediger, III & J. S. Nairne et al. (Eds.), *The nature of remembering: Essays in honor of Robert G. Crowder*. Washington, DC: American Psychological Association

Tulving, E. (2005). Episodic memory and autonoesis: Uniquely human? In H. S. Terrace & J. Metcalfe (Eds.), *The missing link in cognition: Origins of self-reflective consciousness.* New York, NY: Oxford University Press.

Ünal, G., & Hohenberger, A. (2017). The cognitive bases of the development of past and future

episodic cognition in preschoolers. *Journal of Experimental Child Psychology, 162*, 242-258. doi :10.1016/j.jecp.2017.05.014

Viard, A., Chételat, G., Lebreton, K., Desgranges, B., Landeau, B., de La Sayette, V., Eustache, F., & Piolino, P. (2011). Mental time travel into the past and the future in healthy aged adults: An fMRI study. *Brain and Cognition, 75*, 1-9. doi:10.1016/j.bandc.2010.10.009

Wang, Q., Capous, D., Koh, J. B. K., & Hou, Y. (2014). Past and future episodic thinking in middle childhood. *Journal of Cognition and Development, 15*, 625–643. doi: 10.1080/15248372.2013.784977

Wellman, H. M., Cross, D., & Watson, J. (2001). Meta-analysis of theory-of-mind development: The truth about false belief. *Child Development, 72*, 655–684. doi:10.1111/1467 8624.00304

Wellman, H. M., & Liu, D. (2004). Scaling theory-of-mind tasks. *Child Development, 75*, 523-541. doi: 10.1111/j.1467-8624.2004.00691.x

Wheeler, M. A., Stuss, D. T., & Tulving, E. (1997). Toward a theory of episodic memory: The frontal lobes and autonoetic consciousness. *Psychological Bulletin, 121*, 331–354. doi: 10.1037/0033-2909.121.3.331

Williams, J. M. G., Ellis, N. C., Tyers, C., Healy, H., Rose, G., & MacLeod, A. K. (1996). The specificity of autobiographical memory and imageability of the future. *Memory & Cognition, 24*, 116–25. doi:10.3758/BF03197278

Wong, D. L., & Baker, C. M. (1988). Pain in children: Comparison of assessment scales, *Pediatric Nursing, 14*, 9-17. Retrieved from wongbakerfaces.org

Zahn-Waxler, C., Radke-Yarrow, M., & Brady-Smith, J. (1977). Perspective-taking and prosocial behavior. *Developmental Psychology, 13*, 87-88. doi:10.1037/0012-

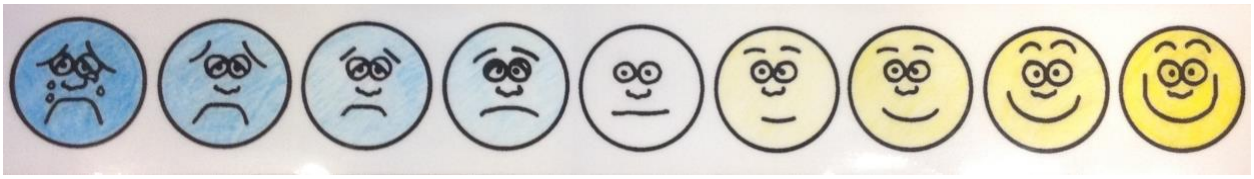
1649.13.1.87

Zhang, M., & Hudson, J. A. (2018). Children's understanding of yesterday and tomorrow. *Journal of Experimental Child Psychology, 170*, 107-133. doi:10.1016/j.jecp.2018.01.010

Zelazo, P. D. (2006). The dimensional change card sort (DCCS): A method of assessing executive function in children. *Nature Protocols, 1*, 297-301. doi:10.1038/nprot.2006.46

Appendices

Appendix A: Faces Rating Scale



1 2 3 4 5 6 7 8 9

1. Really don't like something at all; it's the worst!
2. Really don't like something
3. Don't like something a little more
4. Don't like something a little
5. Just okay
6. Like something a little
7. Like something a little more
8. Really like something
9. Really like something a lot; it's the best!

Appendix B: Experiment 1 Sample Protocol

Child and experimenter come into the lab and sit at a desk across from one another. Child is seated closest to the lab door. A bin with experimental materials is beside the experimenter.

E = experimenter, C = child

(Self-Now Trial: Baseline, all participants)

Let's play a game!

(E presents faces rating scale to C).

E: Today I'm going to be playing games with you and asking you some questions about how much you like different things. Look, here are a whole bunch of faces (sweep hand across scale). **Sometimes we really like something and that makes us feel happy and sometimes we don't really like something and that makes us feel unhappy. The faces that are more yellow** (points to happy part of the scale) **means that you really like something and that makes you feel happier and the faces that are more blue** (points to unhappy part of the scale) **means that you don't really like something and that makes you feel sadder.**

This face means you like something a little, this one means you like something a little more, this one means you really like something and this one means you really like something a lot; it's the best! (E points to each corresponding face on the happy side of the scale).

This face means you don't like something a little, this one means you don't like something a little more, this one means you really don't like something and this one means you really don't like something at all; it's the worst! (E points to each corresponding face on the unhappy side of the scale). **The face in the middle is when you think something is just okay, not the**

best and not the worst, but just okay (E points to corresponding face on the neutral part of the scale).

E: Now I am going to ask you some questions and these are the different choices you can pick your answer from (sweeps hand over rating scale). **There aren't any right or wrong answers, just point to how much you think you would like something.**

(E leaves faces rating scale on table, E takes out child-preferable and adult-preferable items, one at a time, and presents them to C).

I want you to tell me the things you like best <u>right now.</u>

Which one of these do you like best right now, Play-Doh or crossword puzzles?

Child response: _____

a.) How much do you like the _____ right now? [do you really like it/them, do you like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like the _____ right now? [do you really like it/them, do you like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, Kool-Aid or coffee?

Child response: _____

a.) How much do you like the _____ right now? [do you really like it, do you

like it a little, do you think it's just okay, do you not like it a little, or do you not really like it? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like the _____ right now? [do you really like it, do you like it a little, do you think it's just okay, do you not like it a little, or do you not really like it? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, one of these sticker books or one of these magazines?

Child response: _____

a.) How much do you like the _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like the _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, one of these picture books or one of these newspapers?

Child response: _____

a.) How much do you like the _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not

really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like the _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, one of these *Dora the Explorer* videos or one of these cooking videos?

Child response: _____

a.) How much do you like the _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like the _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Okay! Let's play another game!

*(E puts away last preference items and rating scale). E then brings out **paper and crayons** and sets timer for **3 minutes (museum/lab)** of playtime).

Okay! Let's play another game!

(Self-Future Trial, all participants)

(E takes out picture of gender-matched adult and places (and leaves) on table for C to see).

Right now, you're 3/4/5 years old. But one day, you're going to be all grown up. You're going to be as big as this woman/man. Her/His name is Jane/John, and she/he is as big as your Mommy/Daddy. I'm going to show you some things, and I want you to tell me the things you will like best when you're all grown up.

(E takes out rating scale, child-preferable and adult-preferable items, one at a time, and presents them to C).

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, Play-Doh or crossword puzzles?

Child response: _____

a.) How much will you like the _____ when you're all grown up? [will you really like it/them, will you like it/them a little, will you think it's/they're just okay, will you not like it/them a little, or will you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much will you like the _____ when you're all grown up? [will you really like it/them, will you like it/them a little, will you think it's/they're just okay, will you not like it/them a little, or will you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, Kool-Aid or coffee?

Child response: _____

a.) How much will you like the _____ when you're all grown up? [will you really like it, will you like it a little, will you think it's just okay, will you not like it a little, or will you not really like it? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much will you like the _____ when you're all grown up? [will you really like it, will you like it a little, will you think it's just okay, will you not like it a little, or will you not really like it? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, one of these sticker books or one of these magazines?

Child response: _____

a.) How much will you like the _____ when you're all grown up? [will you really like them, will you like them a little, will you think they're just okay, will you not like them a little, or will you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much will you like the _____ when you're all grown up? [will you really like them, will you like them a little, will you think they're just okay, will you not like them a little, or will you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these will you like best when you're all grown up, when you're as big as

Jane/John, picture books or newspapers?

Child response: _____

a.) How much will you like the _____ when you're all grown up? [will you really like them, will you like them a little, will you think they're just okay, will you not like them a little, or will you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much will you like the _____ when you're all grown up? [will you really like them, will you like them a little, will you think they're just okay, will you not like them a little, or will you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, one of these *Dora the Explorer* videos (L) or one of these cooking videos?

Child response: _____

a.) How much will you like the _____ when you're all grown up? [will you really like them, will you like them a little, will you think they're just okay, will you not like them a little, or will you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much will you like the _____ when you're all grown up? [will you really like them, will you like them a little, will you think they're just okay, will you not like them a little, or will you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Appendix C: Gender-Matched Adults

(John)

(Jane)

Appendix D: Experiment 2 Sample Protocol

Child and experimenter come into the lab and sit at a desk across from one another. Child is seated closest to the lab door. A bin with experimental materials is beside the experimenter.

E = experimenter, C = child

(Self-Now Trial: Baseline, all participants)

Let's play a game!

(E presents faces rating scale to C).

E: Today I'm going to be playing games with you and asking you some questions about how much you like different things. Look, here are a whole bunch of faces (sweep hand across scale). **Sometimes we really like something and that makes us feel happy and sometimes we don't really like something and that makes us feel unhappy. The faces that are more yellow** (sweep finger over happy part of scale) **means that you really like something and that makes you feel happier and the faces that are more blue** (sweep finger over unhappy part of scale) **means that you don't really like something and that makes you feel sadder.**

This face means you like something a little, this face means you like something a little more, this face means you really like something and this face means you really like something a lot; it's the best! (E points to each corresponding face on the happy side of the scale).

This face means you don't like something a little, this face means you don't like something a little more, this face means you really don't like something and this face means you really don't like something at all; it's the worst! (E points to each corresponding face on the unhappy

side of the scale).

The face in the middle is when you think something is just okay, not the best and not the worst, but just okay (E points to corresponding face on the neutral part of the scale).

Now I am going to ask you some questions and these are the different choices you can pick your answer from (sweeps hand over rating scale). **There aren't any right or wrong answers, just point to how much you think you would like something.**

(E leaves faces rating scale on table, E takes out child-preferable and baby-preferable items, one pair at a time, and presents them to C. E points/touches items as they are referred to).

I want you to tell me the things <u>you</u> like best <u>right now.</u>

Which one of these do you like best right now, Goldfish Crackers or food in a jar?

Child response: _____

a.) How much do you like _____ right now? [do you really like it/them, do you like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like _____ right now? [do you really like it/them, do you like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, juice boxes or milk in a bottle?

Child response: _____

a.) How much do you like _____ right now? [do you really like it/them, do you like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like _____ right now? [do you really like it/them, do you like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, picture books or sticker books?

Child response: _____

a.) How much do you like _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, rattles or Play-Doh?

Child response: _____

a.) How much do you like _____ right now? [do you really like it/them, do you

like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like _____ right now? [do you really like it/them, do you like it/them a little, do you think it's/they're just okay, do you not like it/them a little, or do you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these do you like best right now, action figures or blankies?

Child response: _____

a.) How much do you like _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much do you like _____ right now? [do you really like them, do you like them a little, do you think they're just okay, do you not like them a little, or do you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Okay! Let's play another game!

*(E puts away last preference items and rating scale. E then brings out **paper and crayons** and sets timer for **3 minutes** of playtime). After the timer sounds, E and child resume study.

(Timer sounds) That means it's time for another game!

(Self-Past Trial, all participants)

(E takes out picture of gender-neutral baby and places (and leaves) on table for C to see).

Right now, you're 3/4/5 years old. But you used to be a baby. You were as small as this baby and her/his name is Tiffany/Tommy.

I'm going to show you some things, and I want you to tell me the things you <u>used to like best</u> <u>when you were a baby</u>.

(E takes out rating scale, places baby picture above scale (child's view). Baby-preferable and child-preferable items presented one at a time. Baby picture and items pointed to/touches as referred to).

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, Goldfish Crackers or food in a jar?

Child response: _____

a.) How much did you like _____ when you were a baby? [did you really like it/them, did you like it/them a little, did you think it/they were just okay, did you not like it/them a little, or did you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much did you like _____ when you were a baby? [did you really like it/them, did you like it/them a little, did you think it/they were just okay, did you not like it/them a little, or did you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these did you like best when you were a baby, when you were as small as

Tiffany/Tommy, juice boxes or milk in a bottle?

Child response: _____

a.) How much did you like _____ when you were a baby? [did you really like it/them, did you like it/them a little, did you think it/they were just okay, did you not like it/them a little, or did you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much did you like _____ when you were a baby? [did you really like it/them, did you like it/them a little, did you think it/they were just okay, did you not like it/them a little, or did you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, picture books or sticker books?

Child response: _____

a.) How much did you like _____ when you were a baby? [did you really like them, did you like them a little, did you think they're just okay, did you not like them a little, or did you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much did you like _____ when you were a baby? [did you really like them, did you like them a little, did you think they're just okay, did you not like them a little, or did you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, rattles or Play-Doh?

Child response: _____

a.) How much did you like _____ when you were a baby? [did you really like it/them, did you like it/them a little, did you think it/they were just okay, did you not like it/them a little, or did you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much did you like _____ when you were a baby? [did you really like it/them, did you like it/them a little, did you think it/they were just okay, did you not like it/them a little, or did you not really like it/them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, action figures or blankies?

Child response: _____

a.) How much did you like _____ when you were a baby? [did you really like them, did you like them a little, did you think they're just okay, did you not like them a little, or did you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

b.) How much did you like _____ when you were a baby? [did you really like them, did you like them a little, did you think they're just okay, did you not like them a little, or did you not really like them? *Experimenter points to each corresponding area on the scale as they ask the question.*] _____

Appendix E: Gender-Neutral Baby

(Tiffany/Tommy)

Appendix F: Experiment 3 Sample Protocol

Child and experimenter come into the lab and sit at a desk across from one another. Child is seated closest to the lab door. A bin with experimental materials is beside the experimenter. E = experimenter, C = child

****

PAST BLOCK

****

<u>Past Block: Self-Now Trials</u>

Let's play a game!

E: I'm going to show you some things and I want you to tell me the things YOU like best RIGHT NOW.

(E takes out child- and baby-preferable items, one pair at a time, and presents them to C. E points & touches items as they are referred to.)

Which one of these do you like best right now, milk in a bottle (R) or juice boxes?

Child response: ____________________

Which one of these do you like best right now, Goldfish Crackers (R) or mashed food?

Child response: ____________________

Which one of these do you like best right now, rattles (L) or Play-Doh?

Child response: ____________________

Which one of these do you like best right now, sticker books (L) or picture books?

Child response: ____________________

Which one of these do you like best right now, action figures (L) or blankies?

Child response: ____________________

Okay! Let's play another game!

****

EF TASKS

****

Dimensional Change Card Sort (Standard version)

*Experimenter places two file boxes on the table: the **blue star** tray to the child's left and the **Red truck** tray to the child's right.*

"***Here's a blue star and here's a red truck. Now, we're going to play a card game. This is the COLOUR game. In the COLOUR game, all the blue ones go here (point to blue star tray, child's left), and all the red ones go there (point to red truck tray, child's right)."***

****1.** Sort one type of test card by colour and say: **"See, here's a blue/red one. So, it goes here (place card face down in correct tray). If it's blue it goes here, but if it's red it goes there (point to correct tray)."***

****2.** Show child OTHER type of test card and say: **"Now here is a blue/red one. Where does this one go?"***

____ *Correct & sorts: **"Very good. You know how to play the colour game."***

____ *Correct but points: **"Very good. You know how to play the colour game. Can you help me put this blue/red one down?"** (ensure card face down in tray)*

____ *Wrong: **" No, this one's blue/red, so it has to go over here in the colour game. Can you help me put this blue/red one down?"** (ensure card face down in tray)*

DEMO	Card	Child's sort	☒ or☑
*1	Blue Truck / Red Star	-	*E SORT*
*2	Blue Truck / Red Star	Red / Blue	

Pre-Switch Phase:

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

(pointing)

**** 1.*** *Randomly select test card and say:* ***"Here's a blue/red one. Where does it go?"*** *(sort card for child if only points, ensure face down in tray – NO feedback)*

"Let's do another one"

Each trial say: "So remember, if it's blue it goes here, but if it's red it goes there. Here's a blue/red one. Where does it go?" NO MORE THAN 2 SAME IN ROW!

Trial	Card	Child's sort	☒ or☑
*1	Blue Truck / Red Star	Red / Blue	
2	Blue Truck / Red Star	Red / Blue	
3	Blue Truck / Red Star	Red / Blue	
4	Blue Truck / Red Star	Red / Blue	
5	Blue Truck / Red Star	Red / Blue	
6	Blue Truck / Red Star	Red / Blue	

Total Correct (colour): _____

Post-Switch Phase

"Now we're going to play a new game. We're not going to play the colour game anymore. We're going to play the SHAPE game. In the shape game, all the stars go here (point to blue star tray, child's left) and all the trucks go there (point to red truck tray, child's right)."

"Remember, if it's a star, put it here (child's left tray) and if it's a truck, put it there okay? (child's right tray)."

DO NOT remove pre-switch cards already in trays

****1.*** *Select test card (not more than 2 of same carrying over from pre-switch trials) and say:* ***"Here's a star/truck. Where does it go?"*** *(sort card for child if only points, ensure face down in tray – NO feedback)*

"Let's do another one"

Each trial say: "So remember, if it's a star it goes here, but if it's a truck it goes there. Here's a star/truck. Where does it go?" NO MORE THAN 2 SAME IN ROW!

Trial	Card	Child's sort	☒ or☑
*1	Blue Truck / Red Star	Star / Truck	
2	Blue Truck / Red Star	Star / Truck	
3	Blue Truck / Red Star	Star / Truck	
4	Blue Truck / Red Star	Star / Truck	
5	Blue Truck / Red Star	Star / Truck	
6	Blue Truck / Red Star	Star / Truck	

Total Correct (shape): _____
Pass? (5+):_____

Let's play another game!

Sun/Moon

"***Now we're going to play a different game!" (Show card with SUN.) "This is a sun, right? When you see this card, I don't want you to say SUN. No, I want you to say MOON.***"

(*Remove the SUN, show the MOON*.) "***This is a moon, right? When you see this card, I don't want you to say MOON. No, I want you to say SUN."***

Training:

(*Show SUN. If hesitation, say*: "What do you say for this one?) Sun **Moon** (Good.)

(*Show MOON. If hesitation, say*: "What do you say for this one?) **Sun** (Good.) Moon

IF WRONG OR NO RESPONSE ON EITHER TRIAL, REPEAT RULES AND TRAINING.

MAX. OF 3 TRAINING SESSIONS. ALWAYS CONTINUE WITH TEST TRIALS.

___/3

Testing *(No feedback)*

Trial	Response	Trial	Response	Trial	Response
1 Moon	**Sun** Moon	8 Sun	Sun **Moon**	15 Moon	**Sun** Moon
2 Sun	Sun **Moon**	9 Sun	Sun **Moon**	16 Sun	Sun **Moon**

3	Sun	Sun	**Moon**	10	Moon	**Sun**	Moon	17	Moon	**Sun**	Moon
4	Moon	**Sun**	Moon	11	Sun	Sun	**Moon**	18	Moon	**Sun**	Moon
5	Sun	Sun	**Moon**	12	Moon	**Sun**	Moon	19	Sun	Sun	**Moon**
6	Moon	**Sun**	Moon	13	Moon	**Sun**	Moon	20	Sun	Sun	**Moon**
7	Moon	**Sun**	Moon	14	Sun	Sun	**Moon**	21	Moon	**Sun**	Moon

Total number correct (bold): _____

Okay! Let's play another game!

<u>Past Block: Self-Past Trials</u>

(E takes out picture of gender-neutral baby and places (and leaves) on table for C to see).

Right now, you're 3/4/5 years old. But you used to be a baby. You were as small as this baby and her/his name is Tiffany/Tommy.

I'm going to show you some things, and I want you to tell me the things YOU USED TO LIKE BEST when YOU were a BABY.

(Child- and baby-preferable items presented one pair at a time. Baby picture and items pointed to/touched when verbally referred to).

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, milk in a bottle (R) or juice boxes?

Child response: _____

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, Goldfish Crackers (R) or mashed food?

Child response: _____

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, rattles (L) or Play-Doh?

Child response: _____

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, sticker books (L) or picture books?

Child response: _____

Which one of these did you like best when you were a baby, when you were as small as Tiffany/Tommy, action figures (L) or blankies?

Child response: _____

Okay! Let's play another game!

****

ToM TASKS

****

Contents False Belief

Child sees a closed Band-Aids box with toy dog inside. ***"Here's a Band-Aids box. What do you think is inside the Band-Aids box?***" _____ (**Band-aids**)

Open box: ***"Let's see… it's really a toy dog inside!***" *Close box.*

Control question:

"Ok, what is in the Band-Aids box?" _____ (**toy dog**)

Target self question:

"When you first saw this box, before we opened it, what did you think was inside?"

_____ *If no response*: "***Band-aids or a toy dog***?" _____ (**Band-aids**)

A toy figure of a Elmo is produced: "***Now here comes Elmo. Elmo has never ever seen inside this Band-Aids box***."

Target other question:

"So, what does Elmo think is inside the box?" **_____** *If no response*:

"***Band-Aids or a toy dog***?"_____ (**Band-Aids**)

Memory question:

"Did Elmo see inside this box?" **_____** (**no**)

Let's play another game!

Change in Location

Experimenter places both characters, both boxes (Green experimenter's Left), and the pig on the table before giving instructions.

"Here's Bert and here's Ernie. And, here's a green box and here's a orange box. Ernie is playing with this toy pig. Then, Ernie puts the toy pig in this green box and leaves to go outside." *Ernie is shown leaving and is then placed out of sight*

"***Now, Bert wants to play with the pig, so he goes over to the green box, gets out the pig, and starts to play with it. And when he's done playing with the pig, he goes over to the orange box, puts the pig in there, and he goes outside***." *Bert is shown leaving and then is placed out of sight.*

"***Look, Ernie is back and wants to play with the pig."***

Target question: "***Where does Ernie think the pig is?"*** [**green** orange] [0 1]

If no response: ***"Where does Ernie think the pig is? Does he think it's in the green box or does he think that it's in the orange box?"*** [green orange]

Control question 1: ***"Where did Ernie put the pig?"*** [**green** orange] [0 1]

Control question 2: ***"Where is the pig really?"*** [green **orange**] [0 1]

Let's play another game!

****

FUTURE BLOCK

****

E: I'm going to show you some things and I want you to tell me the things YOU like best RIGHT NOW.

Future Block: Self-Now Trials

Which one of these do you like best right now, magazines (L) or sticker books?

Child response: _____

Which one of these do you like best right now, wallets (R) or action figures?

Child response: _____

Which one of these do you like best right now, number puzzles (R) or Play-Doh?

Child response: _____

Which one of these do you like best right now, Goldfish Crackers (L) or vegetable stir fry?

Child response: _____

Which one of these do you like best right now, juice boxes (L) or coffee?

Child response: _____

Okay! Let's play another game!

****

CONFLICTING DESIRES

****

Activity Task 1:

E: Let's look at these four things to do: go to the zoo, get a haircut, go to the grocery store, go on a long car ride (E shows child pictures of activities). Show me the one that you like to do best, the one that you REALLY, REALLY like to do.

E: Now point to the one that you don't like best, the one that you REALLY, REALLY don't like to do.

E: OK. So you REALLY like this one (_____) and you REALLY don't like this one (_____). *(Point to chosen pictures and say aloud)*

(Take away pictures)

Now I am going to read you a story and ask you some questions.

STORY

(Place pictures back on table in same order)

E: Will Sam/Sarah choose to go on a long car ride, go to grocery store, get a haircut, or go to the zoo?

_____

(Remove Sam/Sarah)

E: Which thing do you like to do best? _____

E: Which thing do you really not like to do? _____

Activity Trial 2:

E: Let's look at these four things to do: eat candy, take a nap, clean your room, and brush your hair (E shows child pictures of activities). Show me the one that you like to do best, the one that you REALLY, REALLY like to do.

E: Now point to the one that you don't like best, the one that you REALLY, REALLY don't like to do.

E: OK. So you REALLY like this one (_____) and you REALLY don't like this one (_____).*(Point to chosen pictures and say aloud)*

(Take away pictures)

Now I am going to read you a story and ask you some questions.

STORY

(Place pictures back on table in same order)

E: Will Sam/Sarah choose to: brush his/her hair, clean his/her room, take a nap, or eat candy?

_____

(Remove Sam/Sarah)

E: Which thing do you like to do best? _____

E: Which thing do you really not like to do? _____

Let's play another game!

<u>Future Block: Self-Future Trials</u>

(E takes out picture of gender-matched adult and places (and leaves) on table for C to see).

Right now, you're 3/4/5 years old. But one day, you're going to be all grown up. You're going to be as big as this woman/man. Her/His name is Jane/John, and she/he is as big as your Mommy/Daddy. I'm going to show you some things, and I want you to tell me the things you will like best when you're all grown up.

(E takes out rating scale, child-preferable and adult-preferable items, one at a time, and presents them to C).

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, magazines (L) or sticker books?

Child response: _____

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, wallets (R) or action figures?

Child response: _____

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, number puzzles (R) or Play-Doh?

Child response: _____

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, Goldfish Crackers (L) or vegetable stir fry?

Child response: _____

Which one of these will you like best when you're all grown up, when you're as big as Jane/John, juice boxes (L) or coffee?

Child response: _____

Let's play another game!

****

LANGUAGE MEASURE

****

WPPSI

Complete task according to Receptive Vocab & Picture Naming subtest instructions

Testing Notes