CHAPTER EIGHT

# Children's future-oriented cognition

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## Contents



## Abstract

Children's future-oriented cognition has become a well-established area of research over the last decade. Future-oriented cognition encompasses a range of processes, including those involved in conceiving the future, imagining and preparing for future events, and making decisions that will affect how the future unfolds. We consider recent empirical advances in the study of such processes by outlining key findings that have yielded a clearer picture of how future thinking emerges and changes over childhood. Our interest in future thinking stems from a broader interest in temporal cognition, and we argue that a consideration of developmental changes in how children understand and represent time itself provides a valuable framework in which to study future-oriented cognition.

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## 1. Introduction

A long-standing idea in developmental psychology is that children are somehow less "future oriented" that adults (e.g., Chen & Vazsonyi, 2011; Greene, 1986; Nurmi, 1991; Steinberg et al., 2009). The term "future orientation" is a broad one that has been used in a variety of ways (Lewis, 1981; Seginer, 2003, 2009; Shipp & Aeon, 2019; Zimbardo & Boyd, 1999), encompassing processes involved in constructing a coherent representation of the future, imagining future events, focusing on and prioritizing the future, and having certain attitudes toward the future. In a developmental context, being future-oriented is frequently contrasted with what Steinberg et al. (2009) refer to as "youthful short-sightedness," with the idea being that such short-sightedness may hamper decision-making.

Much developmental research on future orientation has focused on adolescents, using questionnaire-based methods to assess aspects of adolescents' thoughts about and attitudes toward the future (e.g., Andretta, Worrell, Mello, Dixson, & Baik, 2013; McKay, Perry, Cole, & Worrell, 2018; Mello & Worrell, 2006; So, Voisin, Burnside, & Gaylord-Harden, 2016). However, over the last two decades the emergence of new experimental techniques to examine children's future-oriented cognition has meant that a clearer picture is now emerging of when children first start imagining the future and the extent to which they think about and prepare for future events. Nevertheless, there are still significant empirical challenges to be faced regarding how best to measure future-oriented cognition in children, and theoretical challenges regarding its developmental significance.

This chapter consists of three sections. In Section 2, we consider recent findings concerning the development of episodic future thinking (EFT), understood as the ability to mentally simulate specific personal events in the future (Atance & O'Neil, 2001). We focus on two main issues: (i) how does EFT develop beyond the preschool period? and (ii) does success on tasks measuring EFT in pre-schoolers really require this distinctive sort of thought? We discuss recent findings from both these areas, and suggest that there is a more basic issue to be addressed, namely whether thought about the future per se is necessary for passing currently used empirical EFT tasks. In Section 3, we elaborate on this notion by addressing what we take to be the fundamental developmental question: When do children have a concept of the future that is similar to that of adults? We outline our theoretical approach to the development of temporal cognition, arguing that children's concept of time undergoes important changes between 3 and 5 years. In Section 4, we turn to the issue of whether children are less "future oriented" than adults, considering three different facets of future-orientedness: (i) focus on the future, (ii) care for the future, and (iii) future-oriented decision-making. We outline how recent empirical research is addressing these issues in children and also highlight important gaps in our current knowledge, particularly those stemming from theoretical advances in the literature on adult decision-making.

## 2. Imagining the future

When Hudson, Mayhew and Prabhakar (2011) wrote their chapter describing research on the development of EFT for *Advances in Child Development and Behavior* in 2011, they subtitled it "Emerging Concepts and Methods," capturing the fact that as a field it was still in its infancy. Substantial empirical progress has been made since then. While we use the term "episodic future thinking," we note that Hudson et al. used the term "episodic foresight" to describe the skill in question; indeed a number of other terms have also been used including "prospection" and "future-directed mental time travel" (Gilbert & Wilson, 2007; Suddendorf & Corballis, 2007). Although there are some differences in emphasis across different theorists who use these various terms, we will assume that of shared central interest is a distinctive type of cognitive skill that involves "pre-experiencing" or mentally simulating a specific personal event located in one's future (Tulving, 2005).

Initial developmental research on EFT was primarily concerned with trying to establish when this type of skill first emerges, but more recently there have been attempts to characterize its subsequent developmental profile across childhood and into adolescence. As described in Section 3.1, there are now good reasons to believe that EFT shows substantial developments right up into adolescence. Section 3.2 will focus on studies with preschoolers; indeed, although developmental research has broadened to include older children, there remains a significant disagreement about whether tasks used to assess EFT actually successfully tap this ability (Burns & Russell, 2016; Dickerson, Ainge, & Seed, 2018).

### 2.1 Studies with older children: Verbal cuing methods

Studies of EFT in adults typically use paradigms in which participants are cued to generate descriptions of specific events in their personal future (e.g., Addis, Pan, Vu, Laiser, & Schacter, 2009; Szpunar & McDermott, 2008). There are obvious difficulties in using such tasks with young children who have limited language skills, and who may struggle with understanding temporal terms referring to specific points in the future (Tillman, Marghetis, Barner, & Srinivasan, 2017). Thus, although a variety of studies have used verbal cueing with pre-schoolers with some degree of success (e.g., Busby & Suddendorf, 2005; Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Quon & Atance, 2010) more recent developmental studies using this technique have focused on children aged 5 years and older.

Coughlin, Lyons, and Ghetti (2014) asked children aged 5–9 years and adults to generate descriptions of specific personal events that had either occurred in the past or were to occur in the future. They found substantial developmental improvements between even the oldest children and the adults in the proportions of event descriptions that were what the authors termed "fully episodic." Fully episodic descriptions were those that described one-off events situated in particular time and place and provided information about imagery, emotions, or thoughts. There were more marked developmental improvements in the proportion of fully episodic descriptions provided for future versus past events. Children, but not adults, also reported finding it easier to generate descriptions of past compared to future events. These findings are consistent with those from other verbal cueing studies that have indicated that EFT abilities improve slowly over childhood and into adolescence, and that children can find it particularly difficult to independently generate episodic descriptions of future events (Abram, Picard, Navarro, & Piolino, 2014; Coughlin, Robins, & Ghetti, 2017; Gott & Lah, 2014; McCormack, Burns, O'Connor, Jaroslawska, & Caruso, 2019; Wang, Capous, Koh, & Hou, 2014).

The details of the mechanisms underpinning these developmental improvements are not fully understood. However, some studies have raised the interesting possibility of links with children's emerging notions of the self. Ghetti and Coughlin (2018) argue that generating simulations of plausible future events requires a coherent self-concept, insofar as it involves considering one's current and future goals and what sorts of future activities one may be likely to engage in. Consistent with this suggestion, Coughlin et al. (2017) found that EFT skills were predicted by the coherence of children's self-concept, as measured by a task that assessed the extent to which children consistently endorsed a variety of descriptions of the self. The latter finding held only for 5- to 7-year-olds, not older children; however, in a recent study of adolescents, McCue, McCormack, McElnay, Alto, and

Feeney (2019) found that future self-connectedness—the extent to which participants judged that they would be similar to their future self—was a predictor of EFT in adolescents. We note also that Wang et al. (2014) argue that cross-cultural differences between European American and Chinese Immigrant children in EFT skills may be reflective of differences in the extent to which there is a parental emphasis on discussing the self and one's own personal goals in the different cultures. Taken together, these findings suggest that it is plausible that there are (perhaps bidirectional) links between emerging notions of self and EFT; however, the nature of such links needs elaboration and further empirical support.

One important theoretical issue concerns the relation between remembering the past episodically and simulating the future episodically. The idea that there is an episodic system supporting both episodic memory and EFT has gained considerably currency (Addis, Wong, & Schacter, 2007; Schacter, Addis, & Buckner, 2007; Szpunar & McDermott, 2008), and forms the basis of the influential constructive episodic simulation account of EFT (Schacter & Addis, 2007; Schacter et al., 2012). According to this account, EFT is presumed to involve recombining details from episodic memory to generate simulations of future events. Does developmental data provide any support for this approach?

Studies of both children and adolescents that have measured both episodic memory and EFT have consistently found moderate positive correlations between these abilities (Bromberg, Wiehler, & Peters, 2015; Coughlin et al., 2014, 2017; McCue et al., 2019; Wang et al., 2014). However, given that episodic memory and EFT tasks typically have the shared requirement to generate a verbal description in response to a cue, such correlations may simply reflect non-episodic factors such as narrative style or communicative goals (Schacter & Madore, 2016). Coughlin et al. (2017) separately measured narrative skills and found that episodic memory was a predictor of EFT even when controlling for narrative ability. Nevertheless, more compelling evidence would come from developmental studies that either examined whether episodic memory was a unique predictor of EFT longitudinally or experimentally demonstrated that manipulations of episodic memory had an impact on EFT. With regard to the latter possibility, recent studies with adults have tried to test the constructive episodic simulation account by demonstrating that EFT can be enhanced using an induction procedure in which participants initially engage in episodically remembering recent events (Madore, Gaesser, & Schacter, 2014; Schacter & Madore, 2016). Adult participants produce richer EFT descriptions if they first complete a task in which they episodically remember (unrelated) recent events, which has been taken as evidence that priming episodic memory retrieval processes is beneficial for EFT. This suggests a promising avenue for developmental research, which could explore whether children's EFT difficulties could be reduced by means of such an induction procedure.

## 2.2 Studies with pre-schoolers: Object saving tasks

Many of the studies on the emergence of EFT in pre-schoolers are versions of "spoon tasks," based on Tulving's (2005) description of an Estonian folk tale, in which a child wakes up from a dream about going to a party at which there was a dessert that she was unable to eat because she did not have a spoon. In order to ensure that this does not happen again, the next night the child takes a spoon to bed with her. Tulving's suggestion is that EFT is recruited in situations in which one must prepare for a future need in a different environment than one is currently located. Research on EFT in non-human animals has used spoon tasks (Dufour & Sterck, 2008; Kabadayi & Osvath, 2017; Mulcahy & Call, 2006; Osvath & Osvath, 2008; see Scarf, Smith, & Stuart, 2014, for review); analogously, there have been numerous studies with young children (Atance & Sommerville, 2014; Cuevas, Rajan, Morasch, & Bell, 2015; Dickerson et al., 2018; Redshaw & Suddendorf, 2013; Russell, Alexis, & Clayton, 2010; Scarf, Gross, Colombo, & Hayne, 2013; Suddendorf, Nielsen, & Von Gehlen, 2011). In a typical paradigm, in Suddendorf et al.'s (2011) "two rooms" task children initially saw, in one specific room, that a particular key opened a box containing a desirable object. Children then carried out an activity in a different room, before being told that they were going to return to the first room. At this point, they were asked to select an object to take back with them; the correct response was to choose the key that would allow them to open the box in the first room. Three-year-olds struggled with this task, whereas older pre-schoolers were more successful. A wave of subsequent studies has tried to clarify when EFT is first in evidence as well as address the issue of what such tasks really measure.

A variant of the "two rooms" procedure was developed by Atance, Louw, and Clayton (2015), in which children visited two rooms, only one of which had toys in it. In the no-toy room, children had to wait without entertainment. They were then taken to a different location where there was a set of toys. In that location, they were told that in the future they were going to visit the two rooms again, and were asked to choose which room they wanted to put the toys in. Just like the findings revealed by Suddendorf et al. (2011), older pre-schoolers, but not 3-year-olds, were successful at choosing the no-toy room. However, in a more recent study, Caza and Atance (2019) reported that 3-year-olds did pass a version of the task in which they had to decide which of two rooms to put some candy. Moreover, Scarf et al. (2013) found that 3-year-olds were successful at choosing to bring a key back to a location where there was a locked treasure box if the delay between encountering the treasure box and object selection was short (0–15 min). Thus, although findings from these types of studies do typically show substantial age-related improvements between 3 and 5, there is now some consensus that there are circumstances in which 3-year-olds are successful (see also Atance, Celebi, Mitchinson, & Mahy, 2019).

What has been a matter of debate, though, is the extent to which these types of tasks successfully measure EFT (Dickerson et al., 2018; Redshaw & Suddendorf, 2013; Russell et al., 2010). One issue concerns whether performance on the task hinges on simply being able to remember the appropriate information about room contents, rather than EFT per se. Atance and Sommerville (2014) asked children to explicitly recall room contents after they had made their selection. They found that age differences seemed to be driven by success on this memory question. Nevertheless, Caza and Atance (2019) found age effects in their task even though memory performance in their youngest age group was high, suggesting that preparing for the future might be challenging for young children even if they can remember relevant information.

Trickier interpretative issues arise when considering whether solving such tasks necessarily requires EFT, and here we will consider three of these: (i) whether the tasks can be solved simply by association; (ii) the extent to which tasks can be solved without considering future needs; and (iii) the extent to which we can be confident that "pre-experiencing" a future event is required. We will also consider (iv) whether passing spoon tasks requires thinking about the future at all.

### *2.2.1 Solving the task using association*

One obvious criticism that can be made of spoon tasks is that children might simply be choosing the object most positively associated with the relevant location. This criticism has been particularly leveled at multi-trial studies with animals (Redshaw, Taylor, & Suddendorf, 2017; Suddendorf & Corballis, 2010; though see Scarf et al., 2014). Although studies with children typically use a single trial, it has nevertheless been suggested that associative knowledge gathered in the initial phase is sufficient to pass the task (Dickerson et al., 2018). Note that this criticism does not apply to the tasks in which children have to decide which of two rooms to place toys or candy (Atance et al., 2015; Caza & Atance, 2019); indeed, children would be expected to systematically choose the wrong room if they simply chose the room most closely associated with the desirable objects.

Dickerson et al. (2018) addressed the issue of associative-based selection by using a procedure in which children initially could acquire positive associations between two different objects and a spatial location. Children initially saw two different boxes that dispensed stickers and learned that each of them was operated by a different colored token. They were then shown one of the boxes being removed, before moving to a different location and, following a delay of approximately 7 min in which children completed a standardized vocabulary task, were asked to select a token to take back to the original location. Children needed to choose the token that operated a box that remained in the first location. Dickerson et al. argued that simply choosing a token with a positive association with the location would mean that children would not distinguish between the two familiar tokens, both of which had successfully been used there to obtain stickers. Three-year-olds and 4-year-olds did not successfully choose the correct token under these circumstances; it was not until children were age 5 that they passed the task.

One possible explanation of children's difficulties is that they failed to remember which box remained in the room. In fact, memory for this information was probed after children had made their object selection, and 4-year-olds responded at chance. Nevertheless, the authors argue that memory failure cannot fully explain 4-year-olds' difficulties: when data only from children who passed the memory question were considered, this age group still did not reliably choose the correct token. The implication of Dickerson et al.'s findings is that younger children may have passed other spoon tasks without engaging in EFT and did so by selecting an object that was positively associated with the relevant spatial location. However, although these findings indicate a very promising way to control for associative responding, Dickerson et al.'s (2018) specific task might be thought to be particularly challenging because children had to learn about two novel pieces of very similar apparatus and which token operated which box. The researchers did check that children could recall which token opened the remaining box, and found that they generally did so successfully, but this knowledge was probed only at the end of the task once the box was back in view with the token choices laid out in front of it, which was likely to have facilitated recall. It may be possible to reduce the learning and memory demands of this task by using two pieces of apparatus that are quite distinct from each other, and that require very different object types for their successful use, potentially objects that do not involve learning entirely arbitrary causal properties.

A recent study by Moffett, Moll, and Fitz Gibbon (2018) also used a task that would be difficult to solve merely based on association. Children visited a room and found out that they did not have a picture of a specific object that they needed in order to complete a game. They then went to another room where they had the opportunity to draw a picture if they wanted, before returning to the room with the game. The measure of interest was whether children would spontaneously draw the picture that they would subsequently need to complete the game. Performance on this task in 4-year-olds was low, with children drawing the necessary picture only about 20% of the time; 5-year-olds performed at a level similar to the younger children on the first trial, but they quickly learned across trials, drawing the correct picture about half of the time. The authors argued that the key feature of their study was that it required a type of proactive planning for the future, in the sense that children had to generate a means (drawing the picture) to an end (finishing the game). Thus, children could not simply select an item that had a positive association with the other location.

Notably, the procedure required a degree of spontaneous future thinking in children that is not required in typical forced-choice spoon tasks, insofar as children were not prompted to draw something they would need in the other room. In this sense, the behavior it measures is closer to the behavior of the child in Tulving's original story who puts the spoon under their pillow of their own volition (Caza & Atance, 2019). In the original story, though, the child did not have to manufacture an object: although they had to "generate a means," presumably what this required was simply fetching an object unprompted. An unprompted task solution itself is rare in spoon tasks with young children (Caza & Atance, 2019). Thus follow ups to Moffett et al.'s (2018) study could try to tease apart the extent to which having to "generate a means" in the stronger sense of manufacturing the necessary object increased the cognitive demands of the task for 4-year-olds or whether the difficulties lay with the need to spontaneously consider and plan for a subsequent need.

### *2.2.2 Consideration of future needs*

In animal spoon tasks, there is an effort made to ensure that object selection is not underpinned by a current motivational state. According to the

Bischof-Köhler hypothesis, animals cannot anticipate and thus prepare for future drive states, and, in putting forward his spoon task proposal, Tulving (2005) emphasized the importance of demonstrating that animals were not successful simply through "anticipated satisfaction of a current need in the very near future" (p. 39). As a result, in animal studies there is typically a relatively long delay between the animal's selection of a tool for future use and the opportunity for using such a tool (Dufour & Sterck, 2008; Kabadayi & Osvath, 2017; Mulcahy & Call, 2006; Osvath & Osvath, 2008). By contrast, in many of the developmental studies, children select an item for immediate use. Redshaw and Suddendorf (2013) did inform children that they would not be returning to the original room for a short delay (i.e., a 5-min period during which a sand-timer elapsed), but given the short delay and the fact that returning to the room was the very next activity that children were due to engage in, children's selections could nevertheless have been made based on their current rather than future motivational state. Thus, we can query whether children are basing their response on what they want right now, or what they are going to want in the future.

Potentially the findings of Russell et al.'s (2010) study, in which children selected an object for use tomorrow, might be interpreted as suggesting that 4-year-olds cannot pass such tasks if there is a long delay. However, as will become apparent below, it is not clear to what extent the introduction of the 24-h waiting period explains the difference between their findings and those of other researchers. Moreover, Caza and Atance's (2019) study, in which 3-year-olds were successful in one condition in which they were asked to plan for a return visit the next day, indicates that a long delay, per se, does not necessarily result in younger pre-schoolers failing the task. Nevertheless, deciding on the appropriate length of delay between object selection and object use is an important methodological issue (Scarf et al., 2014). Indeed, one can distinguish between two distinct issues—one regarding length of delay, and the other regarding whether current motivational state is distinct from the future motivational state that the tasks require preparing for.

Regarding the latter issue, other studies have examined whether children can anticipate and prepare for physiological states that differ from their current state. Atance and Meltzoff (2006) demonstrated that, after eating pretzels and feeling thirsty, both 3- and 4-year-olds did not predict that they would want pretzels rather than water the next day, even though when not thirsty children have a preference for pretzels. One interpretation of this finding is that young children have not yet developed sufficient EFT skills to allow them to imagine having a different preference in the future. However, subsequent research has demonstrated that considerably older children and adults also struggle to make correct predictions under such circumstances (Cheke & Clayton, 2019; Kramer, Goldfarb, Tashjian, & Lagattuta, 2017; Mahy, Grass, Wagner, & Kliegel, 2014), indicating that even in populations known to be adept at EFT, such prediction is difficult. Clearly, it is setting the bar too high to insist that we can only be confident that pre-schoolers can engage in EFT if the task involves direct conflict between current and future physiological states.

There is, though, evidence of a shift between 4 and 5 years in the ability to make predictions and future plans under circumstances in which there is a present-future conflict in desires that does not involve different physiological states. Martin-Ordas (2017) asked children to judge which was their favorite reward, chocolates or stickers. Children were then given some of their favorite reward and had to decide what they wanted to put in a box to have later, their preferred reward or their less preferred reward. If they were due to get the box contents shortly, 5-year-olds tended to choose the less preferred reward; however, if asked to choose for tomorrow, they always preferred to save their favorite reward, indicating a recognition that their preference tomorrow would have shifted back to their favorite reward. Four-year-olds did not show this pattern of performance. This task was made significantly more complex by the fact that children did not simply have to decide what they would want today or tomorrow, but which of the two rewards they wanted to put in a box for themselves and which for another child. Nevertheless, 5-year-olds did seem to be able to anticipate that what they would want tomorrow might be different from what they would want today.

Should we interpret the developmental finding reported by Martin-Ordas (2017) as evidence that 5-year-olds but not 4-year-olds have sufficiently developed EFT to pass the task? The answer to this question is not straightforward: Cheke and Clayton (2019) have argued that EFT may *hinder* performance under circumstances in which there is a conflict between current and future motivational states. Specifically, they suggest that EFT itself may lead to a biased projection of what one's future state will be (e.g., if one is thirsty now, one imagines one's future self being thirsty), meaning that failure to correctly select for a future state might actually be a *consequence* of engaging in EFT rather than evidence that EFT is not being utilized. This is currently a speculative idea that requires empirical testing. However, it is useful to remember the reason for considering whether spoon tasks should involve such a conflict in the first place, namely that we want to rule out the possibility that object selections are not just based on what children currently want right now, rather than what they will want in the future. As will be discussed in Section 2.2.4, we consider this issue to fall under the broader question of whether spoon tasks necessarily involve thinking about the future at all.

### *2.2.3 Pre-experiencing future events*

EFT is assumed to be distinctive in involving the "pre-experiencing" of future personal events. However, Russell et al. (2010) argued that existing studies did not properly address whether the tasks could be passed without engaging in this distinctive type of future thought. They suggested that what is required is a demonstration that children can imagine themselves at a particular spatial location in the future, and in their task, children had to select an object for future use that would be required from an alternative spatial perspective. Children played a game of blow football on a table that had two different sides: a reachable side, at which children were able play the game without any additional props, and an unreachable side, at which children needed a yellow box to step on to reach the table. Children only played the game from the reachable side. Children were then asked to select two items to save for the next day when they would be playing the game from the other, unreachable, side, with one of the correct choices being the yellow box. No 3- or 4-year-olds chose the right items, but more 5-year-olds did so than would be expected by chance. There was also a version of the task in which children had to select items for immediate rather than future use; in this version more 3- and 4-year-olds chose the correct items than would be expected by chance, indicating children did not fail in the former versions because of memory or task comprehension problems.

Russell et al.'s (2010) task has some advantages, insofar as it involves selecting objects in order to carry out an activity at a novel location, it introduces a delay between object selection and use and controls for memory difficulties. Nevertheless, the crucial object that had to be chosen was the yellow box, which was not actually functional to the game itself; rather the presence of the box served as an enabling condition for children to play it. Perhaps it is not surprising that children may have focused on items related to the game itself in their choices. Indeed, they had no reason to believe that the step would not be provided for them. The use of the box as a correct item choice also has implications for what the task involved in terms of spatial perspective-taking, which Russell et al. argued was a key demand of the task if it was to demonstrate envisioning a future experience. Presumably what Russell et al. have in mind is that children must imagine standing at the other side, and then realize that they won't be able to see the tabletop without standing on the box. That is, children need to select something that will enable them to occupy a visual perspective on a scene. However, described this way, the task seems to involve children being able to reason about the conditions under which it is possible to have an appropriate visual experience, rather than simply mentally adopt a different spatial perspective.

In fact, in a more recent study, Russell and colleagues used a different procedure to measure EFT, arguing that object selection tasks, per se, cannot definitively establish that children are capable of envisioning future events. Burns and Russell (2016) asked children to explicitly predict the nature of the future perceptual experiences they would have. In their first experiment, children saw a train that appeared as a different color depending on which side one was looking at. The train was traveling slowly around a circular track; children's task was to predict what the train would look like from different spatial perspectives that they would occupy in the future. Children had to predict what color the train would look like, and also which direction it would be traveling in. Even 3- to 4-year-olds were able to predict the train's color, but only the oldest group of 5- to 6-year-olds were able to also predict the train's direction of travel. Burns and Russell accept, though, that this task might not involve EFT per se, in the sense of imagining a specific personal future experience, because children might simply be reasoning about an imagined current spatial perspective (i.e., what the train typically looks from that spatial perspective). Thus, the task may be a visual perspective-taking task but not an EFT task.

In a second experiment, children had to make a prediction about what a white train would look like from a fixed spatial perspective at the end of a straight train line for one of two teddies wearing glasses with different-colored lenses. They had to predict the color of the train and whether it would appear near or far, which involved predicting the future position of the train that was traveling slowly on the track. All age groups were able to predict color, which arguably was straightforward because the color that each character saw the train to be did not vary as a function of time. However, only a minority of the older 5- to 6-year-olds were able to consistently predict whether the train would look near or far away. Given that Burns and Russell's aim was to measure the ability to predict how things will look once the world has changed (a future temporal perspective), it is unclear what the significance was of the sensitivity to the color of the character's glasses, since this aspect of the character's visual perception did not change over time. It is difficult to judge to what extent adding this element to the task impaired performance on near-far judgments (e.g., children might have been focusing on getting the color right, which is an unusual and salient difference between their own and the teddy's visual experience). More generally, given that EFT is, by definition, a simulation of personal future events, it is also not clear why children were asked to adopt the perspective of a different character. Thus, while Burns and Russell's approach is novel in trying to measure children's ability to envisage the future head-on, it is not straightforward to interpret their findings.

### *2.2.4 Using object saving tasks to measure future thinking*

We agree with Burns and Russell (2016) that it is difficult to make the case that spoon tests necessarily involve seeing future events unfolding "in the mind's eye." However, a more basic question can be asked as to whether such tasks necessarily involve thinking about the future at all, at least as properly understood. Hoerl and McCormack (2019) argued that, at least in the case of spoon tasks used with animals, it is not necessary to assume that such tasks involve thinking about the future—rather the tasks need only involve a sensitivity to the possibility that a situation in which the object will be useful exists in one's extended environment. De facto, that situation will not be encountered until a specific point of time in the future but selecting the right object in and of itself does not require representing such an encounter as temporally situated at such a point in time.

In her version of the spoon task, Martin-Ordas (2017) used a procedure in which children visited two rooms, one with a locked box of marbles and one with a marble run. Subsequently, in a third location, they were asked to choose an item to take back to the rooms with them, with the correct choice being to take a key that would unlock the marble box. Most 4-year-olds chose the key. However, they were also asked an additional question regarding which room they should visit first, the correct answer being the room with the marble box so that they could obtain the marbles before visiting the marble run. It was not until children were 5-years old that they were able to correctly answer the temporal order question. These findings suggest that children may be able to correctly select an item for future use without reasoning about the order in which future events are going to unfold. The issue that this study raises, then, is whether in ensuring that the task requires reasoning about event order, we can be more confident that it necessarily requires thinking about the future. In the next section, we try to unpack what it is involved in possessing a mature concept of time, which in turn will help address this question.

# 3. Conceiving of the future and reasoning about time

What is involved in conceiving of an event as happening in the future? In this section, we want to take a step back and consider in more general terms what the prerequisites for EFT are, and what the developmental stages might be through which future thinking emerges. We first discuss three general aspects of an advanced concept of time that can be seen to underpin EFT capacities, before turning to the question as to how they emerge developmentally.

## 3.1 Components of an advanced concept of time

### *3.1.1 Other times*

At its most basic, EFT requires an ability to transcend the present moment in time in thought and think about the present as just one time among others. Adults' concept of time conceives of time as a framework of different locations at which events can be located, of which the present is just one such location. In our dual-systems account of temporal cognition (Hoerl & McCormack, 2019), we argue that very young children initially operate with a model of the world from which such a temporal dimension is absent. That is, they operate with a model of the world in which times other than the present are simply not represented. In our account, we distinguish between *temporal reasoning*, which does involve thinking about different things happening at different times, and *temporal updating*, a more primitive way of dealing with how things unfold over time. In temporal updating, an individual maintains a model of their current environment, which is updated when new information about that environment is received, with outdated information being discarded, rather than retained in the guise of information about how the world once was. In this way, when things in the individual's environment change, and the individual thus receives new information about its environment, the individual will also change its model of that environment, but without that model itself representing that change (as a difference between how things were before and how they are now). At each moment in time, the model just concerns how things are at that moment. Of course, the model will include information acquired in the past, but that information is not represented as having been acquired at a past time.

As we already pointed out in the preceding section, some of the experiments that have been taken to provide evidence for EFT capacities in children arguably fail to demonstrate that they are capable of more than temporal updating. For instance, in spoon task studies it is often assumed that children who pick the right item to gain access to a desirable object, even if that object is in another location, are engaging in future thinking, because they will only be able to use the item to get access to the object after a delay. However, it is far from clear, whether, in order to pass the task, the child must represent the difference between the current time and the time when she gets access to the object. Rather, she might simply operate with a representation of the object as desirable and located somewhere in her environment and she picks the correct item simply because she wants to access the desirable object.

### 3.1.2 Past and future

Apart from the ability to represent times other than the present, EFT also requires the ability to distinguish between those non-present times according to whether they lie in the past or the future. There are several different factors that underpin this cognitive distinction between past and future in adults' advanced thinking about time. People's conception of the nature of the difference between the past and the future seems partly bound up with the idea of the direction of causation: because causes precede their effects, present events can have a causal influence on the future but not on the past. However, there are further ingredients in people's everyday thinking about time that go beyond this. For instance, it is generally assumed that people also tend to think of the future as objectively containing multiple possible ways in which things may transpire—as being "open"—whereas there is only one "fixed" past. Furthermore, it is also assumed that people's thinking about the past and the future has a dynamic aspect to it, insofar as future events are experienced as coming ever closer in time, then turning present, and after this receding into the past.[a]

One question this raises is what connections might exist between EFT and an ability to think about possibilities. A paradigm developed by Redshaw and Suddendorf (2016) addressed the issue of when children first grasp that there is more than one way that the future might turn out, by using a simplified version of a task first developed by Beck, Robinson, Carroll, and Apperly (2006). In Redshaw and Suddendorf's task, children had to catch a ball dropped down a forked tube; to be sure of reliably catching the ball, children needed to place one hand under each fork. Many 3-year-olds

[a] We note that in fact people's everyday and basic beliefs about the nature of time have not typically been the subject of empirical research, although such beliefs have been the subject of extensive discussion by philosophers who work on time (e.g., Callender, 2017; Miller, Holcombe, & Latham, 2018; Prosser, 2016).

struggled to consistently pass the task, but children reliably pass around 4 years (Redshaw et al., 2019; Suddendorf, Crimston, & Redshaw, 2017; Suddendorf, Watson, Boggart, and Redshaw, 2019). It is unclear whether success on this task reflects epistemic uncertainty (children put out two hands because they simply don't know what will happen) or requires a grasp of the fact that the future itself is uncertain. Nevertheless, the findings suggest that before the age of 4 children do not reliably prepare for more than one possible outcome.

Arguably, a grasp of the future as containing alternative possibilities is one requisite for engaging in planning involving future thinking. Planning itself seems to require recognizing that, at a point in the future, different outcomes could occur, and then seeking to make that outcome occur instead of other possible outcomes (McCormack, 2015).

### *3.1.3 Linear time*

Finally, EFT, in its mature form, also requires a conception of time as unified and linear. That is, not only does EFT involve thinking about future events as happening at a time still to come, but it also involves thinking about different possible future events as standing in systematic temporal relations to each other, so that they, in turn, lie in the future or the past of each other. In particular, it involves thinking of temporal relations as transitive, meaning that, if A is earlier than B, and B earlier than C, A must also be earlier than C. One hallmark of a grasp of temporal relations as transitive is the ability to engage in *temporal decentering* (Cromer, 1971). Temporal decentering concerns the ability to mentally occupy a different point in time, and to consider its deictic relations to other points in time. Thus, when considering a sequence of two future events A and B, it involves grasping, for instance, that while both are now in the future, and B will still be in the future when A is present, A will already be in the past when B is present. Although it is not straightforward to design tasks to measure temporal decentering that are not heavily linguistic, some existing tasks might potentially be interpreted as involving this type of skill. For example, in McColgan and McCormack's (2008) study, children had to store a camera in one of several lockers to then use to take a picture of a kangaroo in a zoo, and it was not until they were around five years of age that children reliably chose a locker that they would pass on the way to the kangaroo cage, rather than a locker they would only pass once they had already been to see the kangaroo. One interpretation of this task is that it involves understanding that at some point in the future, the visit to the kangaroo's cage will be "now" and the act of picking up the camera will need to be located in the past when that happens.

## 3.2 Developmental stages

The three aspects of a mature concept of time that we have identified, and that underpin EFT abilities in adults, are probably best seen as to some degree interrelated and developing in parallel to one another. As for how they develop, we (McCormack & Hoerl, 2017) hypothesize that there are four distinct developmental stages children experience when acquiring a concept of time that include these three features (Table 1). One crucial developmental change, marking the transition between the second and third stages, is the transition from being able to represent events to being able to represent points in time, or the emergence of "event-independent thought about time."

**Table 1** The four proposed stages of the acquisition of temporal concepts.

| Stage | Approximate age | Key features |
|---|---|---|
| (a) Representation of repeated event sequences | <24 months | Event sequences represented but individual occurrences of events not located at specific unique times. Children keep track of whether events in a sequence are completed or yet to come. |
| (b) Event-based time | 2–3 years | Event representations include those that are not part of familiar sequences. Binary distinction that is related to past-future distinction, with past events represented as unalterable, and future events potentially alterable.<br>Times at which events happen not yet represented as distinct from events themselves. |
| (c) Linear event-independent time | 4–5 years | Times at which events happen represented independently from events. Time itself represented as a linear array. Children capable of temporal decentering. |
| (d) Abstract time | 5 + years | Gradual acquisition of the clock and calendar system that is conventional in the child's culture. |

### 3.2.1 Stage (a): Representation of repeated event sequences (<24 months)

When only capable of event-dependent thought, children may initially, in the first stage mark something akin to the distinction between the past and the future, but do so only by representing events as having a certain status (as being completed vs. not completed), rather than by locating them within a framework of points in time. We (McCormack & Hoerl, 2017) suggest that this happens first before 24 months, in the context of children acquiring scripts for regularly occurring event cycles or sequences. Thus, within the context of the bedtime routine of putting on pajamas and then brushing teeth, for instance, children may be able to keep track of the fact that the putting on of pajamas is completed and that tooth brushing comes next. However, their doing so may fall short of genuinely representing the tooth brushing as happening in a future time period. At this early stage, McCormack and Hoerl suggest, children are only able to represent events in terms of where they fall relative to other events in the sequence. They have no conception of events as happening at specific, unique times that would allow them to distinguish between one occurrence of the sequence and another. Hence, they are also not able to represent, say, the difference between the episode of tooth brushing about to come and, say, yesterday's episode of tooth brushing. It is in this sense that they are oriented only with respect to events in the sequence, rather than to points in time.

### 3.2.2 Stage (b): Event-based time (2–3 years)

A second hypothesized developmental stage covers the range of 2–3 years of age. During this stage children think about non-present events even if these events do not form part of a familiar routine and make a binary distinction between them corresponding to the distinction between the past and the future. However, in doing so they are still only thinking about those events rather than thinking of points in time. More specifically we suggest that the basic classification children operate with at this stage relates to whether facts about events are unalterable, because they are completed, or alterable (at least potentially), because they are yet to come. Crucially, making such a binary distinction does not yet enable children to conceive of the systematic temporal relations that obtain between different past or future events.

### 3.2.3 Stage (c): Linear event-independent time (4–5 years)

We (McCormack & Hoerl, 2017) argue that a crucial shift occurs in children's thinking about events at around the ages of 4–5, which is when they become capable of event-independent thinking about time. Event-independent thinking about time involves making the point in time at which an event happens an object of thought in and of itself and grasping the possibility that different events could happen at that point in time, depending on what precedes it. McCormack and Hoerl connect the emergence of event-independent thinking about time specifically with a grasp of time as linear, and with the ability to engage in forms of planning that require reasoning about the order in which events need to happen. Some types of planning require a process of mentally trying out different ways in which the future might unfold and considering different ways in which future times might be occupied with a succession of events (McCormack & Atance, 2011). They thus constitute forms of reasoning that involve event-independent thinking about time. At the same time, they also constitute ways of giving causal significance to the order in which future events will happen, as the order in which actions are carried out has an impact on the overall outcome. In this way, such forms of reasoning—which have been referred to as "temporal-causal reasoning" (McColgan & McCormack, 2008; McCormack & Hoerl, 2005, 2007)—contribute to the ability to grasp a linear conception of time more generally.

### *3.2.4 Stage (d): Abstract time*

A final, fourth, developmental stage we have identified consists of the acquisition of a clock and calendar system, which happens over a protracted period right up to adolescence. We recognize this as a separate developmental stage because it provides an explicit way of labeling times in a manner that does not rely at all on thinking about the events happening at those time. However, we assume that its basic cognitive and conceptual pre-requisites are already in place once the third stage has been mastered, and thus the main developmental achievement subsequently consists in acquiring a conventional system for framing thoughts about different times. The abstract and arbitrary nature of the clock and calendar system means that children need to be explicitly taught to use the system, and their proficiency with it gradually improves over middle to late childhood (Friedman, 1982, 1989).

We have outlined here the components of our model of the development of temporal cognition to illustrate that there are more primitive types of thought that do not involve a mature concept of the future (McCormack, 2015). The model itself is still speculative, but it provides an initial framework for considering how to design studies that might assess children's ability to think about the future that are rooted in some of the components of mature temporal cognition. Elsewhere, we provide some discussion of what types of existing empirical findings are relevant to our account, and also how we see the development of temporal cognition in relation to other aspects of cognitive development (Hoerl & McCormack, 2019; McCormack, 2015; McCormack & Hoerl, 2017). For present purposes, a consequence of adopting this initial framework is that it encourages researchers to consider whether children are capable of thinking about the future, rather than trying to establish whether children have had particular types of experiences. It may prove more fruitful to focus research on whether children are capable of thinking and reasoning about time itself.

## 4. Orienting toward the future

We began this chapter with the long-standing idea that children are in some sense less "future oriented" than adults. In the last section, we considered whether young children's temporal cognition might be radically different from that of adults, insofar as they are just learning to understand what the future is. Once an initial understanding of the future is in place, it is possible to ask whether children then accord the future with the same significance and importance as adults do, which is the issue we address next in this section.

The same question has been asked about adolescents, with questionnaire-based studies examining aspects of adolescent future orientation in order to explore the extent to which it is possible to predict certain types of developmental outcomes, such as academic outcomes or risky behavior (e.g., Apostolidis, Fieulaine, & Soulé, 2006; McKay, Andretta, Magee, & Worrell, 2014; Peetsma & Van der Veen, 2011; Robbins & Bryan, 2004). It is beyond the scope of this chapter to review this research literature on adolescent future orientation (see Mello & Worrell, 2015), but recent findings suggest that it may be of limited usefulness to categorize individuals as "future oriented" per se; rather, level of future orientation may vary depending on the domain under consideration (e.g., finance vs. health; McKay, Perry, Cole, & Magee, 2017) and that there are distinct facets of future-orientation that need to be measured separately (McCue et al., 2019; McKay et al., 2018).

By contrast, relatively little research has attempted to examine future orientation in this way in children before adolescence (though see Lessing, 1972), primarily because of the difficulty of using standard questionnaire-based methods. Steinberg et al. (2009) included a 10- to 11-year-old group as well as adolescents and adults and used a measure of future orientation with sub-scales of planning ahead, time perspective, and anticipation of future consequences. Although there was a general developmental trend for scores to increase on the time perspective and future consequences sub-scales, reported levels of planning dipped between childhood and early adolescence. Thus, there is some evidence to suggest that there are changes in aspects of future orientation between late childhood and early adolescence, but the picture is unclear, and these questionnaire methods are unlikely to be suitable for younger children. Promisingly, though, Mazachowsky and Mahy (2020) have developed a new parental questionnaire to measure children's future orientation—the Children's Future Thinking Questionnaire. This 44-item questionnaire measures several facets of future orientation, including planning, prospective memory, and ability to delay gratification. The questionnaire has been validated by demonstrating that parental responses correlate with children's performance on a range of future thinking tasks; it has also been shown to be sensitive to developmental changes in future orientation. It is likely to prove to be a promising tool in examining the broader developmental significance of future-oriented behavior and cognition.

Other studies have used laboratory-based tasks to examine facets of future orientation in children, and we now turn to recent research examining whether: (i) children show past-future asymmetries in judgments, (ii) they tend to focus on the future, and (iii) the extent to which they prioritize the future in their decision-making.

## 4.1 Temporal asymmetries in judgments

One important strand of research that has been used to argue that adults are future-oriented is research on *temporal asymmetrical judgments*. Studies of temporal asymmetries have shown that adults typically place greater value on future than past events (Caruso, Gilbert, & Wilson, 2008), feel stronger emotions when thinking about the future versus the past (Caruso et al., 2008), and judge that events in the future feel closer than events an equivalent distance in the past (Caruso, Van Boven, Chin, & Ward, 2013; Gan, Miao, Zheng, & Liu, 2016; Rinaldi, Locati, Parolin, & Girelli, 2017). Moreover, adults judge future actions to be more intentional and deliberate than similar past actions (Burns, Caruso, & Bartels, 2012; Caouette, Wohl, & Peetz, 2012), and also judge future misdeeds to be more morally wrong and deserving of punishment than past misdeeds (Caouette et al., 2012; Caruso, 2010). This pattern of findings has been interpreting as suggesting that evolution has built in a tendency for people to care more about the future than the past (Suhler & Callender, 2012; Sullivan, 2018). For example, Suhler and Callender argue that there are evolutionary advantages in having stronger affective responses when thinking about the future because such responses facilitate appropriate planning and preparation for what has yet to happen, and that these affective responses may in turn result in temporal asymmetries in other types of judgments (such as value or moral significance).

Burns, McCormack, Jaroslawska, et al. (2019) examined whether children and adolescents (aged 14–18 years) showed the same sort of temporal asymmetries as adults for three different types of judgments: (i) judgments about the value of events; (ii) about the amount of emotion experienced when thinking about events: and (iii) about how close events felt in time. With regard to the first type of judgment, as a measure of children's valuations of future versus past events, children were asked about how much homework they would be prepared to do to get three extra days off school in the future, or how much they would have been prepared to do to get extra days off in the past. Burns, McCormack, Jaroslawska, et al. (2019) found that by the time children were 9 years of age, they gave greater estimates for future than past events, in line with data from adolescents and adults. Children were also asked to report their emotions when thinking about past or future points in time (e.g., Halloween), and even 6-year-olds reported stronger emotions when thinking about the future versus the past. Moreover, and most strikingly, children as young as 4–5 years judged that future events felt closer than past events. This pattern of results suggests that there are already past-future differences in the way that young children think about events; as children grow older, they start to resemble adults in caring more about future than past events, feeling stronger emotions when thinking about the future, and placing greater value on future than past events.

## 4.2 Focus on the future

Experience sampling methods have been used extensively with adults in order to try to understand the extent to which they focus cognitively on the future (e.g., Busby Grant & Walsh, 2016; Smallwood, Nind, & O'Connor, 2009; Smallwood et al., 2011; Spronken, Holland, Figner, & Ap, 2016). Laboratory-based research on mind-wandering typically uses a procedure in which participants completing another task are interrupted periodically and asked to report whether they are thinking about the past, present, or future. When task demands are low, adults report thinking about the future more often than the past (Baird, Smallwood, & Schooler, 2011). Outside of the laboratory, experience-sampling studies that probe individuals about what they are thinking about during their everyday lives provide evidence that people spend a great deal of time thinking about the future (Busby Grant & Walsh, 2016; Spronken et al., 2016).

Studies of adult mind wandering suggest that thinking about the future is more cognitively demanding than thinking about the past: when adults are engaged in a primary task that is more cognitively demanding, they do not show the tendency to think more about the future than the past (Smallwood et al., 2009, 2011). Moreover, Bertossi and Ciaramelli (2016) found that patients who had ventromedial prefrontal damage reported no future-oriented mind-wandering at all, probably due to difficulties with EFT (Bertossi, Candela, De Luca, & Ciaramelli, 2017). Taken together with developmental findings described in Section 2, these results make it plausible to predict that mind-wandering in children, who have more limited cognitive resources, may not show the same temporal focus as adults.

There are some developmental studies of mind-wandering that test this claim, but they show mixed findings. Zhang, Song, Ye, and Wang (2015) and Ye, Song, Zhang, and Wang (2014) conducted mind wandering studies with children aged from 8 to 14 years; in both studies, children reported thinking about the future around 25% of the time compared to thinking about the past 10–15% of the time, indicating the same tendency as adults during mind-wandering to think about the future. However, in a mind-wandering study with a broader range of age groups (i.e., 6- to 7-year-olds, 9- to 10-year-olds, adolescents aged 14–15 years, and adults), McCormack et al. (2019) found that only adults were more likely to report thinking about the future more than the past, and that age differences could not be explained in terms of working memory. McCormack et al.'s findings potentially provide some support for the idea that children and adolescents are less future-focused than adults. However, their findings need to be replicated, particularly in the light of their conflict with those of Zhang et al. (2015) and Ye et al. (2014). The reason for the conflicting findings is not clear. The most salient difference between the procedures used in these studies was that they used different primary tasks, with McCormack et al. using a relatively undemanding task (participants coloring in a picture), whereas the other studies used more cognitively challenging tasks. Given that studies with adults indicate that future focus is more likely to be found when the primary task is not demanding, if anything one might have predicted that

McCormack et al. would have been more likely to find a future focus reported by the participants in their study. Thus, as things stand, further developmental studies of mind wandering are required to resolve this issue.

One striking finding from the McCormack et al. (2019) study was the absence of a future focus in mind wandering even in the adolescent sample. We can turn to the broader literature on future orientation in adolescents to see to what extent this result is consistent with other findings. Using a self-report measure, McKay, Percy, Goudie, Sumnall, and Cole (2012) found that there was an increase across adolescence between 11 and 16 years in the amount of time reported spent thinking about the future. Park et al. (2017) examined the extent to which individuals focus on the future by looking at language use in social media, with messages classified in terms of whether they referred to past, present, or future time-periods. Interestingly, they found that there was an increase in future focus across adolescence from 13 years to adulthood, with a corresponding decrease in past and present focus. Thus, empirical research using a variety of techniques suggests that there is an increase across adolescence in the amount of time spent thinking about the future. As yet, we know little about such changes across childhood, but given that there is emerging evidence that appropriate experience sampling methods can be used with children, it is possible to address this issue empirically.

## 4.3 Future-oriented decision-making

At the root of the interest in children's "short-sightedness" is the idea that it prevents children from making decisions that are in their best interests in the longer term. Indeed, the most extensively-studied aspect of future-oriented behavior in the laboratory in both adults and children is future-oriented decision-making, specifically intertemporal choice (Loewenstein & Prelec, 1992; Read & Read, 2004), whereby participants must decide whether to take a smaller reward now or a wait for a larger reward. As with questionnaire studies on future orientation, there has been considerable research on intertemporal choice in adolescents (e.g., Alan & Ertac, 2018; Audrain-McGovern et al., 2009; Chesson et al., 2006; de Water, Cillessen, & Scheres, 2014; Khurana et al., 2015; Steinberg et al., 2009), again with much of this research attempting to identify individual differences that might be predictive of other developmental outcomes. Most of this research has used versions of the monetary temporal discounting task, in which participants complete a series of trials in which they choose between two hypothetical rewards, a smaller reward now or a larger reward a certain distance in the future. This task allows the calculation of the extent to which future rewards are discounted, typically examined as a function of the distance in the future at which the reward is located.

Studies examining intertemporal choice in children have typically used quite different procedures than those used with adolescents, involving real rather than hypothetical rewards, only one or two delay periods (usually much shorter than those used with adolescents), and many fewer trials (e.g., Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Labuschagne, Cox, Brown, & Scarf, 2017; Lemmon & Moore, 2007; Schwarz, Schrager, & Lyons, 1983). Recent studies of future-oriented decision-making in young children have also examined children's tendency to save a resource, rather than intertemporal choice per se (e.g., Atance, Metcalf, & Thiessen, 2017; Kamawar, Connolly, Astle-Rahim, Smygwaty, & Vendetti, 2019; Lee & Carlson, 2015).

One key issue in research on children's intertemporal choice is how to characterize the cognitive processes that underpin developmental change, with a particular focus on the extent to which performance reflects some aspect of control processes (e.g., Atance et al., 2017; Labuschagne et al., 2017; Lee & Carlson, 2015; Peverill, Garon, Brown, & Moore, 2017). However, in the literature on intertemporal choice in adults, two theoretical developments have brought aspects of temporal cognition itself to the fore when considering the processes that shape patterns of decisions. First, Boyer (2008) influentially argued that a primary function of EFT is to facilitate intertemporal choice, arguing that this form of cognition serves to make salient the emotional states associated with future rewards (see Bulley, Henry, & Suddendorf, 2016, for discussion). Evidence for this claim comes from studies that have shown that priming adults to engage in EFT during intertemporal choice tasks reduces the discounting of future rewards (e.g., Benoit, Gilbert, & Burgess, 2011; Peters & Büchel, 2010). Second, Kim and Zauberman (2009, 2019) have argued that how subjectively far away in the future a reward feels is closely related to the extent to which it is discounted (i.e., if a reward feels very distant, participants are less likely to decide to delay its receipt). Evidence for this claim comes from studies that show that there is a relation between adults' judgments of the subjective distance of future points in time and the way in which future rewards are discounted as a function of time (Kim & Zauberman, 2009, 2019; Zauberman, Kim, Malkoc, & Bettman, 2009). Both of these proposals have important developmental consequences that have not yet been fully tested, suggesting the hypothesis that the way in children represent and think about the future itself might contribute to developmental changes in future-oriented decision-making.

With regard to the role of EFT, studies with adolescents have provided support for the idea that EFT skills may play a role in intertemporal choice, reporting similar priming effects to those observed in adults (Bromberg, Lobatcheva, & Peters, 2017; Daniel, Said, Stanton, & Epstein, 2015), and finding that EFT skills are predictive of the degree of adolescents' discounting of future rewards (Bromberg et al., 2015; McCue et al., 2019). What is less clear is whether the developmental emergence of EFT earlier in childhood affects children's tendency to prefer immediate rewards.

In fact, Atance and Jackson (2009) found no relation between young children's performance on EFT measures and their performance on a delay maintenance task. In delay maintenance tasks, children must wait for a time period, and any point during the delay can terminate the wait and receive the smaller reward. This task differs from intertemporal choice tasks in which a choice cannot be revoked. Performance in delay maintenance tasks is likely to reflect children's ability to resist ongoing temptation, rather than being reflective of the extent to which future rewards are discounted. Thus, to test Boyer's (2008) theory it would be more appropriate to look at the relations between EFT and children's performance on intertemporal choice tasks.

An additional relevant study is that conducted by Chernyak, Leech, and Rowe (2017), which bears similarities to priming studies with adults. Young children discussed some future events with an experimenter for a fixed time period, and then completed a series of tasks, including an intertemporal choice task. Although discussing the future enhanced children's performance on some measures of future-oriented behavior (i.e., those involving planning), it did not affect their inter-temporal choices (see also Leech, Lemingruber, Warneken, and Rowe, 2019). We note, though, that in adult studies, EFT is cued on every trial immediately before participants make a choice, whereas there was just one priming session at the start of the test battery in Chernyak et al.'s study.

Burns, McCormack, O'Connor, et al. (2019) conducted a study in which they looked at the relation between children's performance on a set of EFT measures and an intertemporal choice task (i.e., small reward now versus large reward tomorrow). The EFT measures were a version of the spoon task, a verbal cueing measure in which children produced descriptions of future events, and Atance and Meltzoff's (2005) Picture Book task. The EFT measures did not correlate with each other, and after controlling for age and IQ, only the spoon task measure was related to performance on the intertemporal choice task. It is notable that this measure involves selecting and saving an object for use the next day, suggesting that the relation between intertemporal choice and this measure might be due to the common "saving" requirement. In a second study, Burns, McCormack, O'Connor, et al. (2019) used three cueing conditions, such that before making each intertemporal choice, children were cued to think about: (i) events due to happen the next day; (ii), events that had happened the previous day; or (iii) events that usually happen every day. These conditions were compared against a control condition in which no cues were used. Findings from adults suggest that future cueing enhances intertemporal choice. In fact, what Burns et al. found was that children performed worse in all the cueing conditions than in the control condition, suggesting that for young children the cognitive demands of thinking about non-current events may detract from their ability to make prudent choices.

In summary, as things stand, there is only limited evidence that the developmental emergence of EFT has an impact on children's future-oriented decision-making, and it is possible that the nature of the relation between EFT and intertemporal choice changes over the course of childhood as EFT skills themselves become more established. Nevertheless, studying development provides a useful context in which to test Boyer's (2008) hypothesis about EFT and future-oriented decision-making.

What about the second possible developmental hypothesis that can be derived from research on temporal discounting in adults (Kim & Zauberman, 2009, 2019), that subjective temporal distance of future points in time may have an impact on children's intertemporal choice? Assessing this idea properly involves using tasks that: (i) systematically manipulate the time period involved in such choices (in order to yield a time-based discounting function) and (ii) measure children's subjective temporal distance judgments, neither of which are straightforward. With regard to the first issue, it is not clear whether the standard temporal discounting task that varies delay period is appropriate for use with children (Staubitz, Lloyd, & Reed, 2018). Burns, Fay, et al. (2019) examined this issue by testing 7- to 9-year-olds using a child-friendly temporal discounting task in which children decided between an immediate monetary reward or a larger one from 7 to 180 days later; they used concrete pictures of the rewards and accompanying auditory descriptions of the choices. Burns, Fay, et al. (2019) were able to examine the extent to which children passed check trials and, also produced systematic data on the discounting task. These researchers found that around 70% of children seemed to engage with the task properly. Thus, in principle, it is possible to use this type of variable delay task with children, although with the caveat that care is taken to check whether each individual's data is suitable for inclusion.[b] Given the issue of subjective time estimates, in their study of temporal asymmetries Burns, McCormack, Jaroslawska, et al. (2019) showed that children as young as 4–5 years can make basic judgments about the subjective distance of events in the past versus the future. We are currently exploring, with somewhat older children, the extent to which more nuanced subjective distance judgments can be made about the relative distances of future time-periods and also examining how these relate to patterns of decisions on a child-friendly temporal discounting task. The findings from these studies will shed additional light on how the way children think about time relates to their future-oriented decision-making.

## 5. Conclusions and future directions

In this chapter, we have outlined how recent empirical advances mean that we now know much more about children's future-oriented cognition than was known a decade ago. Thinking about the future is challenging to young children and continues to improve into adolescence. Nevertheless, there is also evidence than even 3-year-olds can prepare for what is to come (Atance et al., 2019; Caza & Atance, 2019), although whether this involves EFT is not yet clear. An understanding of the nature of the future itself—as a linear array of times in which many possible events could unfold—is likely to emerge gradually over the preschool period. Once children possess this understanding, the extent to which the future is valued and prioritized appears to increase developmentally into adolescence. However, even 6-year-olds report that future events feel closer than events in the past and report stronger emotions when thinking about the future compared to the past, indicating that things that have yet to happen have significance in their mental lives.

Despite this growing body of empirical trends, there is still much left to explore about the development of future-oriented cognition in children. First, we still know relatively little about the broader developmental importance of changes in future thinking in childhood. Notably, despite the focus

[b] See Burns, Fay, et al. (2019) for inclusion criteria in detail; these included whether children gave appropriate answers on control trials and whether children produced data on the discounting task that were systematic with respect to the effect of temporal duration.

on research on EFT, little is yet known about how the emergence of EFT impacts other aspects of children's thinking and behavior. Progress here is hampered by lack of agreement about how best to measure EFT in young children. We have suggested that empirical studies with young children could potentially be re-focused around questions regarding children's temporal concepts, rather than trying to establish when children can mentally simulate or "pre-experience" the future. However, measuring children's understanding of time is itself far from empirically straightforward. While we have outlined some of the elements of temporal understanding, we are aware that there are few paradigms that directly examine these components. Given how fundamental the ability to represent and think about time is in people's mental lives, developing such paradigms would constitute valuable progress.

Once future-oriented cognition is considered within the broader context of the ability to represent and think about time itself, novel directions for empirical research with older children also emerge. As we have described, there are already tasks that will allow a more detailed examination of the extent to which children focus on the future, care about it, and prioritize it when making decisions. But interesting issues can also be raised regarding how these facets of future orientation are linked to the way time itself is represented. Thus, we conclude by giving three examples.

First, we have already mentioned that we are currently examining the idea that the subjective temporal distance of future points in time may affect the types of intertemporal choices children make. Second, an issue we have not considered here, but which is the subject of considerable attention in the adult temporal representation literature, is the way in which regions of time are mapped on to space (Bender & Beller, 2014; Núñez & Cooperrider, 2013). Once children acquire conventional time-space mappings (in many cultures, the future is represented as stretching out in front of the body, Caruso et al., 2013) research can ask whether this impacts the way children plan or prepare for the future. And third, children's gradual acquisition of mastery of the clock and calendar system has been studied (Friedman, 1982), but nothing is known about whether this acquisition of a very powerful means of representing time changes other aspects of children's mental lives, and whether this too impacts how children consider and prepare for the future. The ways that children think about and represent time is likely to have far-reaching developmental effects and considering such effects may provide a useful framework to guide the study of developmental processes of future-oriented cognition.

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## References


Abram, M., Picard, L., Navarro, B., & Piolino, P. (2014). Mechanisms for remembering the past and imagining the future—New data from autobiographical memory tasks in a lifespan approach. *Consciousness and Cognition*, *29*, 76–89. https://doi.org/10.1016/j.concog.2014.07.011.

Addis, D. R., Pan, L., Vu, M. A., Laiser, N., & Schacter, D. L. (2009). Constructive episodic simulation of the future and the past: Distinct subsystems of a core brain network mediate imagining and remembering. *Neuropsychologia*, *47*(11), 2222–2238. https://doi.org/10.1016/j.neuropsychologia.2008.10.026.

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

Alan, S., & Ertac, S. (2018). Fostering patience in the classroom: Results from a randomized educational intervention. *Journal of Political Economy*, *126*, 1865–1911. https://doi.org/10.1086/699007.

Andretta, J. R., Worrell, F. C., Mello, Z. R., Dixson, D. D., & Baik, S. H. (2013). Demographic group differences in adolescents' time attitudes. *Journal of Adolescence*, *36*, 289–301. https://doi.org/10.1016/j.adolescence.2012.11.005.

Apostolidis, T., Fieulaine, N., & Soulé, F. (2006). Future time perspective as predictor of cannabis use: Exploring the role of substance perception among French adolescents. *Addictive Behaviors*, *31*, 2339–2343. https://doi.org/10.1016/j.addbeh.2006.03.008.

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

Atance, C. M., & Jackson, L. K. (2009). The development and coherence of future-oriented behaviors during the preschool years. *Journal of Experimental Child Psychology*, *102*, 379–391. https://doi.org/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. https://doi.org/10.1016/j.jecp.2014.09.001.

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. https://doi.org/10.1016/j.cogdev.2005.05.001.

Atance, C. M., & Meltzoff, A. N. (2006). Preschoolers' current desires warp their choices for the future. *Psychological Science*, *17*(7), 583–587. https://doi.org/10.1111/j.1467-9280.2006.01748.x.

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

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

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

Audrain-McGovern, J., Rodriguez, D., Epstein, L. H., Cuevas, J., Rodgers, K., & Wileyto, E. P. (2009). Does delay discounting play an etiological role in smoking or is it a consequence of smoking? *Drug and Alcohol Dependence*, *103*, 99–106. https://doi.org/10.1016/j.drugalcdep.2008.12.019.

Baird, B., Smallwood, J., & Schooler, J. W. (2011). Back to the future: Autobiographical planning and the functionality of mind-wandering. *Consciousness and Cognition*, *20*, 1604–1611. https://doi.org/10.1016/j.concog.2011.08.007.

Beck, S. R., Robinson, E. J., Carroll, D. J., & Apperly, I. A. (2006). Children's thinking about counterfactuals and future hypotheticals as possibilities. *Child Development*, 77, 413–426. https://doi.org/10.1111/j.1467-8624.2006.00879.x.

Bender, A., & Beller, S. (2014). Mapping spatial frames of reference onto time: A review of theoretical accounts and empirical findings. *Cognition*, *132*, 342–382. https://doi.org/10.1016/j.cognition.2014.03.016.

Benoit, R. G., Gilbert, S. J., & Burgess, P. W. (2011). A neural mechanism mediating the impact of episodic prospection on farsighted decisions. *Journal of Neuroscience*, *31*, 6771–6779. https://doi.org/10.1523/JNEUROSCI.6559-10.2011.

Bertossi, E., Candela, V., De Luca, F., & Ciaramelli, E. (2017). Episodic future thinking following vmpfc damage: Impaired event construction, maintenance, or narration? *Neuropsychology*, *31*(3), 337–348. https://doi.org/10.1037/neu0000345.

Bertossi, E., & Ciaramelli, E. (2016). Ventromedial prefrontal damage reduces mind-wandering and biases its temporal focus. *Social Cognitive and Affective Neuroscience*, *11*(11), 1783–1791. https://doi.org/10.1093/scan/nsw099.

Boyer, P. (2008). Evolutionary economics of mental time travel? *Trends in Cognitive Sciences*, *12*, 219–224. https://doi.org/10.1016/j.tics.2008.03.003.

Bromberg, U., Lobatcheva, M., & Peters, J. (2017). Episodic future thinking reduces temporal discounting in healthy adolescents. *PLoS One, 12*. e0188079. https://doi.org/10.1371/journal.pone.0188079.

Bromberg, U., Wiehler, A., & Peters, J. (2015). Episodic future thinking is related to impulsive decision making in healthy adolescents. *Child Development*, *86*, 1458–1468. https://doi.org/10.1111/c.dev.12390.

Bulley, A., Henry, J., & Suddendorf, T. (2016). Prospection and the present moment: The role of episodic foresight in intertemporal choices between immediate and delayed rewards. *Review of General Psychology*, *20*, 29–47. https://doi.org/10.1037/gpr0000061.

Burns, Z. C., Caruso, E. M., & Bartels, D. M. (2012). Predicting premeditation: Future behavior is seen as more intentional than past behavior. *Journal of Experimental Psychology: General*, *141*, 227–232. https://doi.org/10.1037/a0024861.

Burns, P., Fay, O., McCafferty, M., McKeever, V., Atance, C., & McCormack, T. (2019). Examining children's ability to delay reward: Is the delay discounting task a suitable measure? *Journal of Behavioral Decision Making*. https://doi.org/10.1002/bdm.2154.

Burns, P., McCormack, T., Jaroslawska, A., Fitzpatrick, A., McGourty, J., & Caruso, E. M. (2019). The development of asymmetries in past and future thinking. *Journal of Experimental Psychology: General*, *148*, 272–288. https://doi.org/10.1037/xge0000464.

Burns, P., McCormack, T., O'Connor, P., Fitzpatrick, A., & Atance, C. (2019). *The effect of future thinking on delay of gratification in young children*. Manuscript submitted for publication.

Burns, P., & Russell, J. (2016). Children's predictions of future perceptual experiences: Temporal reasoning and phenomenology. *Developmental Psychology*, *52*(11), 1820–1831. https://doi.org/10.1037/dev0000197.

Busby Grant, J., & Walsh, E. (2016). Exploring the use of experience sampling to assess episodic thought. *Applied Cognitive Psychology*, *30*, 472–478. https://doi.org/10.1002/acp.3215.

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

Callender, C. (2017). *What makes time special?* Oxford, England: Oxford University Press.

Caouette, J., Wohl, J. A., & Peetz, J. (2012). The future weighs heavier than the past: Collective guilt, perceived control and the influence of time. *European Journal of Social Psychology*, *42*, 363–371. https://doi.org/10.1002/ejsp.1857.

Caruso, E. M. (2010). When the future feels worse than the past: A temporal inconsistency in moral judgment. *Journal of Experimental Psychology: General*, *139*, 610–624. https://doi.org/10.1037/a0020757.

Caruso, E. M., Gilbert, D. T., & Wilson, T. D. (2008). A wrinkle in time - asymmetric valuation of past and future events. *Psychological Science*, *19*, 796–801. https://doi.org/10.1111/j.1467-9280.2008.02159.x.

Caruso, E. M., Van Boven, L., Chin, M., & Ward, A. (2013). The temporal Doppler effect: When the future feels closer than the past. *Psychological Science*, *24*, 530–536. https://doi.org/10.1177/0956797612458804.

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

Cheke, L. G., & Clayton, N. S. (2019). What is the role of episodic foresight in planning for future needs? Theory and two experiments. *Quarterly Journal of Experimental Psychology*, *72*, 1961–1976. https://doi.org/10.1177/1747021818820808.

Chen, P., & Vazsonyi, A. T. (2011). Future orientation, impulsivity, and problem behaviors: A longitudinal moderation model. *Developmental Psychology*, *47*, 1633–1645. https://doi.org/10.1037/a0025327.

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

Chesson, H. W., Leichliter, J. S., Zimet, G. D., Rosenthal, S. L., Bernstein, D. I., & Fife, K. H. (2006). Discount rates and risky sexual behaviors among teenagers and young adults. *Journal of Risk and Uncertainty*, *32*, 217–230. https://doi.org/10.1007/s11166-006-9520-1.

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. https://doi.org/10.1016/j.cogdev.2014.02.001.

Coughlin, C., Robins, R. W., & Ghetti, S. (2017). Development of episodic prospection: Factors underlying improvement in middle and late childhood. *Child Development*, *90*, 1109–1122. https://doi.org/10.1111/cdev.13001.

Cromer, R. F. (1971). The development of the ability to decenter in time. *British Journal of Psychology*, *62*(3), 353–365. https://doi.org/10.1111/j.2044-8295.1971.tb02046.x.

Cuevas, K., Rajan, V., Morasch, K. C., & Bell, M. A. (2015). Episodic memory and future thinking during early childhood: Linking the past and future. *Developmental Psychobiology*, *57*(5), 552–565. https://doi.org/10.1002/dev.21307.

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

de Water, E., Cillessen, A. H. N., & Scheres, A. (2014). Distinct age-related differences in temporal discounting and risk taking in adolescents and young adults. *Child Development*, *85*, 1881–1897. https://doi.org/10.1111/cdev.12245.

Dickerson, K. L., Ainge, J. A., & Seed, A. M. (2018). The role of association in pre-schoolers' solutions to "spoon tests" of future planning. *Current Biology*, *28*, 2309–2313. https://doi.org/10.1016/j.cub.2018.05.052.

Dufour, V., & Sterck, E. H. M. (2008). Chimpanzees fail to plan in an exchange task but succeed in a tool-using procedure. *Behavioural Processes*, *79*, 19–27. https://doi.org/10.1016/j.beproc.2008.04.003.

Friedman, W. J. (1982). Conventional time concepts and children's structuring of time. In W. J. Friedman (Ed.), *The developmental psychology of time* (pp. 171–208). New York, NY: Academic Press.
Friedman, W. J. (1989). The representation of temporal structure in children, adolescents, and adults. In I. Levin & D. Zakay (Eds.), *Time and human cognition: A life-span perspective* (pp. 259–304). Amsterdam, The Netherlands: Elsevier.
Gan, Y., Miao, M., Zheng, L., & Liu, H. (2016). Temporal Doppler effect and future orientation: Adaptive functions and moderating conditions. *Journal of Personality*, *85*, 313–325. https://doi.org/10.1111/jopy.12242.
Ghetti, S., & Coughlin, C. (2018). Stuck in the present? Constraints on children's episodic prospection. *Trends in Cognitive Sciences*, *22*(10), 846–850. https://doi.org/10.1016/j.tics.2018.07.013.
Gilbert, D. T., & Wilson, T. D. (2007). Prospection: Experiencing the future. *Science*, *317*, 1351–1354. https://doi.org/10.1126/science.1144161.
Gott, C., & Lah, S. (2014). Episodic future thinking in children compared to adolescents. *Child Neuroscience: A Journal on Normal and Abnormal Development in Childhood and Adolescence*, *20*, 625–640. https://doi.org/10.1080/09297049.2013.840362.
Greene, A. (1986). Future-time perspective in adolescence: The present of things future revisited. *Journal of Youth and Adolescence*, *15*, 99–113. https://doi.org/10.1007/BF02141732.
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. https://doi.org/10.1016/j.cogdev.2011.09.006.
Hoerl, C., & McCormack, T. (2019). Thinking in and about time: A dual systems perspective on temporal cognition. *Behavioral and Brain Sciences*, *42*, 1–77. https://doi.org/10.1017/S0140525X18002157.
Hongwanishkul, D., Happaney, K. R., Lee, W. S., & Zelazo, P. D. (2005). Assessment of hot and cool executive function in young children: Age-related changes and individual differences. *Developmental Neuropsychology*, *28*, 617–644. https://doi.org/10.1207/s15326942dn2802_4.
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. https://doi.org/10.1016/B978-0-12-386491-8.00003-7.
Kabadayi, C., & Osvath, M. (2017). Ravens parallel great apes in flexible planning for tool-use and bartering. *Science*, *357*(6347), 202–204. https://doi.org/10.1126/science.aam8138.
Kamawar, D., Connolly, K., Astle-Rahim, A., Smygwaty, S., & Vendetti, C. (2019). Preschoolers' saving behavior: The role of planning and self-control. *Child Development*, *90*(4), e407–e420. https://doi.org/10.1111/cdev.13037.
Khurana, A., Romer, D., Betancourt, L. M., Brodsky, N. L., Giannetta, J. M., & Hurt, H. (2015). Experimentation versus progression in adolescent drug use: A test of an emerging neurobehavioral imbalance model. *Development and Psychopathology*, *27*, 901–913. https://doi.org/10.1017/S0954579414000765.
Kim, B. K., & Zauberman, G. (2009). Perception of anticipatory time in temporal discounting. *Journal of Neuroscience, Psychology, and Economics*, *2*, 91–101. https://doi.org/10.1037/a0017686.
Kim, B. K., & Zauberman, G. (2019). Psychological time and intertemporal preference. *Current Opinion in Psychology*, *26*, 90–93. https://doi.org/10.1016/j.copsyc.2018.06.005.
Kramer, H. J., Goldfarb, D., Tashjian, S. M., & Lagattuta, K. H. (2017). "These pretzels are making me thirsty": Older children and adults struggle with induced-state episodic foresight. *Child Development*, *88*(5), 1554–1562. https://doi.org/10.1111/cdev.12700.

Labuschagne, L. G., Cox, T. J., Brown, K., & Scarf, D. (2017). Too cool? Symbolic but not iconic stimuli impair 4-year-old children's performance on the delay-of-gratification choice paradigm. *Behavioural Processes*, *135*, 36–39. https://doi.org/10.1016/j.beproc.2016.11.014.

Lee, W. S., & Carlson, S. M. (2015). Knowing when to be "rational": Flexible economic decision making and executive function in preschool children. *Child Development*, *86*(5), 1434–1448. https://doi.org/10.1111/cdev.12401.

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. https://doi.org/10.1016/j.jecp.2018.12.008.

Lemmon, K., & Moore, C. (2007). The development of prudence in the face of varying future rewards. *Developmental Science*, *10*, 502–511. https://doi.org/10.1111/j.1467-7687.2007.00603.x.

Lessing, E. E. (1972). Extension of personal future time perspective, age, and life satisfaction of children and adolescents. *Developmental Psychology*, *6*(3), 457–468. https://doi.org/10.1037/h0032576.

Lewis, C. C. (1981). How adolescents approach decisions: Changes over grades seven to twelve and policy implications. *Child Development*, *52*, 538–544. https://doi.org/10.2307/1129172.

Loewenstein, G., & Prelec, D. (1992). Anomalies in intertemporal choice: Evidence and an interpretation. *The Quarterly Journal of Economics*, *107*(2), 573–597. https://doi.org/10.2307/2118482.

Madore, K. P., Gaesser, B., & Schacter, D. L. (2014). Constructive episodic simulation: Dissociable effects of a specificity induction on remembering, imagining, and describing in young and older adults. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *40*(3), 609. https://doi.org/10.1037/a0034885.

Mahy, C. E., Grass, J., Wagner, S., & Kliegel, M. (2014). These pretzels are going tomake me thirsty tomorrow: Differential development of hot and cool episodic foresight in early childhood? *British Journal of Developmental Psychology*, *32*(1), 65–77. https://doi.org/10.1111/bjdp.12023.

Martin-Ordas, G. (2017). 'Will I want these stickers tomorrow?' Preschoolers' ability to predict current and future needs. *British Journal of Developmental Psychology*, *35*(4), 568–581. https://doi.org/10.1111/bjdp.12195.

Mazachowsky, T. R., & Mahy, C. E. V. (2020). Construction of the children's future thinking questionnaire: A reliable and valid parent-report measure of children's future oriented cognition. *Developmental Psychology*. https://doi.org/10.1037/dev0000885.

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

McCormack, T. (2015). The development of temporal cognition. In R. M. Lerner, L. S. Liben, & U. Mueller (Eds.), *Vol. 2. Handbook of child psychology and developmental science, volume 2: Cognitive processes* (7th ed., pp. 624–670). Hoboken, New Jersey: Wiley-Blackwell.

McCormack, T., & Atance, C. M. (2011). Planning in young children: A review and synthesis. *Developmental Review*, *31*(1), 1–31. https://doi.org/10.1016/j.dr.2011.02.002.

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*(4), 774–787. https://doi.org/10.1007/s00426-018-1077-5.

McCormack, T., & Hoerl, C. (2005). Children's reasoning about the causal significance of the temporal order of events. *Developmental Psychology*, *41*(1), 54–63. https://doi.org/10.1037/0012-1649.41.1.54.

McCormack, T., & Hoerl, C. (2007). Young children's reasoning about the order of past events. *Journal of Experimental Child Psychology*, *98*(3), 168–183. https://doi.org/10.1016/j.jecp.2007.06.001.
McCormack, T., & Hoerl, C. (2017). The development of temporal concepts: Learning to locate events in time. *Timing and Time Perception*, *5*(3–4), 297–327. https://doi.org/10.1163/22134468-00002094.
McCue, R., McCormack, T., McElnay, J., Alto, A., & Feeney, A. (2019). The future and me: Imagining the future and the future self in adolescent decision making. *Cognitive Development*, *50*, 142–156. https://doi.org/10.1016/j.cogdev.2019.04.001.
McKay, M. T., Andretta, J. R., Magee, J., & Worrell, F. C. (2014). What do temporal profiles tell us about adolescent alcohol use? Results from a large sample in the United Kingdom. *Journal of Adolescence*, *37*(8), 1319–1328. https://doi.org/10.1016/j.adolescence.2014.09.008.
McKay, M. T., Percy, A., Goudie, A. J., Sumnall, H. R., & Cole, J. C. (2012). The temporal focus scale: Factor structure and association with alcohol use in a sample of Northern Irish school children. *Journal of Adolescence*, *35*(5), 1361–1368. https://doi.org/10.1016/j.adolescence.2012.05.006.
McKay, M. T., Perry, J. L., Cole, J. C., & Magee, J. (2017). Adolescents consider the future differently depending on the domain in question: Results of an exploratory study in the United Kingdom. *Personality and Individual Differences*, *104*, 448–452. https://doi.org/10.1016/j.paid.2016.09.002.
McKay, M. T., Perry, J. L., Cole, J. C., & Worrell, F. C. (2018). What time is it? Temporal psychology measures relate differently to alcohol-related health outcomes. *Addiction Research and Theory*, *26*, 20–27. https://doi.org/10.1080/16066359.2017.1309032.
Mello, Z. R., & Worrell, F. C. (2006). The relationship of time perspective to age, gender, and academic achievement among academically talented adolescents. *Journal for the Education of the Gifted*, *29*, 271–289. https://doi.org/10.1177/016235320602900302.
Mello, Z. R., & Worrell, F. C. (2015). The past, the present, and the future: A conceptual model of time perspective in adolescence. In M. Stolarski, N. Fieulaine, & W. van Beek (Eds.), *Time perspective theory; Review, research and application*. Cham: Springer. https://doi.org/10.1007/978-3-319-07368-2_7.
Miller, K., Holcombe, A., & Latham, A. J. (2018). Temporal phenomenology: Phenomenological illusion versus cognitive error. *Synthese*. https://doi.org/10.1007/s11229-018-1730-y.
Moffett, L., Moll, H., & Fitz Gibbon, L. (2018). Future planning in preschool children. *Developmental Psychology*, *54*(5), 866–874. https://doi.org/10.1037/dev0000484.
Mulcahy, N. J., & Call, J. (2006). Apes save tools for future use. *Science*, *312*(5776), 1038–1040. https://doi.org/10.1126/science.1125456.
Núñez, R., & Cooperrider, K. (2013). The tangle of space and time in human cognition. *Trends in Cognitive Sciences*, *17*, 220–229. https://doi.org/10.1016/j.tics.2013.03.008.
Nurmi, J. E. (1991). How do adolescents see their future? A review of the development of future orientation and planning. *Developmental Review*, *11*, 1–59. https://doi.org/10.1016/0273-2297(91)90002-6.
Osvath, M., & Osvath, H. (2008). Chimpanzee (Pan troglodytes) and orangutan (Pongo abelii) forethought : Self-control and pre-experience in the face of future tool use. *Animal Cognition*, *11*(4), 661–674. https://doi.org/10.1007/s10071-008-0157-0.
Park, G., Schwartz, H. A., Sap, M., Kern, M. L., Weingarten, E., Eichstaedt, J. C., et al. (2017). Living in the past, present, and future: Measuring temporal orientation with language. *Journal of Personality*, *85*(2), 270–280. https://doi.org/10.1111/jopy.12239.
Peetsma, T., & Van der Veen, I. (2011). Relations between the development of future time perspective in three life domains, investment in learning, and academic achievement. *Learning and Instruction*, *21*(3), 481–494. https://doi.org/10.1016/j.learninstruc.2010.08.001.

Peters, J., & Büchel, C. (2010). Episodic future thinking reduces reward delay discounting through an enhancement of prefrontal-mediotemporal interactions. *Neuron*, *66*, 138–148. https://doi.org/10.1016/j.neuron.2010.03.026.
Peverill, S., Garon, N., Brown, A., & Moore, C. (2017). Depleting and motivating self-regulation in preschoolers. *Cognitive Development*, *44*, 116–126. https://doi.org/10.1016/j.cogdev.2017.09.005.
Prosser, S. (2016). *Experiencing time*. Oxford, England: Oxford University Press.
Quon, E., & Atance, C. M. (2010). A comparison of preschoolers' memory, knowledge and anticipation of events. *Journal of Cognition and Development*, *11*, 37–60. https://doi.org/10.1080/15248370903453576.
Read, D., & Read, N. L. (2004). Time discounting over the lifespan. *Organizational Behavior and Human Decision Processes*, *94*(1), 22–32. https://doi.org/10.1016/j.obhdp.2004.01.002.
Redshaw, J., & Suddendorf, T. (2013). Foresight beyond the very next event: Four-year-olds can link past and deferred future episodes. *Frontiers in Psychology*, *4*, 404. https://doi.org/10.3389/fpsyg.2013.00404.
Redshaw, J., & Suddendorf, T. (2016). Children's and apes' preparatory responses to two mutually exclusive possibilities. *Current Biology*, *26*, 1758–1762. https://doi.org/10.1016/j.cub.2016.04.062.
Redshaw, J., Suddendorf, T., Neldner, K., Wilks, M., Tomaselli, K., Mushin, I., et al. (2019). Young children from three diverse cultures spontaneously and consistently prepare for alternative future possibilities. *Child Development*, *90*(1), 51–61. https://doi.org/10.1111/cdev.13084.
Redshaw, J., Taylor, A. H., & Suddendorf, T. (2017). Flexible planning in ravens? *Trends in Cognitive Sciences*, *21*(11), 821–822. https://doi.org/10.1016/j.tics.2017.09.001.
Rinaldi, L., Locati, F., Parolin, L., & Girelli, L. (2017). Distancing the present self from the past and the future: Psychological distance in anxiety and depression. *The Quarterly Journal of Experimental Psychology*, *70*, 1106–1113. https://doi.org/10.1080/17470218.2016.1271443.
Robbins, R. N., & Bryan, A. (2004). Relationships between future orientation, impulsive sensation seeking, and risk behavior among adjudicated adolescents. *Journal of Adolescent Research*, *19*, 428–445. https://doi.org/10.1177/0743558403258860.
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. https://doi.org/10.1016/j.cognition.2009.08.013.
Scarf, D., Gross, J., Colombo, M., & Hayne, H. (2013). To have and to hold: Episodic memory in 3- and 4-year-old children. *Developmental Psychobiology*, *55*(2), 125–132. https://doi.org/10.1002/dev.21004.
Scarf, D., Smith, C., & Stuart, M. (2014). A spoon full of studies helps the comparison go down: A comparative analysis of Tulving's spoon test. *Frontiers in Psychology*, *5*, 893. https://doi.org/10.3389/fpsyg.2014.00893.
Schacter, D. L., & Addis, D. R. (2007). The cognitive neuroscience of constructive memory: Remembering the past and imagining the future. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *362*(1481), 773–786. https://doi.org/10.1098/rstb.2007.2087.
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. https://doi.org/10.1038/nrn2213.
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. https://doi.org/10.1016/j.neuron.2012.11.001.
Schacter, D. L., & Madore, K. P. (2016). Remembering the past and imagining the future: Identifying and enhancing the contribution of episodic memory. *Memory Studies*, *9*(3), 245–255. https://doi.org/10.1177/1750698016645230.

Schwarz, J. C., Schrager, J. B., & Lyons, A. E. (1983). Delay of gratification by preschoolers: Evidence for the validity of the choice paradigm. *Child Development*, 620–625. https://doi.org/10.2307/1130048.

Seginer, R. (2003). Adolescent future orientation: An integrated cultural and ecological perspective. *Online Readings in Psychology and Culture*, *6*, 1–13. https://doi.org/10.9707/2307-0919.1056. International Association for Cross-Cultural Psychology.

Seginer, R. (2009). *Future orientation: Developmental and ecological perspectives*. Springer. https://doi.org/10.1007/b106810.

Shipp, A. J., & Aeon, B. (2019). Temporal focus: Thinking about the past, present, and future. *Current Opinion in Psychology*, *26*, 37–43. https://doi.org/10.1016/j.copsyc.2018.04.005.

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

Smallwood, J., Schooler, J. W., Turk, D. J., Cunningham, S. J., Burns, P., & Macrae, C. N. (2011). Self-reflection and the temporal focus of the wandering mind. *Consciousness and Cognition*, *20*(4), 1120–1126. https://doi.org/10.1016/j.concog.2010.12.017.

So, S., Voisin, D. R., Burnside, A., & Gaylord-Harden, N. K. (2016). Future orientation and health related factors among African American adolescents. *Children and Youth Services Review*, *61*, 15–21. https://doi.org/10.1016/j.childyouth.2015.11.026.

Spronken, M., Holland, R. W., Figner, B., & Ap, D. (2016). Temporal focus, temporal distance, and mind-wandering valence: Results from an experience sampling and an experimental study. *Consciousness and Cognition*, *41*, 104–118. https://doi.org/10.1016/j.concog.2016.02.004.

Staubitz, J. L., Lloyd, B. P., & Reed, D. D. (2018). A summary of methods for measuring delay discounting in young children. *The Psychological Record*, *68*, 239–253. https://doi.org/10.1007/s40732-018-0292-1.

Steinberg, L., O'Brien, L., Cauffman, E., Graham, S., Woolard, J., & Banich, M. (2009). Age differences in future orientation and delay discounting. *Child Development*, *80*, 28–44. https://doi.org/10.1111/j.1467-8624.2008.01244.x.

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

Suddendorf, T., & Corballis, M. C. (2010). Behavioural evidence for mental time travel in nonhuman animals. *Behavioural Brain Research*, *215*(2), 292–298. https://doi.org/10.1016/j.bbr.2009.11.044.

Suddendorf, T., Crimston, J., & Redshaw, J. (2017). Preparatory responses to socially determined, mutually exclusive possibilities in chimpanzees and children. *Biology Letters*, *13*(6), 20170170. https://doi.org/10.1098/rsbl.2017.0170.

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. https://doi.org/10.1111/j.1467-7687.2010.00950.x.

Suddendorf, T., Watson, K., Bogaart, M., & Redshaw, J. (2019). Preparation for certain and uncertain future outcomes in young children and three species of monkey. *Developmental Psychobiology*. https://doi.org/10.1002/dev.21898.

Suhler, C., & Callender, C. (2012). Thank goodness that argument is over: Explaining the temporal value asymmetry. *Philosophers' Imprint*, *12*, 1–16. http://hdl.handle.net/2027/spo.3521354.0012.0315.

Sullivan, M. (2018). *Time biases: A theory of rational planning and personal persistence*. Oxford, England: Oxford University Press.

Szpunar, K. K., & McDermott, K. B. (2008). Episodic future thought and its relation to remembering: Evidence from ratings of subjective experience. *Consciousness and Cognition*, *17*(1), 330–334. https://doi.org/10.1016/j.concog.2007.04.006.

Tillman, K. A., Marghetis, T., Barner, D., & Srinivasan, M. (2017). Today is tomorrow's yesterday: Children's acquisition of deictic time words. *Cognitive Psychology*, *92*, 87–100. https://doi.org/10.1016/j.cogpsych.2016.10.003.

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* (pp. 3–56). New York, USA: Oxford University Press.

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. https://doi.org/10.1080/15248372.2013.784977.

Ye, Q., Song, X., Zhang, Y., & Wang, Q. (2014). Children's mental time travel during mind wandering. *Frontiers in Psychology, 5*. https://doi.org/10.3389/fpsyg.2014.00927.

Zauberman, G., Kim, B. K., Malkoc, S. A., & Bettman, J. R. (2009). Discounting time and time discounting: Subjective time perception and intertemporal preferences. *Journal of Marketing Research*, *46*, 543–556. https://doi.org/10.1509/jmkr.46.4.543.

Zhang, Y., Song, X. L., Ye, Q., & Wang, Q. Q. (2015). Children with positive attitudes towards mind-wandering provide invalid subjective reports of mind-wandering during an experimental task. *Consciousness and Cognition*, *35*, 136–142. https://doi.org/10.1016/j.concog.2015.05.006.

Zimbardo, P. G., & Boyd, J. N. (1999). Putting time in perspective: A valid, reliable individual-differences metric. *Journal of Personality and Social Psychology*, *77*, 1271–1288. https://doi.org/10.1037/0022-3514.77.6.1271.