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My future self: Young children's ability to anticipate and explain future states

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Abstract

Two experiments examine preschool-aged children's ability to anticipate physiological states of the self. One hundred and eight 3-, 4-, and 5-year-olds were presented with stories and pictorial scenes designed to evoke thought about future states such as thirst, cold, and hunger. They were asked to imagine themselves in these scenarios and to choose one item from a set of three that they would need. Only one of the items could be used to address the future state. In both experiments, developmental differences were obtained for correct item choices and types of verbal explanations. In Experiment 2, the performance of the 3- and 4-year-olds was negatively affected by introducing items that were semantically associated with the scenarios but did not address the future state, whereas the 5-year-olds' performance was not. Results are discussed with respect to children's understanding of the future, theory of mind, and inhibitory control skills.

Keywords: Cognitive development; Future thinking; Self; Explanations

Thinking about the future is an integral aspect of human cognition. Much of our behavior is future-oriented. For instance, in choosing a career path, we may anticipate how the various options will contribute to our future happiness and success. We then modify our present actions to bring about these future goals. In this example, we are predicting the emotional consequences, or states, that our particular career choice will engender. However, there are other states, in addition to emotional ones, that are important for us to anticipate. For example, we may anticipate how our behavior will affect our own, or another's, mental state

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(e.g., "what will he *think* if I do X?"). Perhaps at the most basic level, we may anticipate how an event will lead to a particular physiological state of the self (e.g., "Will I be *hungry* during the interview if I don't eat breakfast?"). The ability to predict that an event will lead to a future state—emotional, mental, physiological, and other is one of the most highly adaptive aspects of human cognition. It is often argued to be unique to humans (e.g., Roberts, 2002; Suddendorf & Busby, 2003).

From a developmental perspective, we might expect that children's ability to reflect on their own physiological states would emerge prior to the ability to reflect on their own mental states. Indeed, there is evidence that during the third year of life, children most often talk about their own physiological states, with talk about their own emotional, and mental, states being less common (Bretherton & Beeghly, 1982). However, less attention has been directed to children's talk and behavior as these pertain to states that might occur in the *future*. Thus, we know little about children's ability to anticipate future states of the self, or their knowledge about the events that may give rise to these states.

The ability to adopt perspectives on the future self is an important aspect of the mature theory of mind (cf. Suddendorf & Busby, 2003; Suddendorf & Corballis, 1997). However, traditional theory of mind research has mainly explored children's use of mental states, such as beliefs and desires, to explain and predict others' behavior in the present or past. Children's ability to make predictions about their *own future* states – states that differ from their current ones – has been largely ignored, despite the centrality of future thinking in the adult framework. For instance, can children anticipate that walking a long distance in the hot sun will lead to the physiological state of thirst, or that walking on wet rocks may lead to falling and hence the physiological state of hurt? Exploring young children's ability to anticipate how various situations can lead to particular physiological states of the self is the goal of the current research.

1. Conceptual distinctions

There is both theoretical and empirical work that can be brought to bear in trying to discern what children know about the future. This research has not received systematic review and organization, and we begin by drawing some conceptual distinctions that we believe help to structure the area and its literature. First, we focus on studies that have explored children's future-oriented language followed by those which have explored their future-oriented behavior. In discussing language, we note the difference between children's talk about familiar/routine events, and their talk about more personally relevant, or episodic (e.g., Tulving, 1984), events. In discussing behavior, we distinguish between planning, delay of gratification, and anticipation. We use these distinctions as a basis for proposing a new method for assessing children's understanding of the future that examines their anticipation skills in novel contexts involving the self.

1.1. Future-oriented language

By 3 years of age, children talk both about familiar/routine events as well as events that hold more personal significance. Following Tulving (1984), the latter could be thought of as more "episodic" in nature. In terms of the former, 3-year-olds can provide scripts of what typically happens when you go to McDonald's or when you bake cookies (e.g., Hudson, Fivush, & Kuebli, 1992). Although sometimes sparse, children's scripts are often accurate and sequentially correct (Nelson, 1986). However, it is unclear how much script-based knowledge about the world actually reflects the child's ability to envision herself in a future event. For example, in providing an account of "what will happen at McDonald's," one might ask whether the child is truly "projecting" herself into the future to determine how this particular event will unfold, or whether she is drawing predominantly on her memory of how this event has typically unfolded in the past. Haith (1997) has drawn a distinction between future thinking in which memory and experience play a central role, versus future thinking in which we must imagine events that have never occurred before—or, for which we have no precedent. Drawing upon Tulving's (1984) distinction between episodic and semantic memory, Atance and O'Neill (2001) contrasted *episodic future thinking*, which they defined as the ability to project the self into the future to pre-experience an event, with *semantic future thinking*, or more general "knowledge about the future."

There is evidence that by 3 years of age, children talk about future events that do not appear to be rooted in any particular script, and could thus be described as more episodic in structure (e.g., "I might go to Sean's house") (e.g., Atance & O'Neill, 2005; Nelson, 1989; O'Neill & Atance, 2000). Kuczaj and Daly (1979) have also shown that children as young as 3 years of age have the capacity for future hypothetical reference. At this point, it is important to note that although Tulving and others have argued that episodic memory does not fully develop until 4 or 5 years of age (e.g., Nelson, 1992; Perner & Ruffman, 1995; Wheeler, Stuss, & Tulving, 1997), no similar arguments have been put forth about when episodic future thinking may develop. They may or may not be closely coupled in development.

1.2. Planning

There is a substantial amount of research that has examined young children's planning skills, along with various tasks designed to measure the development of these skills (e.g., Carlson, Moses, & Claxton, 2004; Fabricius, 1988; Friedman & Kofsky Scholnick, 1997; Gardner & Rogoff, 1990; Gauvain, 1999; Gauvain & Rogoff, 1989; Hudson, Shapiro, & Sosa, 1995; Klahr & Robinson, 1981; Shapiro & Hudson, 2004; Wellman, Fabricius, & Sophian, 1985). For instance, children have been administered the Tower of Hanoi task which requires them to move discs in a particular sequence from peg to peg to arrive at a specified endpoint (e.g., Carlson et al., 2004; Klahr & Robinson, 1981); "search" tasks, in which children must plan how best to minimize the distance traveled from one point to the next to obtain a series of objects (e.g., Fabricius, 1988; Wellman et al., 1985); "route planning" tasks, in which children must navigate as efficiently as possible through a model grocery store to obtain specified items (e.g., Gauvain & Rogoff, 1989), or plan a route from start to finish through a maze (e.g., Gardner & Rogoff, 1990). Children's planning skills have also been assessed in more "real-world" contexts. Hudson et al. (1995) asked children to plan for the familiar events of going to the beach and going grocery-shopping. Children's performance across most of these different types of tasks improves with age, with a noticeable increase in the age range between 3 and 5 years (e.g., Carlson et al., 2004; Hudson et al., 1995).

There are several points worth noting about these studies on children's planning. First, few have included preschoolers as young as 3 years of age. In fact, Benson (1997) pointed out the virtual lack of established paradigms to assess the planning skills of 2- to 4-year-old children. Second, although the performance of 3-year-olds tested in the existing paradigms is generally quite poor (e.g., Hudson et al., 1995), it is important to note that there are many demands inherent to planning that go above and beyond future thinking per se. For instance, planning comprises multiple processing components such as problem representation, goal selection, strategy choice, strategy execution, and strategy monitoring (Scholnick & Friedman, 1993). Thus, one could imagine being able to project the self into a future event, without necessarily having the ability to plan for that event. Similarly, most of the existing planning tasks do not actually assess the child's ability to project the *self* into the future. For instance, asking a child to move the discs on a Tower of Hanoi task, or to plan a route through a maze, are intuitively (as well as procedurally) quite different from asking the child to project into the future to anticipate outcomes that involve the self.

1.3. Delay of gratification

In delay of gratification tasks (e.g., Mischel, Shoda, & Rodriguez, 1989), children are faced with two options: receiving a small reward (e.g., 2 mini-marshmallows), or receiving a large reward (e.g., 10 mini-marshmallows). Children are told that they can have the smaller reward immediately, or that they can wait to obtain the larger reward. In general, the ability to delay gratification in this context, as well as similar ones, increases with age (Mischel et al., 1989; Moore, Barresi, & Thompson, 1998; Thompson, Barresi, & Moore, 1997). For instance, Moore and his colleagues found that 4- and 5-year-olds delay choosing one sticker immediately, in favor of two stickers later, significantly more often than 3-year-olds. To do so, children must anticipate that receiving two stickers *later*, is more desirable than receiving one *right now*. Children's success in this task cannot simply be a function of their script-based knowledge, given that it is unlikely that they have experienced this situation in the past. At some level, children must be representing their future self. Yet, this task carries the added difficulty that children must first inhibit the desire to have an immediate reward in favor of a more distant one. It is possible that, for the younger children, this inhibitory control component interferes with their ability to think about their future self.

1.4. Anticipation

Our ability to *anticipate* the future can be distinguished from our ability to *plan* for the future. We argue that it is possible to assess children's ability to anticipate future states of the self in contexts that do not draw heavily on their planning or inhibitory control skills. For instance, imagine a trip that will entail camping and hiking. Given that we will be outdoors a great deal of the time, we will likely anticipate the occurrence of a number of physiological states such as thirst, hunger, cold, wet, etc. However, we may not yet have a plan for how we will prepare for each of these. The distinction between anticipation and planning is important as one can hypothesize that a young child is able to anticipate, and think about, the future without necessarily being able to plan for the future (e.g., *anticipating* going to the park, but not knowing how to *plan* for this event).

To sum up, if we are interested in obtaining evidence of children's nascent ability to think about the future, it may be important to assess this ability in a context that: (1) does not draw heavily on their planning skills, (2) minimizes the role of inhibitory control skills, and (3) requires children to go beyond anticipating the steps in a well-known sequence of events (e.g., anticipating that once the cake comes out, it is time to sing happy birthday). The goal of the present research was to design a task fulfilling these requirements and to use it to gather information about children's anticipation of future states of the self.

2. Experiment 1

Experiment 1 examined how 3-, 4-, and 5-year-old children would perform when presented with a series of future events that, from an adult's perspective, would evoke thought about particular physiological states of the self. For example, if told about an event that entailed walking down a long road on a sunny day, adults would likely anticipate the possibility of thirst, and thus a need for water. We chose events that did not form part of a preschooler's daily routine to minimize, as much as possible, "script-based" responses. Rather than ask children to anticipate events connected with bedtime, bathtime, or going to preschool/daycare, we asked them to think about the following: (1) walking across a sunny desert, (2) walking across a rocky stream, (3) walking along a long dirt road, (4) walking across a snowy forest, (5) walking up a steep, long mountain, and (6) walking close to a waterfall. These events were chosen in order to evoke thought about the following states, respectively: sun in eyes, hurt, thirst, cold, hunger, and wet. Note that these are all states with which even young children are familiar. What is necessary is for children to anticipate how these events can lead to the corresponding states, which are themselves well-known.

After the presentation of each event, children were asked which item among a set of three they would need to bring with them. One item in each set could be used to address the state in question; the other two could not. The "correct" item choices for each of the six events described above were: sunglasses, Band-Aids, water, winter coat, lunch, and raincoat, respectively. If children were anticipating the state that could potentially arise during each event, then they should choose the item that would address it. These items were piloted extensively with 3-, 4-, and 5-year-old children ($N = 30$) to ensure that each was an item with which the children were familiar. For instance, although a sun visor/hat could also address the state of having sun in one's eyes, pilot work revealed that younger children were not familiar with this and so it was not a good item to include. The "incorrect" item choices for each of the six events were also extensively piloted to ensure that they did not address a plausible future need which children could draw upon to justify choosing them.

Our goal was to determine whether, in this controlled context, young children would choose the item that could be used to address the state in question, as opposed to choosing randomly.

2.1. Method

2.1.1. Participants

Participants were 54 children, with 18 children in each of the following three age groups: 3 years (mean age = 38.5 months, range = 38–39 months); 4 years (mean age = 50.5 months, range = 50–51 months); 5 years (mean age = 62.3 months, range = 62–63 months). Equal numbers of girls and boys were tested in each of the three age groups. Four additional children were tested, but were not included due to fussiness ($N = 3$) and experimenter error ($N = 1$). Participants were mostly White, from middle-class backgrounds, with English as their first language. The children were recruited by telephone calls from the University of Washington child studies participant pool. Parents gave informed consent for their children's participation and received parking reimbursement; children received a toy for their participation.

2.1.2. Materials

Materials included a large book which contained 12 pages, each with a 28 cm × 36 cm color photograph, along with 18 separate 13 cm × 18 cm cards that had printed on them color photographs of a variety of common items (e.g., Band-Aids, soap, lunch, water, etc.). A large yellow plastic box in which children were asked to put these photographed items (hereafter referred to simply as *items*) was also used.[1]

2.1.3. Procedure

Each child was tested individually and was seated adjacent to the experimenter at a small table. The experimenter brought out the book and told children that she was going to show them some pictures. Children received two blocks of six trials each. The first block consisted of six *warm-up scenarios*, whereas the second consisted of six *test scenarios*. Each scenario entailed the experimenter showing children a photograph and then asking them to pretend that they were going to go to the scene depicted in the photograph. The order of the scenarios within each block was counterbalanced.

2.1.3.1. Warm-up scenarios. These warm-up scenarios were intended to familiarize children with the structure and the language of the task. They were intended to be easy scenarios on which children could succeed and become engaged with the game. Children were presented with six photographs, one by one, depicting the following scenes: (1) a birthday party, (2) a bedroom, (3) a swimming pool, (4) a bathtub, (5) a kitchen, and (6) a grocery store. Children were asked to describe what they saw in the photograph (i.e., "What do you see in this picture?"), and were then asked to imagine participating in a corresponding scenario (e.g., "Okay, let's pretend that you are going to go to this birthday party. It's time to get ready to go"). On the basis of both previous research (e.g., Hudson et al., 1992; Hudson & Shapiro, 1991) and pilot work, we reasoned that each of these scenarios would be part of

[1] We decided not to use real objects for the following reasons: (1) in pilot work, children became overly involved with the real objects which could potentially mask their underlying capacity to think about a *future* rather than an *immediate* use of the object, and (2) because we were using photographs to illustrate the different scenarios, we did not want to confuse the children with using real, rather than photographed, choice items.

the young child's script-based knowledge. Children were then presented with three items and were asked to choose the one they would need to bring with them to the scenario in question (e.g., "Which one of these do you need to bring with you?"). For each scenario there was a correct choice (e.g., birthday card) along with two incorrect/distracter choices (e.g., lunch, toothpaste).

The items were placed on the table in front of the child with the placement of the correct item (i.e., to the child's left, right, or middle) counterbalanced across scenarios. If children did not choose the correct item on at least 4 of the 6 warm-up scenarios, then their data were excluded from the analyses. We reasoned that failure to choose the correct item in at least 4 of the 6 warm-up scenarios suggested that children were not properly engaged in the experimental task and/or did not understand the instructions, especially since these scenarios were highly familiar. Only two 3-year-old children were excluded for this reason.

2.1.3.2. Test scenarios. Children were presented with six photographs depicting the following scenes: (1) a sandy desert with a sun and blue sky overhead (*desert*), (2) a rocky stream surrounded by a forest (*stream*), (3) a long dirt road bordered by trees and shrubs with blue sky overhead (*road*), (4) snow-covered mountains and valley surrounded by trees (*snow*), (5) two grassy mountains with a valley in between (*mountain*), and (6) a waterfall bordered by grass (*waterfall*) (see Fig. 1). After describing what they saw in the photograph, children were asked to imagine themselves participating in a corresponding scenario. For each scenario, children were simply told to pretend that they were going to walk across the depicted scene. For example, the *stream* scenario was as follows: "What do you see in this picture? Okay, let's pretend that you are going to go walk across the rocks. It's time to get ready to go!" At this point, the experimenter presented children with the three items and said, "Which one of these do you need to bring with you: a pillow, Band-Aids, or toothpaste?" Children selected the item that they thought they would need, and then placed it in the yellow box. Here, the correct answer is Band-Aids, because in this future scenario one might anticipate falling on the slippery rocks. Similarly, in the desert scenario the correct answer is sunglasses, because one might anticipate getting sun in one's eyes.[2] Table 1 provides a complete list of the scenarios and item choices. In the test scenarios, children were also asked to explain *why* they had selected the item (i.e., How come you need to bring X?).

2.1.3.3. Control trials. Once the children had completed the six warm-up and six test scenarios, they were administered six control trials to check that the correct item choices in the test scenarios did not correspond, by chance, to the children's favorites. The results of earlier pilot work involving $N = 30$ children for baseline picture preferences revealed that they did not choose the correct items more than 1/3 of the time. In the control trials, each set of three items used in the six test scenarios was presented to the children and they were simply asked to select the item that was their favorite.

[2] We chose to test the anticipation of only one state for each scenario. Of course, there are multiple states one could test. For example, for the *desert* scenario, sunglasses were the correct item, but one could have used water, for instance, or a myriad of other choices. The point is that in the triad of pictures presented to each subject for each scenario, only one item would plausibly satisfy the future state that would ensue.

Fig. 1. Photographs of the six test scenarios presented to children in the picture-book task.

Table 1
Scenarios and item choices in Experiment 1

Scenario	Correct item	Distracter 1	Distracter 2
Warm-up			
Birthday	Card	Lunch	Toothpaste
Bedtime	Pillow	Sunglasses	Comb
Swimming	Water wings	Winter coat	Mirror
Bathtime	Soap	Band-Aids	Blanket
Cookies	Bowl	Raincoat	Shampoo
Grocery store	Money	Water	Towel
Test			
Desert	Sunglasses	Soap	Mirror
Stream	Band-Aids	Pillow	Toothpaste
Road	Water	Card	Shampoo
Snow	Winter coat	Water wings	Towel
Mountain	Lunch	Bowl	Comb
Waterfall	Raincoat	Money	Blanket

2.1.4. Scoring

For the test scenarios, the following two dependent measures were scored: (1) a *nonverbal* measure: children's behavioral choices; and (2) a *verbal explanation* measure: children's explanations for their item choices. The nonverbal measure allowed us to determine whether children chose the item that could be used to address the future state in question. The verbal measure was used to determine how children were explaining their choices and, more specifically, whether they explained their correct item choices by explicitly referring to a future state (e.g., "I'm *gonna* get *hungry*," or "I *might* get *cold*"). More formally, for an explanation to be coded as referring to a future state, it had to include: (1) a *future* term, and (2) the corresponding *state* term. Future terms included: *Going to/gonna*; *will*; *could*; *would*; *can*; *when*; *might*; *maybe*; *in case*; and *if*. State terms included words that explicitly referred to internal feelings; for example, *hungry*, *thirsty*, *hurt*, *cold*, etc.

All remaining explanations that did not fulfill the dual *future state* criteria were cast into the following two categories: (1) *future talk* (e.g., "it's *gonna* be hot"), and (2) *non-future talk* (e.g., "because it's for drinking," "because it's cold"). If children failed to provide any explanation at all, or provided an explanation that was nonsensical, then these were also coded as *non-future talk*. Note that *future state* explanations differ from *future talk* in that the former explicitly reference the future physiological state in question.

Children's item choices and verbal explanations were coded independently by two scorers. Agreement for item choices and verbal explanations were 100% and 97%, respectively. Kappas for each scenario ranged from .86 to 1.00, with an average kappa of .93. Disagreements were resolved through discussion.

2.2. Results

2.2.1. Nonverbal measure

Three-, 4-, and 5-year-olds chose the correct item on 74%, 91%, and 97% of the scenarios, respectively. A one-way ANOVA revealed that there was a significant difference in the number of correct items chosen as a function of age, $F(2, 51) = 8.51$, $p = .001$. Follow-up Student–Newman–Keuls comparisons revealed that 4-year-olds ($M = 5.44$, S.D. = .86) and 5-year-olds ($M = 5.83$, S.D. = .51) did not differ significantly from one another and that each chose the correct item significantly more often than 3-year-olds ($M = 4.44$, S.D. = 1.50). Overall, the girls chose the correct item more often than boys, $F(1, 52) = 4.06$, $p = .049$, but no such sex effect was observed in Experiment 2, and therefore we do not discuss it further.

Finally, and importantly, binomial analyses revealed that, for *each* of the three age groups, and for *each* of the six scenarios (i.e., desert, road, stream, snow, mountain, waterfall), children chose the correct item significantly more often than would be expected by chance (33.3%), all p values <.001, and as might be expected, children also chose the correct item significantly more often than either of the incorrect distracter items (all p values <.001).

To ensure that children were not simply choosing the correct items in the test scenarios because these were their favorites, we also compared children's choices on the test scenarios with their choices on the control trials. Here, it is important to show that in the control trials, when asked to choose their favorites, children do not systematically choose the sunglasses, Band-Aids, water, winter coat, lunch, and raincoat. Analyses comparing children's choices on the test scenarios to their choices on the control trials revealed that at each age and for each test scenario (save one), children chose the correct item significantly more often than they chose this same item in the corresponding control trial, all p's < .001. The sole exception was the mountain scenario for the 4-year-olds in which children chose the lunch at the same rates in the test scenario and control trial. However, the overall pattern of these findings showed that the items children chose on the test scenarios were not prepotent or favorite items.

2.2.2. Verbal explanation measure

We assessed whether children's correct item choices were accompanied by explanations that made reference to a *future state* (e.g., "I *might* get *thirsty*," "you *could* get *cold*").

A one-way ANOVA revealed that there was a significant effect of age on the proportion of *future state* explanations provided, $F(2, 51) = 7.02$, $p = .002$. Student–Newman–Keuls comparisons revealed that 4- and 5-year-olds (respectively, $M = .62$, S.D. = .29, $M = .71$, S.D. = .25) did not differ from each other and both provided a significantly greater proportion of *future state* explanations than did 3-year-olds ($M = .35$, S.D. = .35). There was a significant effect of age on the proportion of *future talk* provided, $F(2, 51) = 7.01$, $p = .002$. Again, 4- and 5-year-olds (respectively, $M = .80$, S.D. = .22, $M = .82$, S.D. = .19) used a greater proportion of *future talk* than did 3-year-olds ($M = .52$, S.D. = .37). Although children provided future state explanations for each of the six scenarios, their tendency to do so differed across scenarios (Table 2).

2.3. Discussion

At each of the three ages, children most often chose the item that would address the future physiological state that each scenario would likely evoke. This was especially true of the 4- and 5-year-olds whose performance was near ceiling and significantly higher than that of the 3-year-olds. On the verbal explanation measure, 4- and 5-year-olds provided a significantly greater proportion of explanations for their correct item choices that made

Table 2
Verbal explanations for correct item choices containing reference to a future state as a function of scenario in Experiment 1

Scenario	Future state references (%)
Desert (sun in eyes)	33
Stream (hurt)	75
Road (thirst)	69
Snow (cold)	47
Mountain (hunger)	72
Waterfall (wet)	63

reference to a future state, than did the 3-year-olds. Insofar as the younger children did not tend to *explain* their item choices by making explicit reference to a future state, might their thinking be qualitatively different from that of the older children?

First, it is important to consider the role of language. Specifically, the older children may simply have had better language skills than the younger ones, thus allowing them to verbally refer to a future state. Undoubtedly, a typically-developing 5-year-old has superior language skills to a typically-developing 3-year-old. However, the specific aspects of language that are important in this case are: (1) language referring to the future, and (2) language referring to internal states. With respect to these aspects in particular, there is evidence that by 3 years of age, children have the means to talk about the future as reflected in their use of terms such as *will* and *gonna* (Bliss, 1988; Gee, 1985; Harner, 1981). Moreover, by 3 years of age children talk about the sorts of physiological states that were tested in our two experiments (Bretherton & Beeghly, 1982). Thus, we would argue that the observed developmental change cannot be fully accounted for by differences in language skills. In what follows, we discuss an alternative account for this change.

One possibility is that the 3-year-olds succeeded in choosing the correct item in the picture-book task by making a semantic/thematic association between the scene depicted in the photograph and the correct item. Thus, when shown a scene depicting a sun in the sky (i.e., the *desert* scene), children made the link to "sunglasses" because sunglasses can be associated with a sunny desert. This could be contrasted with children reasoning that walking across a sunny desert *will cause them* to have sun in their eyes. We describe the former as reflecting an associative link whereas the latter, a causal one. If forming an associative link was the basis for the 3-year-olds' choices, then it is not surprising that only a minority of these children made reference to a future state in explaining their choice (one can see the value of having both behavioral and explanation data because it can help clarify children's reasoning in this context, see, e.g., Wellman & Liu, in press). Such an argument is consistent with research showing that in the domain of analogical reasoning 3-year-olds may, on some occasions, rely on associations rather than causal relations to solve particular problems (Goswami & Brown, 1989, 1990). For instance, in Goswami and Brown (1989), children were presented with three picture cards. The first two depicted an initial state along with a transformation (e.g., chocolate → melted chocolate), whereas the third depicted only an initial state (e.g., snowman). Children were then asked to pick a fourth card that would complete the "melting" analogy. The correct card in this case was a card depicting a melted snowman. However, results indicated that 3- and 4-year-old children sometimes chose the card depicting a sled suggesting that they were making an associative, rather than an analogical, choice.

There is, however, a difficulty with this associative argument. There does not exist an apparent semantic link between the correct item and the described scenario for *each* of the photographed scenes that children viewed in the picture-book task (see Fig. 1). For instance, it is not evident how "Band-Aids" – the correct choice for the *stream* scenario – is semantically associated with a scene depicting a rocky stream. Yet, at all ages, children chose the Band-Aids for this scenario significantly more often than would be expected by chance.

Nonetheless, this does not preclude the possibility that, in the domain of future thinking, young children may initially be more concerned with the structure of an event. In our paradigm, this may have led them to search for choices that were associated with the event (e.g., sunglasses "go with" or are associated with sunny deserts) rather than anticipating how the event would cause them to feel (i.e., the future state that they may experience). Failing to make such an association, children may have been forced to more fully consider other options—including those that address a potential future state. Our current task can be modified to explore this possibility: If we purposely present children with an item that is associated with a given scenario, but that does not address a future state of the self, then a number of 3-year-olds should fall prey to choosing it because of its high associative value.

Thus, in Experiment 2, we retained the items that constituted a correct choice in Experiment 1—as each of these items addressed a future physiological state of the self. We also introduced items that *did not* address a future physiological state, but that held an associative link to the six described test scenarios. We refer to these items as *semantic associates*.

3. Experiment 2

Experiment 2 examined whether performance on the picture-book task would be negatively affected by presenting children with semantic associates from which to choose. These new items were as follows: seashell for *desert*; fish for *stream*; plant for *road*; ice cubes for *snow*; sticks for *mountain*; and rocks for *waterfall*. These items were chosen because each was judged by adults, at least, to hold a surface association to the scene. For example, seashells tend to be associated with sand since seashells can be found in sandy places. Yet, a seashell is not a particularly useful item to bring to a desert. In contrast, sunglasses, which can be used to address the future state of having sun in one's eyes, are. As in Experiment 1, these new items were piloted with $N = 30$, 3-, 4-, and 5-year-olds to ensure that they were familiar with them and did not tend to provide plausible needs that would justify choosing them. For instance, although one could argue that a sled might have made a good semantic associate for us to use in the *snow* scenario (sleds are indeed associated with snow), it would also be useful were one to visit a snowy place and so would not be a good foil. Ice cubes, on the other hand, are also associated with the concept of snow and cold, and are not useful to bring to a snowy place. Therefore, we chose to use ice cubes and not a sled as an appropriate foil. For some scenarios we chose an item that could potentially be found in that location (e.g., sticks for the *mountain* scenario) and thus could also be viewed as forming an associative link to the described scenario in that way.

Table 3
Scenarios and item choices for the test trials in Experiment 2

Scenario	Correct item	Distracter 1	Semantic associate
Desert	Sunglasses	Soap	Seashell
Stream	Band-Aids	Pillow	Fish
Road	Water	Present	Plant
Snow	Winter coat	Bathing suit	Ice cubes
Mountain	Lunch	Bowl	Sticks
Waterfall	Raincoat	Money	Rocks

3.1. Method

3.1.1. Participants

Participants were 54 children, with 18 children in each of the following three age groups: 3 years (mean age = 39.1 months, range = 39–40 months); 4 years (mean age = 51.6 months, range = 50–53 months); 5 years (mean age = 62.9 months, range = 62–65 months). Equal numbers of girls and boys were tested in each of the three age groups. Six additional children were tested, but subsequently replaced: two for fussiness and four for not having passed the warm-up criterion (correct choice on 4/6 of the warm-up scenarios). Participants were selected from the same pool as in Experiment 1 and given the same inducements.

3.1.2. Materials

Materials were identical to those in Experiment 1, save for the photographs of the six semantic associate items. Table 3 provides a complete list of items for the test scenarios. In the warm-up scenarios, we also replaced the birthday card with a present, and the water wings with a bathing suit (a boy's suit was used for the boys, and a girl's suit was used for the girls).

3.1.3. Procedure

The picture-book task was administered in the same manner as in Experiment 1. Once children had completed the 12 warm-up and test scenarios, we administered six control trials to determine the items which were the children's favorites.

3.1.4. Scoring

The same two dependent measures and measures of scoring agreement were used as in Experiment 1. Agreement for item choices was 100%. Agreement for verbal explanations was 98%. Kappas for each scenario ranged from 0.86 to 1.00, with an average kappa of 0.95.

3.2. Results

3.2.1. Nonverbal measure

The 3-, 4-, and 5-year-olds chose the correct item on 61%, 75%, and 92% of the test scenarios, respectively. A one-way ANOVA showed that the number of correct choices varied as a function of age, $F(2, 51) = 9.79$, $p < .001$. Student–Newman–Keuls pairwise comparisons

Table 4
Breakdown of item choices across age in Experiment 2

Scenario	Age		
	3-year-olds	4-year-olds	5-year-olds
Desert			
Sunglasses	14	17	17
Soap	2	0	0
Seashell	2	1	1
Stream			
Band-Aids	7	8	14
Pillow	2	0	1
Fish	9	10	3
Road			
Water	14	15	17
Present	1	0	0
Plant	3	3	1
Snow			
Winter coat	10	17	18
Bathing suit	1	0	0
Ice cubes	7	1	0
Mountain			
Lunch	12	12	16
Bowl	0	1	0
Sticks	6	5	2
Waterfall			
Raincoat	9	12	17
Money	1	1	0
Rocks	8	5	1

Note. The correct item is bolded.

revealed that the 5-year-olds, $M = 5.50$, S.D. = .79, chose the correct item significantly more often than the 3-year-olds and 4-year-olds (respectively, $M = 3.67$, S.D. = 1.57, $M = 4.50$, S.D. = 1.25), and the 4-year-olds.

As can be seen in Table 4, when children erred, they most often did so because they chose the semantic associates. Chi-square analyses revealed that the 3-year-olds were no more likely to choose the correct item, as compared to the semantic associate, on the *stream*, *snow*, *mountain*, and *waterfall* scenarios. The 4-year-olds were no more likely to choose the correct item as compared to the semantic associate on the *stream*, *mountain*, and *waterfall* scenarios. In contrast, 5-year-olds were significantly more likely to choose the correct item than the semantic associate on each of the six test scenarios. Moreover, this age effect was not due to the younger children preferring the particular items that constituted the semantic associates. In the control trials, children's tendency to choose the semantic associates as their favorites was no higher than chance (32.78%), with the same being true for the 3- and 4-year-olds' data (27.78%).

Table 5
Verbal explanations for correct item choices containing reference to a future state as a function of scenario in Experiment 2

Scenario	Future state references (%)
Desert (sun in eyes)	31
Stream (hurt)	72
Road (thirst)	59
Snow (cold)	31
Mountain (hunger)	65
Waterfall (wet)	66

3.2.2. Verbal explanation measure

As in Experiment 1, 5-year-olds ($M = .59$, S.D. = .27) tended to provide a greater proportion of *future state* explanations for their correct item choices than 3- and 4-year-olds ($M = .44$, S.D. = .39, $M = .40$, S.D. = .37, respectively), however this difference did not reach statistical significance. Similarly, 5-year-olds tended to provide a greater proportion of *future talk* ($M = .70$, S.D. = .22) than did 3- and 4-year-olds ($M = .61$, S.D. = .39, $M = .56$, S.D. = .36, respectively), but this was also not significant. As in Experiment 1, children's tendency to explain their correct item choices by making reference to a future state varied across scenarios (Table 5).

3.3. Discussion

The introduction of the semantic associate items in Experiment 2 significantly affected the 3- and 4-year-old children's performance on this task, but not the 5-year-olds'. In Experiment 1, children chose the correct item significantly more often than either of the incorrect items. However, on a number of test scenarios in Experiment 2, the younger children (3- and 4-year-olds) chose the incorrect semantic associate item as often as they chose the correct item. This finding suggests that during the early preschool years, children's thinking about a future event, and hence decisions that they make about a future event, may draw heavily on their knowledge about the thematic structure of the event, rather than how they anticipate themselves feeling in that event.

4. General discussion

The primary goal of these experiments was to determine whether preschool-aged children are capable of anticipating future states of the self. Children were administered a newly-designed picture-book task which required them to select items that could address a variety of physiological states of the self. In addition, children were asked to *explain* their item choices.

In Experiment 1, 3-, 4-, and 5-year-olds chose the items that would address a future state significantly more often than would be expected by chance and more often than they chose any of the other distracter choices, which were presented to them. The performance of the 4- and 5-year-olds was virtually at ceiling (91% and 97% correct item choices, respectively).

The performance of the 3-year-olds (74%) was above chance, but significantly lower than that of the older children. Thus, when presented with situations that, for adults, evoke thought about a series of different states (i.e., sun in eyes, hurt, thirst, cold, hunger, and wet), preschoolers tended to choose the items that would serve to address these states.

A developmental difference was also obtained for children's verbal explanations for their correct item choices. Whereas 5-year-olds explained their choices by making reference to a future state 71% of the time, and 4-year-olds did so 62% of the time, 3-year-olds did so only 35% of the time. We will discuss children's verbal explanations in more detail later.

In Experiment 2, children were purposely presented with items that were associated with the scenarios (i.e., semantic associates) but did not address a future state of the self. Results indicated that 3-, 4-, and 5-year-olds chose the correct items 61%, 75%, and 92% of the time. Only the 5-year-olds chose the correct item significantly more often than the semantic associate for each of the six test scenarios.

These developmental effects are intriguing. Based on the results of Experiment 2, it is tempting to conclude that young children (3- and 4-year-olds) were not able to infer how the various events would cause them to feel and, instead, were more influenced by the thematic structure of the event. However, there are two points weighing against this view.

First, in Experiment 1, children chose the correct item even in those instances in which an obvious semantic link was not evident between this particular item and the scenario (e.g., Band-Aids in the *stream* scenario).

Second, such an associative argument is not fully consistent with what we know from recent research on children's causal reasoning. For instance, Gopnik et al. (2004) argue that children – including those as young as 3 years of age – are not restricted to judgments of cause and effect based on mere associations, but rather are able to extract "causal maps" which allow them to represent causal relations among events. This would suggest that in our task children could make causal inferences of the type that "walking close to waterfalls can lead to getting wet," for instance.

If children as young as 3 years of age do indeed possess the causal knowledge required to make the various inferences in our picture-book task, why did their performance on the behavioral measure suffer in Experiment 2? The crux of our argument is as follows: Although young children have the ability to anticipate that certain situations can cause certain physiological states, this nascent ability is fragile and can be easily disrupted. In Experiment 2, in particular, 3-year-olds may have been drawn to the semantic associate items because these constituted the most obvious surface link to the described scenario. Because these children are building up thematic knowledge about the structure of various events, this type of information may be more accessible or salient to them. Indeed, 3-year-olds chose the fish – the semantic associate – just as often as they chose the Band-Aids in the *stream* scenario. Fish live in water, and so a fish "goes with" the rocky stream scene, but, at least to the adult mind, and with respect to anticipating the future states of one's self, one is better off bringing Band-Aids, than bringing a fish. There was a clear developmental change in this scenario: Whereas 9 of 18, 3-year-olds, and 10 of 18, 4-year-olds chose the fish, only 3 of 18, 5-year-olds did so. Thus, in a context in which children must prepare for a future event by choosing items to bring, our data suggest that 3- and 4-year-olds are seduced by associates, whereas the older children remain focused on the future state of the self. On this view, children younger than 5 years of age are *capable* of causal reasoning in our task but this ability may be disrupted when another related option is presented.

One final point to consider is the possibility that the younger children's difficulty resided not in their ability to *anticipate* a particular state per se, but instead, in *knowing* the item that would address this state. Thus, a child may have anticipated that walking down a long road may lead to thirst, but lacked the knowledge that water would remedy this state. Although this is possible, it seems unlikely that 3-year-olds do not have the knowledge that thirst creates a need for water, or that hunger creates a need for food. However, the question of how our knowledge about the world interacts with our ability to think about, and plan for, future events certainly merits further research.

We now return to the issue of children's *verbal explanations*. Overall, younger children tended to make fewer references to future states in their item explanations than did older children. This is interesting in light of data suggesting that children as young as 3 years of age can use verbal explanations to account for actions and events across various domains. For instance, Schult and Wellman (1997) found that 3-year-olds can appropriately explain the actions of others in terms of biological, physical, and psychological causes. More recently, Wellman and Liu (in press) have argued that *postdictions* are in fact easier for children than *predictions* because in the former there is more information about what actually happened, whereas in the latter, one must consider many possible outcomes. However, asking children to explain a choice based on an event that has not yet happened (e.g., getting hurt or feeling thirsty), as was the case in our picture-book task, may provide a different challenge. Explanations of future, as yet unexperienced, events may represent a new explanatory category that is more difficult for children than explanations about choices made for events that have actually occurred.

It is also possible that the limitation resides in the particular type of explanations that are required: If young children are only starting to become aware of *future states of the self*, then they may be just beginning to make behavioral choices that reflect this awareness, but still not yet be capable of formulating causal explanations based on this awareness. Note that although previous work has examined children's talk about various states (e.g., Bretherton & Beeghly, 1982), no special attention has been devoted to how often children referred to their potential *future* occurrence.

We conclude by outlining several factors implicated in children's reasoning about future states of the self, and by situating this ability within social-cognitive development and children's behavior in everyday life.

First, inhibitory control may be involved in thinking about future states of the self. Although we designed our task in a manner that did not explicitly draw on inhibitory control skills, these skills may be an inherent feature of future thinking. This is because thinking about the future often requires us to suspend consideration of our current states to focus on how we anticipate feeling in the future. One possibility for the younger children's difficulty choosing the correct item in Experiment 2, is that they were unable to inhibit choosing an item that was associated with the scene (and thus attractive for this reason), in favor of one that could be used to address a future state.

Inhibitory control skills may also be related to children's performance on the verbal measure. It is possible that because children were not experiencing the state that they were asked to anticipate (e.g., children were not currently wet), they may have had difficulty drawing upon this state as an explicit reason for having chosen the correct item.

A second factor is children's developing theory of mind. At the heart of having a representational theory of mind is the ability to adopt multiple perspectives on the world. This ability is generally difficult for 3-year-old children. For instance, 3-year-olds have difficulty making the distinction between appearance and reality (e.g., Flavell, Flavell, & Green, 1983), and so will tend to deny that an object can appear one way to their eyes (e.g., rock) but truly be something else (e.g., sponge). Three-year-olds also have difficulty acknowledging that people's beliefs may differ from reality (as the child knows it), and so tend to predict that people will act according to reality, rather than according to their beliefs (e.g., Wimmer & Perner, 1983). Similarly, children have difficulty acknowledging that they, themselves, once held a belief about the world that was false (e.g., Gopnik & Astington, 1988). We suggest that the ability to adopt multiple perspectives on the world also applies to our thinking about the *self in the future*. What is challenging in this case is that the child must represent herself in potentially different states than those which she is currently experiencing. Interestingly, the results of our study suggest that 3-year-olds, and even 4-year-olds, have difficulty with this, whereas 5-year-olds have much less.

It is noteworthy that in certain circumstances, even adults have difficulty accurately predicting future states of the self. Researchers have examined adults' ability to predict both physiological states such as hunger and thirst as well as emotional states such as happiness and sadness in both self and other (e.g., Gilbert, Gill, & Wilson, 2002; Nisbett & Kanouse, 1969; Read & van Leeuwen, 1998; Van Boven & Loewenstein, 2003). With respect to physiological states, specifically, we know that adults shopping for food to be consumed *later*, are nevertheless influenced by their *current* state (e.g., Nisbett & Kanouse, 1969). The hungrier the individual, the more groceries he, or she, is likely to buy. The ability to anticipate a future state that is opposite to the one currently being experienced may be especially difficult for young children—a possibility that we are currently exploring (Atance & Meltzoff, 2005).

Our findings also have implications for understanding children's behavior in everyday life. We know that 2- and 3-year-olds talk about the future (e.g., Atance & O'Neill, 2005; Nelson, 1989), and that by about 4 years of age, children can begin to make decisions that benefit a future, but not a present, self (e.g., Moore et al., 1998). What the current study adds is information concerning children's reasoning about everyday events that will affect their future states. In homes, preschools, and during organized play, children often appear to be unplanful, and notoriously fail to take into account how they will feel in a future situation. For example, if the family lives in sunny Florida but must pack for a trip to Grandma's house in Maine in the winter, children may refuse to bring a winter coat, insisting that this item will not be needed. Younger preschoolers may be particularly susceptible to this error because, as the current work shows, they are not as adept in considering future states of the self as are older children. Consequently, their decisions about the future are not necessarily made with the future self in mind. This may be especially true when children are confronted with information that might interfere with this process, as demonstrated in Experiment 2. Children's tendency to respond on the basis of the thematic structure of an event may overpower causal reasoning about how the event will impact them.[3]

Clearly, more work needs to be done before we can make strong conclusions about the factors that influence children's decisions about the future, as well as their future thinking more generally. However, we believe that we have developed an approach for amassing new information about how children think about and explain present choices based on their anticipation of future states of the *self* and for assessing both children's behavioral choices and their verbal explanations and justifications for them. We anticipate that there will be an expansion in work devoted to children's understanding of the future, their place in it, and the neural concomitants of such thought processes.

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[3] The fact that children may rely more on their knowledge about the structure of an event may not be entirely detrimental in everyday life. For example, when questioned about a birthday party, a 3-year-old may focus on the fact that it would be useful to bring along a present (based on script knowledge). However, this same child may be more limited in projecting herself into this event to anticipate that, for example, eating cake will make her feel full. Such realizations are not always needed in the life of a child, especially since their future can often be anticipated by a parent (who may not plan a large dinner after the birthday party). As children gain more experience, they will be better able to envision themselves in these events even without external help. Thus, world experience, in addition to advancements in inhibitory control and theory of mind, doubtless plays a role in the ontogenesis of future thinking.

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