Assessing the role of memory in preschoolers' performance on episodic foresight tasks

Cristina M. Atance\textsuperscript{a} & Jessica A. Sommerville\textsuperscript{b}

\textsuperscript{a} School of Psychology, University of Ottawa, Ontario, Canada
\textsuperscript{b} Department of Psychology, University of Washington, Seattle, WA, USA

Published online: 29 Jul 2013.

To cite this article: Cristina M. Atance & Jessica A. Sommerville (2014) Assessing the role of memory in preschoolers' performance on episodic foresight tasks, Memory, 22:1, 118-128, DOI: \texttt{10.1080/09658211.2013.820324}

To link to this article: \texttt{http://dx.doi.org/10.1080/09658211.2013.820324}
Assessing the role of memory in preschoolers’ performance on episodic foresight tasks

Cristina M. Atance1 and Jessica A. Sommerville2

1School of Psychology, University of Ottawa, Ontario, Canada
2Department of Psychology, University of Washington, Seattle, WA, USA

A total of 48 preschoolers (ages 3, 4, and 5) received four tasks modelled after prior work designed to assess the development of “episodic foresight”. For each task, children encountered a problem in one room and, after a brief delay, were given the opportunity in a second room to select an item to solve the problem. Importantly, after selecting an item, children were queried about their memory for the problem. Age-related changes were found both in children’s ability to select the correct item and their ability to remember the problem. However, when we controlled for children’s memory for the problem, there were no longer significant age-related changes on the item choice measure. These findings suggest that age-related changes in children’s performance on these tasks are driven by improvements in children’s memory versus improvements in children’s future-oriented thinking or “foresight” per se. Our results have important implications for how best to structure tasks to measure children’s episodic foresight, and also for the relative role of memory in this task and in episodic foresight more broadly.

Keywords: Cognitive development; Memory; Future thinking; Episodic foresight; Episodic memory.

Although developmental psychologists have long been intrigued by the emergence and development of children’s memory, it is only recently that the study of children’s future thinking has also become a topic of study in cognitive development. In particular the term “episodic foresight” was recently introduced (Suddendorf & Moore, 2011) to describe the specific capacity to “imagine future scenarios and use such imagination to guide current action” (p. 296). Although memory appears to be critically implicated in this capacity (a point to which we return in the section entitled Theories about the link between memory and foresight), there is nonetheless the recognition that episodic foresight can also entail the mental projection of a novel event (i.e., one that has not been experienced in the past) (e.g., Atance & O’Neill, 2005; Haith, 1997) or the flexible recombination of past event details (e.g., Schacter & Addis, 2007) and, as such, is not merely a recapitulation of the past. Several developmental approaches to study episodic foresight exist (for a review, see Suddendorf & Moore, 2011) with one of the most popular involving children’s ability to select an item (from among an array) for future use, hereafter referred to as “item choice tasks”.

An early study using this approach was conducted by Atance and Meltzoff (2005), in which 3-, 4-, and 5-year-old children were shown photographs of various outdoor locations (e.g., a desert) and were asked to imagine themselves visiting these locations. They were then presented with a group of items, one of which (e.g., sunglasses) could address a potential need (e.g., sun in eyes...
in the specific location. Children’s ability to select the correct item (i.e., sunglasses) and also to explain their choice in a future-oriented manner (e.g., “I might get sun in my eyes”) improved significantly with age. Although these results may indeed reflect an increase in children’s episodic foresight between ages 3 and 5, an alternative possibility is that children relied on semantic knowledge (e.g., sunny locations require sunglasses) to succeed (especially since the events in question were hypothetical and thus unlikely to actually occur in the children’s futures).

These potential limitations are not as applicable to another type of item choice task also designed to assess episodic foresight based on a proposal by Tulving (2005) and Suddendorf and Busby (2005). In Tulving’s proposal, commonly referred to as the “spoon test”, a young girl dreams about a party where all the guests are being served a delicious chocolate pudding. A spoon is required to eat the pudding but the young girl did not bring one. The next evening she falls asleep while holding a spoon in her hand to pretend to have broken the one that had just been used. At this point children were told that they would go to another room but that they would later return to the first room to play with the box. After playing unrelated games for 15 minutes in the other room, children were presented with four objects and asked to select one to take back to the first room. The target object in this case was a yellow triangle key, whereas the distractor items were a red cross key, a red square key, and a yellow square key. The majority of 4-year-olds (65%) selected the correct key (thus ostensibly displaying foresight), while significantly fewer 3-year-olds (29%) did so. Only the 4-year-olds’ performance was significantly above chance.

As an example, Suddendorf et al. (2011) showed children a locked box with a triangular keyhole and demonstrated that it could be opened to retrieve a sticker using a red triangle key. Children were then allowed to use the key on two consecutive trials. The experimenter subsequently created a future need for a key by pretending to have broken the one that had just been used. At this point the children were told that they would go to another room but that they would later return to the first room to play with the box. After playing unrelated games for 15 minutes in the other room, children were presented with four objects and asked to select one to take back to the first room. The target object in this case was a yellow triangle key, whereas the distractor items were a red cross key, a red square key, and a yellow square key. The majority of 4-year-olds (65%) selected the correct key (thus ostensibly displaying foresight), while significantly fewer 3-year-olds (29%) did so. Only the 4-year-olds’ performance was significantly above chance.

A critical issue with item choice tasks (both those used with humans and non-human animals) is the extent to which task success (i.e., selecting the correct item), and age-related changes in children’s performance, are driven by memory for the past event versus foresight, per se. Both the little girl in Tulving’s (2005) spoon test and the children in Suddendorf et al. (2011) needed to remember the problem with which they were faced to then choose the correct item to solve it. Nonetheless, younger children (and possibly non-human animals) may fail item choice tasks for at least two reasons, each having different implications for the development of episodic foresight. The first is that they cannot remember their past experience (or some critical aspect of it), thus logically precluding them from choosing the correct item. The second is that they remember their past experience but cannot use this information
to select the correct item for future use. In other words, both memory and foresight are critical for episodic foresight and thus it is possible to conceive of failure on item choice tasks as being predominantly due to limitations in memory, or predominantly due to limitations in foresight.

Although Suddendorf et al. (2011) did not explicitly query children about their memory for the problem, children performed less well in a condition in which they had to wait 15 minutes facing away from the problem (but in the same room) prior to choosing the tool than in a condition in which they were quickly led to another room to choose the tool. This finding is consistent with the argument that children may fail such tasks primarily because they cannot remember critical information about their past experience (e.g., the shape of the keyhole), and not necessarily because they lack foresight. This concern has also been raised by Hudson et al. (2011), who argue that children may fail item choice tasks due to an inability to remember any number of aspects of their past experience and that, when memory demands are reduced, as was the case in Suddendorf et al.’s condition in which children experienced no delay between seeing the problem and selecting the item, 3- and 4-year-olds perform no differently.

The strongest evidence to this effect is a recent study by Scarf, Gross, Colombo, and Hayne (2013). These authors used an item choice paradigm in which 3- and 4-year-olds discovered a locked treasure chest in a sandbox, but no key with which to open it. Children returned for a second session 24 hours later and were presented with a group of items, including a key, before returning to the sandbox. Only the 4-year-olds chose the key at a rate higher than chance. Interestingly, in a second experiment in which a delay of 15 minutes was introduced, the 3-year-olds’ performance was now above chance. This suggests that the 3-year-olds’ difficulty with the 24-hour condition lay in their inability to remember the original episode and not necessarily in their inability to use foresight.

The current study builds on Scarf et al.’s (2013) findings in several different ways. First, we wanted to rule out the possibility that children’s failure to select the correct item in Scarf et al. was impacted by processes other than memory that may also be affected by length of delay (e.g., 24 hours vs 15 minutes) and age (e.g., 3 vs 4). For example, some 3-year-olds might have remembered the problem after a delay longer than 15 minutes, yet selected an incorrect item because their motivation to solve the problem had decreased, and another item had perhaps become more desirable. Although Scarf et al. report that those children who selected the incorrect item did not explain their choice by referring to the sandbox or treasure chest (thus presumably not remembering the earlier episode), it is possible that a more explicit memory question (e.g., “What was in the sandbox?”) might have elicited this information. If so, this would imply that some of the children who chose the incorrect item retained memory of the past episode but lacked the foresight to address it. Accordingly, in our study we explicitly asked children their memory for the original problem, thus allowing us to make conclusions about the extent to which selecting the incorrect item was due to limitations in memory versus foresight. In addition we included three different age groups (3, 4, 5) to determine whether, after controlling for children’s memory for the problem, we would detect developmental differences in children’s correct item choices (or, ostensibly, their “foresight”).

If memory is indeed the limiting factor in item choice tasks, then one would predict that when children are explicitly queried about their memory for the problem, those who choose the incorrect item (i.e., fail to show foresight) will not remember the problem, whereas those who choose the correct item necessarily will. Moreover, and perhaps more critically, when controlling for memory for the past event it is possible that no age-related improvements in children’s correct item choices would be detected. In contrast, if children’s correct item choices, and age-related changes in such performance, are driven at least in part by developments in foresight, then a significant effect of age should be detected even when memory for the past event is controlled for. This would show that it is not solely memory for the problem that is increasing with age, but also children’s foresight to address it.

THEORIES ABOUT THE LINK BETWEEN MEMORY AND FORESIGHT

Questions about the link between memory and foresight nicely parallel prior debates regarding the relation between remembering and reasoning more broadly. Some authors have suggested that remembering and reasoning are inextricably
linked. On the one hand, scholars have argued that accurate memory is a precondition for successful reasoning (Howe & Rabinowitz, 1991), and that when relevant information is sufficiently encoded even preschool age children can engage in relatively sophisticated forms of reasoning, such as transitive inferences (e.g., Bryant & Trabasso, 1971). On the other hand, constructivists have argued that what children remember is shaped by their level of reasoning (Piaget & Inhelder, 1973). Although these proposals differ in their direction of influence (e.g., memory → reasoning versus reasoning → memory) both stress the dependence of memory and reasoning. In contrast, other researchers have suggested that memory and reasoning are independent processes, given that reasoning performance is not dependent on memory for background information, age-related changes in memory are unrelated to age-related changes in reasoning, and interventions that improve memory for background information do not necessarily enhance reasoning performance (e.g., Brainerd & Reyna, 1992, 1993). In either case these prior studies motivate an investigation about the relation between memory and foresight, and highlight the importance of the specific cognitive processes that are brought to bear on a given experimental task.

Tulving (1985, 1999) has argued that a crucial feature of episodic memory is that it allows an individual to mentally travel into both the past and the future. In addition many researchers have now argued that the adaptive significance of episodic memory is that it allows individuals to mentally pre-experience their futures (e.g., Klein, Loftus, & Kihlstrom, 2002; Klein, Robertson, & Delton, 2010; Schacter, Addis, & Buckner, 2007; Suddendorf & Corballis, 1997, 2007; Tulving, 2005). More specifically, Schacter, Addis, and Buckner (2008) argue that people simulate future episodes by flexibly recombining event details from the past, or what they term the “constructive episodic simulation hypothesis”. Indeed, a variety of evidence suggests that there are striking similarities between our memory for the past and our thoughts about the future (e.g., Addis, Pan, Vu, Laiser, & Schacter, 2009; D’Argembeau & Van der Linden, 2004; Schacter et al., 2007; Spreng & Levine, 2006). Studies requiring adult participants to report both personal past events and imagine personal future ones demonstrate that these two forms of thought rely on similar cognitive and neural processes (e.g., Addis et al., 2009; Szpunar, Watson, & McDermott, 2007). Research with young children is consistent with these results. For example, children’s ability to report an event that happened yesterday and predict one that will happen tomorrow emerge around the same time in development and tend to be related (e.g., Busby & Suddendorf, 2005; Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Quon & Atance, 2010; Suddendorf, 2010). These findings are consistent with the fact that memory for past events is necessary for the future. But is memory sufficient to allow us to pre-experience the future?

Researchers have argued that thinking about a future event requires processes over and above remembering a past event (e.g., Atance & O’Neill, 2005; Haith, 1997; Schacter & Addis, 2007; Schacter et al., 2007; Szpunar et al., 2007). For example, to construct a future event one must flexibly recombine past event details (Schacter et al., 2007). These ideas are supported by the fact that several brain regions are significantly more active when individuals think about the future than when they think about the past (Okuda et al., 2003; Szpunar et al., 2007). Developmental data that show that children tend to perform better on past versus future versions of the same task (e.g., Busby Grant & Suddendorf, 2009; McColgan & McCormack, 2008) are also consistent with this claim. These findings suggest that, although memory for past events is required for episodic foresight, it is not sufficient for episodic foresight. Indeed, in addition to remembering the event of not having a spoon to eat the pudding, the little girl in Tulving’s spoon test needed to display the foresight to obtain one and bring it to the necessary location (in this case to bed with her). As such, episodic foresight tasks should be structured in a way that requires that individuals show both memory of a past event and anticipate encountering it again in the future (i.e., foresight). Although theory suggests that these two components should be related, evidence also suggests that memory, alone, is not sufficient for episodic foresight. However, to date, item choice tasks modelled after Tulving’s spoon test have not measured the relative contribution of each to task performance.

**THE CURRENT STUDY**

The first goal of our study was to investigate whether age-related changes on item choice tasks designed to tap children’s episodic foresight can
be explained by age-related changes in foresight per se, or whether they are better explained by age-related changes in children’s memory for past events. A secondary goal was to examine the relation between children’s ability to select the item needed to solve the problem (i.e., “foresight”) and their memory for the past problem. Because episodic foresight requires memory for past events, performance on these two questions should be correlated. The strength of this correlation, however, speaks to the degree of overlap between these two constructs.

Similar to Suddendorf et al. (2011), we developed tasks in which children were presented with a novel problem in one room and then, after a delay, were presented with a set of items/tools in another room, one of which could be used to solve the problem. We attempted to make each task motivating and self-relevant for children by introducing a clear goal/reward. For each task, and after the delay, children were first asked which item would be needed to solve the problem (“item choice” question), and next whether they remembered the problem they had encountered in the first room (“memory” question). As such our procedure was similar to the ones used by Suddendorf and Busby (2005), Suddendorf et al. (2011), and Scarf et al. (2013), except that children were explicitly queried about their memory for the problem after they had selected the item. We asked the item choice and memory questions in this fixed (rather than counterbalanced) order because we did not want the memory question to serve as a reminder to the problem.

"Smiley Face Task. Children were brought to the first room (the “snail room”) and the experimenter told them that she had a smiley face drawing that she wanted to give them. She then retrieved the drawing and expressed dismay at the fact that one of the (plastic “google”) eyes had come unglued (“Oh no, one of the eyes has fallen off so I can’t give it to you!”). Children were then led to the second room (the “lady bug room”) but were told that the smiley face drawing and the eye would remain in the first room. This was done so that children knew that the problem could be accessed later. After looking at pictures for 5 minutes in the second room, children were told that it was time to return to the snail room (“OK, now it’s time to go back to the snail room and you can take one of these things with you”). Children were presented with scissors, an eraser, a shovel, and glue (correct option), and were asked the item choice question (“Which one of these do you want to take with you?”). At no point did the experimenter remind children of the problem with which they had been faced in the snail room. Children received a score of 1 on the item choice question if they chose the correct item; otherwise, they received a score of 0.

1 Although Suddendorf et al. (2011) used a 15-minute delay, Suddendorf and Busby (2005) used only a 5-minute delay. Because age-related differences were obtained using both of these delay periods, we decided to use a 5-minute delay to ensure that the testing session was not inordinately long.

METHOD

Participants

A total of 48 children were recruited in a large city using advertisements in newspapers, daycare centres, and local retailers: 16 3-year-olds (8 boys; Mage = 40.81 months, range = 37–46 months), 16 4-year-olds (8 boys; Mage = 54.12 months, range = 48 to 59 months), and 16 5-year-olds (8 boys; mean age = 65.25 months, range = 60 to 69 months). One additional 3-year-old was tested but did not complete the session due to fussiness. A total of 77% of the sample was White, 6% was Black, 2% was Asian, and the remaining 15% did not provide this demographic information. The majority of participants were from middle-class backgrounds. Children received a small gift for their participation.

Materials, design, and procedure

Children received four problem-solving tasks that were all identically structured but that varied in their content. Children were presented with a novel problem in one room and then travelled to a second room where they played unrelated games for 5 minutes before being told that they would return to the first room and could select one of four items to bring with them. In all cases one of the items could be used to solve the problem, whereas the other three could not. We describe only one task in detail since all four tasks were administered in exactly the same way. Tasks were administered in one of four counterbalanced orders.

Smiley Face Task. Children were brought to the first room (the “snail room”) and the experimenter told them that she had a smiley face drawing that she wanted to give them. She then retrieved the drawing and expressed dismay at the fact that one of the (plastic “google”) eyes had come unglued (“Oh no, one of the eyes has fallen off so I can’t give it to you!”). Children were then led to the second room (the “lady bug room”) but were told that the smiley face drawing and the eye would remain in the first room. This was done so that children knew that the problem could be accessed later. After looking at pictures for 5 minutes in the second room, children were told that it was time to return to the snail room (“OK, now it’s time to go back to the snail room and you can take one of these things with you”). Children were presented with scissors, an eraser, a shovel, and glue (correct option), and were asked the item choice question (“Which one of these do you want to take with you?”). At no point did the experimenter remind children of the problem with which they had been faced in the snail room. Children received a score of 1 on the item choice question if they chose the correct item; otherwise, they received a score of 0.
Immediately after children made their choice they were asked the explanation question (“How come you chose the X?”). If children’s explanations made explicit reference to the object in the snail room (e.g., “for the eye/smiley face”), or to the action to be carried out in the snail room (e.g., “to glue the picture”), thus demonstrating memory for the problem, then they received a score of 1. If children were unable to provide a response (or said “I don’t know”) or their explanations were irrelevant, they were given a score of 0. In these instances children were immediately asked the memory question (“What’s on the table in the snail room?”). To receive a score of 1 children’s responses needed to reference the object on the table in the snail room (e.g., “smiley face”, “eye”), otherwise they were given a score of 0. Children were automatically assigned a score of 1 on the memory question if they had provided a correct response to the explanation question.

Regardless of children’s responses to the previous questions, the experimenter next went to the snail room to retrieve the smiley face drawing and the missing eye. If children had chosen the correct item they were then invited to use it to solve the problem (i.e., glue the eye on the smiley face). If children had chosen incorrectly then all four items were placed in front of them on the table and, with the problem visible, they were asked a knowledge question (“Which one of these can you use to fix this picture?”). This question was asked to ensure that children could solve the problem in the present, and thus that their failure to select the correct item was not due to lack of problem-solving ability. Children received a score of 1 on the knowledge question if they selected the correct item; otherwise they received a score of 0. Regardless of the correctness of children’s responses to the knowledge question they were invited to use the glue to solve the problem.

Frog Task. In the frog task children were told that the experimenter wanted to show them a toy. Children then learned that the toy (a small green frog) was submerged in a tall container filled with water and could not be obtained by simply reaching into the container (“Oh no, the toy is in the water at the bottom of this long tube so I can’t show it to you”). The four options with which children were presented to solve the problem were a candle, a flashlight, a fork, and a long pair of tongs (correct option). Unexpectedly, two children chose the fork to obtain the frog and then explained this choice in a future-oriented manner (e.g., “because it can get the frog out”). It was difficult not to credit these children with foresight and thus they were given scores of 1 on the item choice, explanation, and memory questions. One additional child chose the fork but did not make verbal reference to the problem in response to the explanation question and thus was given a score of 0 on both the item choice and explanation questions.

Juice task. In the juice task children were told that the experimenter wanted to give them some juice. Children chose which kind of juice they wanted (grape, apple, or orange) and the experimenter poured it into a glass that was on a 33 × 48 cm plastic tray. Children then learned that the glass was glued to the centre of the tray so that it was impossible to drink the juice (“Oh no, the glass is stuck to the board so you can’t drink it!”). The four options with which children were presented to solve the problem were a paintbrush, a ruler, a pencil, and a straw (correct option). Unexpectedly, some of the children (n = 7) chose the ruler to obtain the juice and then explained this choice in a future-oriented manner (e.g., “because it might make the cup unstuck” or “because it can get the cup off”). Again, it was difficult not to credit these children with foresight and thus children who chose the ruler and also explained this choice by making reference to the problem were given a score of 1 on the item choice, explanation, and memory questions. However, if children chose the ruler and then did not explain this choice by making verbal reference to the problem (n = 4), then a score of 0 was given on both the item choice and explanation questions.

Smarties task. In the Smarties task children were told that the experimenter wanted to give them some Smarties. Children then learned that the Smarties were locked inside a box (“Oh no, the Smarties are locked inside this box, so I can’t give you any”). The four options with which children were presented to solve the problem were a comb, a crayon, tape, and a key (correct option).

RESULTS

Children’s performance on the item choice and memory questions

To determine whether children selected the item needed to solve the problem, we analysed their
responses to the item choice question. Sex did not affect children’s responses to this question and so the data were collapsed across this variable. Tasks on which children failed the knowledge control question were excluded \( (n = 4, n = 3, n = 2, \text{and } n = 0, \text{for the Smiley Face, Frog, Juice, and Smarties tasks, respectively}) \) because this indicated an inability to solve the problem in the present. Children’s scores on the item choice question were summed across the four tasks and then divided by the total number of tasks for which children answered the knowledge control question correctly. The ensuing proportion scores were entered into a one-way ANOVA, revealing a significant effect of age, \( F(2, 45) = 4.20, p < .05 \), partial eta squared = .16. A series of Tukey post-hoc tests showed that 5-year-olds \( (M = .75, SD = .27) \) outperformed both 3-year-olds \( (M = .47, SD = .36) \) and 4-year-olds \( (M = .46, SD = .31) \). The performance of 3- and 4-year-olds did not differ significantly. As expected, these findings show that children’s ability to select an item for future use shows significant age-related improvements during the preschool years. Also recall that, for each task, children were asked to explain the reason for their item choice. For those instances in which children selected the correct item (and collapsing across all four tasks), 46% \( (11/24) \), 79% \( (23/29) \), and 81% \( (38/47) \) of 3-, 4-, and 5-year-olds’ explanations either made explicit reference to the object in the snail room, or to the action to be carried out in the snail room.

However, to explore possible age-related changes in children’s memory for the problem with which they had been faced, we analysed their responses to the memory questions. Sex did not affect children’s responses to the memory questions and so the data were collapsed across this variable. As with our analyses on the foresight questions, tasks for which children answered the knowledge control question incorrectly were excluded. Thus children’s scores on the memory question were summed across the four tasks and then divided by the total number of tasks for which children answered the knowledge control question correctly. The ensuing proportion scores were then entered into a one-way ANOVA, revealing a significant effect of age, \( F(2, 45) = 9.19, p < .001 \), partial eta squared = .29. A series of Tukey post-hoc tests showed that 5-year-olds \( (M = .81, SD = .23) \) outperformed both 3-year-olds \( (M = .36, SD = .33) \) and 4-year-olds \( (M = .56, SD = .32) \), while the performance of these last two age groups did not differ significantly.

### Potential links between memory and foresight

One of our goals was to address the relation between children’s foresight and their memory for the problem. At a descriptive level, the percentage of trials in which children at each age passed the memory question but failed the item choice question was low: 23, 29, and 15 for 3-, 4-, and 5-year-olds, respectively, suggesting a tight correspondence between children’s performance on these questions. This was confirmed statistically by a significant correlation between the proportion of correct responses on the item choice questions and the proportion of correct responses on the memory questions, controlling for age, Pearson \( r = .53, p < .001 \). This analysis suggests that the capacities to choose an item for future use (or “foresight”) and memory likely draw on overlapping, although not identical, processes.

### Relative contributions of memory and foresight to task success

Our primary goal was to explore whether age-related changes in children’s ability to select the item needed to solve the future problem are best explained by age-related changes in foresight per se, or whether they are better explained by age-related changes in children’s memory for past events. To explore this issue we re-ran the analysis on children’s item choice scores but now controlling for children’s memory scores using a one-way ANCOVA. The effect of age on children’s item choice scores was no longer significant, \( F(2, 44) = 1.23, p = .30 \). Means for the proportion of correct responses on the item choice questions after controlling for the proportion of correct responses on the memory questions were .59, .48, and .62 for the 3-, 4-, and 5-year-olds, respectively. We also ran a multiple regression to predict children’s proportion scores on the item choice questions after controlling for the proportion of correct responses on the memory questions. The regression equation was significant, \( R^2 = .35 \), adjusted \( R^2 = .32 \), \( F(2, 45) = 12.10, p < .001 \). However, this significant effect was solely driven by children’s memory for the problem, \( B = .57, t(45) = 4.23, p < .001 \), not age, \( B = .001, t(45) = .17, p = .86 \). Taken together, these findings suggest that children’s performance on the item choice question is significantly predicted by
DISCUSSION

Children were given tasks that required them to remember a problem and then secure its future solution. Their capacity to select the correct item to do so increased significantly with age, which is consistent with the general pattern reported in previous research on episodic foresight (e.g., Atance & Meltzoff, 2005; Russell, Alexis, & Clayton, 2010; Suddendorf & Busby, 2005; Suddendorf et al., 2011). Although we did not detect a significant difference in correct item choices between ages 3 and 4, as has been reported in previous work using item choice tasks (e.g., Suddendorf et al., 2011), this might have been because children in our study received multiple tasks that all varied in the type of problem with which they were faced. After children selected the item to bring back to the first room, they were also asked what was on the table in that room. Explicitly asking children this memory question has not been done in previous work but, here too, our results indicated that memory for the problem significantly improved with age.

Although these age-related improvements (both on the item choice and memory questions) are informative, our main goal was to determine the extent to which memory, rather than foresight, is driving age-related changes in children’s performance on item choice tasks. A secondary goal was to examine how children’s foresight and memory for the problem were related. With respect to the latter, children’s performance on the memory and item choice questions was significantly correlated, which is consistent with theories that argue for an overlap between the processes involved in remembering our pasts and mentally projecting into our futures. They are also consistent with data showing that children’s reports of past and future events are related (e.g., Suddendorf, 2010).

However, there were also instances in our study in which children remembered the past event but failed to select the correct item (23%, 29%, and 15% for 3-, 4-, and 5-year-olds, respectively). These results may be explained in two ways. One possibility, which was raised in the Introduction, is that episodic foresight requires more than memory for the past event. In addition to cognitive processes that allow for the recombination of past events to create a future event, researchers have also argued that future events are more hypothetical and uncertain (e.g., Atance & O’Neill, 2005). Thinking about future events may also rely on imaginative capacity to a greater extent than thinking about past events because one must construct an event that has not yet been experienced (McColgan & McCormack, 2008). A second, not mutually exclusive, possibility is that any lack of overlap between children’s performance on the memory and item choice questions is not driven by non-overlapping processes, but rather by the lack of overlap in task demands. The current study used a forced-choice response format for the item choice questions and an open-ended response format for the memory questions. Future studies should directly equate task demands between these two questions in order to resolve these two possibilities.

More importantly, our results speak to what might be driving age-related changes in children’s performance on item choice tasks. Our findings suggest that, when children remember a past event, their ability to select the correct item to secure a future solution does not vary as a function of age. In this sense our findings are consistent with research (e.g., Bryant & Trabasso, 1971) demonstrating that even relatively young children perform well on reasoning tasks when they have sufficiently encoded the relevant information. Moreover, when directly pitted against one another (i.e., regression analysis), memory for past events, not age, significantly predicted children’s performance on the item choice questions. These results are consistent with several possibilities. The first is that remembering one’s past experience is sufficient to drive future-directed behaviour. As such, memory development would be the main predictive factor in episodic foresight. Although this is an intriguing theoretical possibility that is consistent with the idea that the adaptive significance of memory is to allow for foresight, it does not fit with theory and data (outlined in the Introduction) about how future thinking requires skills that are different from memory. Nonetheless, our findings raise the interesting possibility that there is variability in the extent to which memory is related to different forms of future-directed behaviours. Whereas some instances of future-directed behaviour might rely heavily on our past experiences, others might place more of a toll on recombination and
constructive capacities, as well as the capacity to imagine an event that is relatively novel.

A second possibility to account for our findings is that any additional factors (e.g., imaginative capacity) required for episodic foresight do not undergo development between ages 3 and 5. Although our data cannot speak to this specific issue, there exist at least several different methods to examine children’s episodic foresight that do show age-related improvements. One is simply to ask children to report an event that they will do in the future, for example the next day (e.g., Busby & Suddendorf, 2005; Hayne et al., 2011; Quon & Atance, 2010; Suddendorf, 2010). Here, results show that children’s ability to report events that their parents rated as accurate increases significantly between ages 3 and 5. Although children’s ability to report such events has also been shown to be significantly related to their ability to report past events (e.g., Suddendorf, 2010) it is unlikely that correctly answering the future questions can be accomplished solely on the basis of children’s memory for the past. Another method to assess episodic foresight that also does not appear to draw heavily on children’s memory was developed by Russell et al. (2010). In their task preschoolers played a game with an experimenter that entailed each person standing on opposite sides of a table with a goal at each end and a ball to blow into it. The two essential items to play the game included a straw (with which to blow the ball) and, to play the game from the experimenter’s side of the table (but not the child’s), a box to stand on. Children were told that they would be returning the next day to play the game from the experimenter’s side and they should save two items (from an array of six) to do so. Children were asked this question while standing directly in front of the items that they were asked to choose from and the game table, thus ostensibly reducing the memory demands of the task. Yet only 5-year-olds chose the correct items at a rate higher than would be expected by chance. In contrast, 3-, 4-, and 5-year-olds all succeeded when asked to choose the two items that they would need to play the game “right now”. Arguably, memory demands were equated between the “future” and “right now” conditions and thus the difference in performance was likely due, in part, to the younger children’s inability to mentally project into the future.

Thus, given the empirical evidence just presented, it seems doubtful that children’s episodic foresight does not undergo significant development between ages 3 and 5. Instead the final possibility we suggest is that item choice tasks (specifically those designed to mirror Tulving’s spoon test) might test only weakly, or not at all, constituents that are most definitive of episodic foresight. Rather they appear to be largely dependent on children’s memory for the problem without necessarily requiring an additional “foresight” component to succeed. In this respect our data are consistent with those reported by Scarf et al. (2013), but also highlight the strong relation between children’s responses to the item choice and memory questions and, more importantly, that memory for the problem (and not age) is the only variable that significantly predicts children’s performance on item choice tasks.

In light of our findings, an important issue to address is how best to refine item choice tasks reported in this study (and elsewhere) so as to tap the “foresight” component of episodic foresight. A first step in this process is to point out several important distinctions between our (and others’) item choice tasks and Tulving’s (2005) spoon test. In the tasks developed thus far the item choice question is forced choice. That is, children are asked which item from a set of, for example, four they wish to select. The format of this question might cue children to the correct response. For example, in scenarios that are more associative in nature (e.g., needing a key to unlock a box), children might not need foresight to succeed, but rather need only associate the correct item with their memory of the problem. In contrast, in Tulving’s (2005) original proposal the young girl retrieves the spoon to eat the pudding of her own volition. It is likely that this kind of “spontaneous” (rather than “forced choice”) action places stronger demands on foresight and also more accurately mirrors the type of situation that an individual may face in everyday life. As such, a means to bring our tasks (and those of others) more in line with Tulving’s initial proposal is to transform the item choice question into an open-ended one, thus requiring children to spontaneously decide what is needed to solve the problem. Another related issue is that in Tulving’s spoon test the little girl’s behaviour (i.e., bringing the spoon to bed with her) demonstrates that the spoon was chosen as a function of the future event and not as a function of an association between the spoon and her memory of the event (otherwise she would have had no reason to bring the spoon to bed with her). In contrast, in existing item choice tasks it is unclear whether selecting a key to open a box, for example, need involve
anything more than the recollection/association that the key in question can be used to open a/the box. Moreover, because children are told that they are returning to the room that contains the problem, they have no choice but to bring the selected item with them. It would seem possible to modify existing tasks in a way that would incorporate a more “spontaneous” item choice measure, as well as a requirement that selecting the correct item reflects thought about the future as well as memory for the past.

**CONCLUSION**

The study of episodic foresight is gaining momentum in developmental psychology. This is important both for learning more about an understudied aspect of children’s cognition and because developmental methods lend themselves well to the study of such fundamental issues as the link between memory and foresight and the relative extent to which individuals draw on each of these capacities when making adaptive choices for the future. Especially intriguing in this respect is how different forms of future-directed behaviours may differentially rely on memory for the past. In recent years several clever methods have also been developed to tap into children’s episodic foresight. One such method—and the one we used in the current study—is modelled after Tulving’s (2005) spoon test, and entails showing children a problem in one room and then later giving them the opportunity to address it (e.g., select an item) in another room. Significant age-related changes in children’s ability to select the correct item have been documented in our study and elsewhere. However, the results of our study suggest that this type of task, as currently structured, is largely assessing children’s memory, not their foresight. We have provided various suggestions about how this task might be structured to ensure that it is drawing on foresight as well as memory, which in turn will aid in further pinpointing developmental changes in episodic foresight, more broadly, and also the specific role that memory plays in these changes.

**REFERENCES**


Klein, S. B., Loftus, J., & Kihlstrom, J. F. (2002). Memory and temporal experience: The effects of episodic memory loss on an amnesic patient’s ability...


