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Development of Episodic Prospection: Factors Underlying Improvements in Middle and Late Childhood

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Episodic prospection is the mental simulation of a personal future event in rich contextual detail. This study examined age-related differences in episodic prospection in 5- to 11-year-olds and adults (N = 157), as well as factors that may contribute to developmental improvements. Participants' narratives of past, future, and make-believe events were coded for episodic content, and self-concept coherence (i.e., how coherently an individual sees himself or herself) and narrative ability were tested as predictors of episodic prospection. Although all ages provided less episodic content for future event narratives, age-related improvements were observed across childhood, suggesting future event generation is particularly difficult for children. Self-concept coherence and narrative ability each independently predicted the episodic content of 5- and 7-year-olds' future event narratives.

Individuals routinely engage in thoughts about their future (D'Argembeau, Renaud, & Van Der Linden, 2011). Some of these thoughts involve episodic prospection (also referred to as episodic future thinking or foresight), which is the simulation of a personal future event that is isolated in space and time, and that includes contextual detail such as imagery and feelings (Tulving, 1985). Episodic prospection may be adaptive because it provides a motivational basis for self-regulation in the present (Buckner & Carroll, 2007; Suddendorf & Corballis, 2007). For example, a student's mental pre-experience of his or her graduation date—visualizing the packed auditorium, hearing cheering from family members in the audience, and feeling excited—may increase that student's motivation to work hard to ensure the event becomes a reality. Research supports this notion, showing a positive effect of episodic prospection on decision making (Bromberg, Wiehler, & Peters, 2015), academic habits (Pham & Taylor, 1999), and prosocial tendencies (Gaesser, Horn, & Young, 2015).

Effort has been made to understand the development of episodic prospection given its adaptive function. The majority of this work has focused on its emergence and development during the preschool years (e.g., Busby & Suddendorf, 2005; Russell, Alexis, & Clayton, 2010). However, recent research suggests that episodic prospection continues to develop across childhood and into adolescence (Coughlin, Lyons, & Ghetti, 2014; Gott & Lah, 2014; Wang, Capous, Koh, & Hou, 2014; Wang, Hou, Tang, & Wiprovnick, 2011). These later developmental periods are marked by increased independence (Sanders, 1985), creating a context within which the development and associated benefits of episodic prospection may have greater functional consequences. The current study aims to better understand age-related differences in episodic prospection during these later periods, and to examine factors associated with these differences.

Development of Episodic Prospection

Research examining early childhood has highlighted a functional relation between episodic

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memory and episodic prospection (e.g., Atance, Louw, & Clayton, 2015; Russell et al., 2010), consistent with the idea that the former supports the latter by providing content for future event simulations (Addis et al., 2007). This research substantiates the prediction that episodic prospection should improve during late childhood, given that episodic memory continues to develop then (Ghetti & Angelini, 2008; Willoughby, Desrocher, Levine, & Rovet, 2012).

A handful of recent studies have begun to test this prediction. While Coughlin et al. (2014) showed strong age-related improvements between 5, 7, and 9 years of age, and adults in the amount of detail included in narratives of both past and expected future events, participants were least successful at episodic prospection across ages. Similarly, Gott and Lah (2014) showed that 8- to 10-year-olds included significantly fewer semantic and episodic details in their narratives of past and future events compared to 14- to 16-year-olds, and that this difference was greatest for episodic details. They also found that children and adolescents tended to generate fewer details for future compared to past events overall (Gott & Lah, 2014; see also Wang et al., 2014). Thus, despite the continued development of both abilities, episodic prospection appears most challenging. An important unanswered question is which features of episodic prospection explain why it may be particularly challenging for children.

Factors Underlying the Development of Episodic Prospection

The constructive episodic simulation hypothesis posits that episodic prospection occurs when an individual flexibly recombines elements from their episodic memory to construct and elaborate a mental simulation of a novel future event (Schacter & Addis, 2007). This process is typically described as occurring via construction and elaboration phases. We propose that event generation (i.e., the identification of a suitable event) can be distinguished as an initial phase that is distinct from these other two phases; without identifying a target event, event construction and elaboration cannot occur. In this section, we consider how the demands associated with each phase of episodic prospection may contribute to children's difficulty with it.

Event Generation

We contend that to achieve episodic prospection an individual must first generate a future event that is (a) personal and (b) plausible. In other words, episodic prospection requires individuals to generate a target event within the realm of personally plausible future situations. Although this part of the process may be less challenging for adults, we consider it important when characterizing the development of episodic prospection.

Previous research supports the importance of the event generation phase. Martin-Ordas, Atance, and Caza (2014) observed that 3- to 5-year-olds are less successful at describing personal future events when they are required to *generate* them (Busby & Suddendorf, 2005), compared to when they are asked to report on *specific events* generated by their parents (Hayne, Gross, Mcnamee, Fitzgibbon, & Tustin, 2011). And, in a context that provided little support for event generation, 5- to 9-year-olds' episodic prospection was close to floor (Coughlin et al., 2014). These results suggest that difficulties with event generation may contribute to children's episodic prospection limitations. We examine this possibility in the present study by quantifying the amount of generation prompts participants received. This allows us to assess whether the generation of future events poses unique challenges (particularly for younger children) compared to the generation of past and make-believe events, as discussed in the next section.

Episodic Simulation Through Construction and Elaboration

Once a future event has been generated, the individual must construct a mental representation of it (i.e., event construction) that is elaborated with rich contextual detail (i.e., event elaboration; Schacter & Addis, 2007). Hassabis and Maguire (2007) refer to this ability as scene construction, defining it as the generation, maintenance, and visualization of a scene within which an event is mentally experienced (see also Hassabis, Kumaran, Vann, & Maguire, 2007; Lind, Williams, Bowler, & Peel, 2014).

The present study examined whether children's difficulty with episodic prospection may also be due to limitations with the episodic simulation of a novel event (i.e., event construction and elaboration). Although the capacity to retrieve episodic detail might constrain both episodic prospection and the episodic recollection of past events, only episodic prospection requires the episodic simulation of a novel event via the *flexible recombination* of episodic details from past experiences (Schacter & Addis, 2007). If developmental differences in flexible retrieval during childhood (Ackerman, 1982; DeMaster, Coughlin, & Ghetti, 2016; Levy-Gigi & Vakil, 2010) contribute to children's difficulty with episodic prospection, then they should also have difficulty engaging in the episodic simulation of other novel events that are not in the future. Instead, if these difficulties are unique to episodic prospection, then episodic content should still be lower for future versus make-believe events. To test these competing hypotheses, we compared participants' ability to episodically simulate personal future versus make-believe events. We expected episodic prospection might be unique because its simulation demands are additionally constrained by what is personally plausible. Thus, self-knowledge about what is personally plausible, and the coherence of this knowledge, may be critical for episodic prospection.

Self-concept coherence is the degree to which individuals have a consistent and organized set of beliefs about their traits, abilities, values, and other personal characteristics (Coughlin & Robins, 2017). Although we are unaware of any work examining the developmental relation between self-concept coherence and episodic prospection, there is evidence of a developmental relation between self-concept coherence and children's reminiscing about past events (Bird & Reese, 2006; Fivush, 1994; Fivush & Nelson, 2006). And, Howe and Courage (1997) have proposed that the self is a knowledge structure that organizes an individual's memories of personal experiences, and it is only through this structure that memories can become organized autobiographically (see also Conway & Pleydell-Pearce, 2000; Conway, Singer, & Tagnini, 2004). We propose that the self may serve a similar role in episodic prospection, guiding the individual to selectively generate and organize possible future events, and that developmental differences in the structure, content, and valence of self-representations during childhood and adolescence (Harter, 1999) may contribute to the protracted trajectory of episodic prospection.

Episodic Prospection in Context: Taking into Account Narrative Ability

Prior research has shown that language ability assessed via tests of vocabulary can account for many correlations between episodic prospection and relevant cognitive constructs during childhood (e.g., executive function and theory of mind; Atance & Jackson, 2009; Hanson, Atance, & Paluck, 2014). The present study controlled for language ability using a narrative task given that the linguistic features of narratives include vocabulary, grammatical structure, and relations among sentences (Peterson & McCabe, 1983). However, we note that both narrative ability and episodic prospection require the integration of temporal and contextual details into a coherent picture, and that a relation between the two abilities has been proposed (Nelson & Fivush, 2004; Rubin & Umanath, 2015). There is also a rich literature showing an important relation between narrative skill (acquired through joint reminiscence) and autobiographical memory development (Farrant & Reese, 2000; Fivush, 2011), a relation that could conceivably extend to the development of future event imagination. Thus, although narrative ability was assessed primarily as a control measure, there is reason to predict a functional relation between it and episodic prospection.

The Present Study

The present study investigates age-related improvements in episodic prospection in 5- to 11-year-olds and adults. These age groups were selected based on evidence of age-related improvements in episodic prospection from middle childhood to adulthood (Coughlin et al., 2014; Gott & Lah, 2014; Wang et al., 2011, 2014).

We assessed narratives about personal future events and compared them to narratives about personal past and make-believe events. When participants could not independently generate a spatiotemporally isolated event during this task, they were systematically prompted to do so; these prompts were quantified to provide an index of difficulty with event generation. The episodic content included in narratives was scored for *episodicity* using a scheme that rewarded each feature of episodic content in a hierarchical manner, such that higher scores met the criteria of increasingly higher levels of episodicity. These scores were used to compare developmental differences in the episodic content of future, past, and make-believe narratives. Self-concept coherence and narrative ability were also assessed.

We predicted that limitations in event generation would contribute to children (especially younger children) requiring a disproportionate number of prompts for future compared to past and make-believe events. We also predicted that future event narratives would be less episodic than past event narratives (Gott & Lah, 2014). For comparisons between episodic prospection and the episodic simulation of make-believe events, we considered two alternative predictions: (a) children would perform similarly across these conditions if limitations in episodic simulation underlie their difficulty with episodic prospection, or (b) children would perform better in the make-believe versus episodic prospection condition if limitations in episodic simulation do not provide a full account of their difficulty with episodic prospection, and other factors including self-concept coherence and narrative ability might also support the development of this capacity.

Method

Participants

A total of 157 participants were divided into five age groups: thirty 5-year-olds (*M* = 5.5 years, range = 5.1–6.0 years; 15 males), thirty-two 7-year-olds (*M* = 7.6 years, range = 7.0–7.9 years; 16 males), thirty-three 9-year-olds (*M* = 9.6 years, range = 9.1–10.4 years; 16 males), thirty 11-year-olds (*M* = 11.6 years, range = 10.8–12.4 years; 15 males), and 32 young adults (*M* = 21.5 years, range = 18.5–27.7 years; 17 males). Twelve additional participants were enrolled in the study but excluded from final analyses: five were lost to follow-up (one 9-year-old, one 11-year-old, and 3 adults), four for video equipment failure (one 11-year-old and 3 adults), and 3 for noncompliance with the experimenters' directions (two 5-year-olds and one 9-year-old).

Participation occurred between the years 2013 and 2015. All participants were recruited from a university town in northern California with plenty of child activities and facilities. Children were recruited through community events and their families received $10 per hour for participating. Young adults were recruited through an undergraduate recruitment system and received course credit for participating. The sample was 65% Caucasian, 17% multiracial, 13% Asian, 2% African American, 2% Native American or Alaska Native, and 2% other. Ninety percent of the sample had at least one parent with some college education, and 89% of the sample had a family income of $25,000 or greater. All participants were fluent in English and without known cognitive impairment.

Materials and Procedure

Experimental tasks were completed across two sessions spaced approximately 5–9 days apart to prevent participant fatigue. All tasks were administered to participants individually by a female experimenter in a quiet testing room.

Session 1

The *episodic thinking interview* was administered during this session. This interview was adapted from a cue-word method developed to examine autobiographical memory in school-age children (Bauer, Burch, Scholin, & Guler, 2007; see also Addis et al., 2007). It consisted of 10 trials during which participants were asked to provide a narrative of a personal event (four past events, four future events, and two make-believe events), each related to a cue phrase. We constrained the interview to 10 trials (a duration of approximately 1–1.5 hr) in order to facilitate children's participation, choosing to maximize trials within the past and future conditions since a comparison of these conditions was the most critical focus of the present study. Cue phrases referred to common activities (e.g., eating something yummy, going to a sports field), were of mildly positive affect, and counterbalanced across conditions. Trials within each condition were blocked, and participants were asked about past and future events (order counterbalanced across participants) prior to being asked about make-believe events in order to avoid response contamination of "real" versus "make believe." A practice trial for each condition preceded the test trials for that condition.

At the beginning of each past or future event trial, participants were instructed to "Think of a real thing that (happened or will happen) to you in the (last or next) few months. Think of one time when you (cue phrase), and tell me everything you can think of about it." The terms "last few months" and "next few months" were used given young children's fluency with basic temporal terms (Grant & Suddendorf, 2011) and allowed for the matching of temporal distance across past and future conditions. At the beginning of each make-believe trial, participants were instructed to "Come up with a make-believe thing. Think of one time when you (cue phrase), and tell me everything you can think of about it." Participants were told that events should be personal events, isolated in space and time, and not an everyday occurrence (i.e., episodicity criteria). If participants failed to meet these criteria, the experimenter provided prompts according to a strict schedule: (a) General prompts were provided when no event was reported (e.g., "Let's close our eyes and think really hard about it"); (b) prompts for a specific event were provided when a generic, repeated, or continuous event was reported (e.g., "Can you think of one time when you (generic or repeated event)?"); and (c) prompts for an event from the correct temporal period were provided when a participant provided an event from the wrong temporal period (see Table S1 for full prompting schedule). These represent the generation phase prompts.

After reporting an event (whether specific or not), each participant (regardless of performance) was asked each of the following four questions once in order to encourage event elaboration: (a) "Can you tell me more about what (was, will be, or is) happening?," (b) "Can you tell me more about who (was, will be, or is) there?," (c) "Can you tell me more about where this (was, will be, or is) happening?," and (d) "Can you tell me more about when this (was, will be, or is) happening?" All narratives were recorded and later transcribed by a research assistant.

During Session 1, participants also completed the first part of the Self-Concept Assessment for Children (SCA-C; part "a" or "b" according to counterbalancing condition). The SCA-C is a novel adaptation of the Children's Self-View Questionnaire (CSVQ; Eder, 1990). In the original CSVQ, participants complete trials during which they observe two identical puppets take turns endorsing opposite ends of a psychological dimension (e.g., "I like meeting new people" and "I don't like meeting new people"), and then select the puppet that is most similar to how they see themselves. Together, trials cover multiple psychological dimensions of the self-concept. The SCA-C uses the same stimuli and general format as the CSVQ, but institutes several changes. First, participants report their self-conceptions (which puppet they are similar to) using a two-step forced choice response option presented on a computer touch screen (see following and Figure 1), eliminating the need for verbal report and providing a more sensitive measure of the child's self-concept than the CSVQ (which used a one-step forced choice response option). Second, unlike the CSVQ which used the same two puppets for all statement pairs, animations of different students are used across statement pairs. Using animations of different students lessens the possibility of a single student stating contradictory information, reducing potential confusion caused from seeing the same puppet endorse mulitple conflicting statements (e.g., "I am happiest when I'm by myself" on one trial and then "It's more fun to do things with other people than by myself" on another trial). The use of

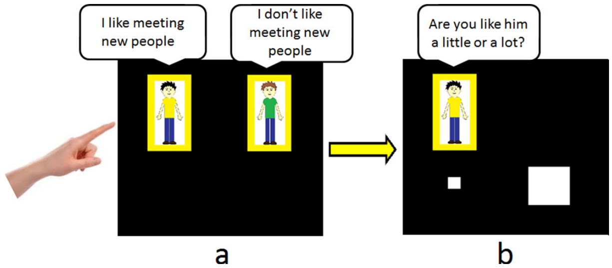

Figure 1. **One trial from the adapted version of the Self-Concept Assessment for Children. (a) Participants observe a pair of students take turns endorsing opposite ends of a specific psychological dimension and are asked to choose the student from the pair this is most like them (by touching that student's picture). (b) Participants are asked to report whether they are like the student they chose either a little (by touching the little box) or a lot (by touching the big box). Trials are scored on a 4-point Likert scale ranging from 0 (*endorsing the puppet at the low end of the psychological dimension a lot*) to 3 (*endorsing the puppet at the high end of the psychological dimension a lot*).**

animated students also makes the task more appropriate for older children who might be less willing to interact with puppets.

In the SCA-C, participants were told that students would introduce themselves by saying statements about themselves on the first day of school. Participants then completed trials during which they observed a pair of students (not identical, but matched for looks and gender) take turns endorsing opposite ends of various psychological dimensions. For each pair of students, participants were required to (a) choose the student from the pair that was most like them, and (b) report whether they were like that student "a little" or "a lot" (represented by either a small or large square). All responses were made on a touch-screen monitor, reducing the need for verbal reports and allowing for the direct recording of response times. Prior to starting test trials, participants were told that there were no right or wrong answers, that the most important thing was to tell the truth about who they are, and allowed to practice across two practice trials.

The SCA-C includes 78 statement pairs, divided into two sets of 39 statement pairs. The two sets can be administered one right after another or on separate days to provide a more accurate representation of the participant's stable self-view and to prevent potential fatigue. The latter should be a minimal concern given that the original CSVQ was administered on a single day to children as young as 3 years of age (Eder, 1990) and has been used across the preschool years (Bird & Reese;

Welch-Ross, 2001). Sixty-two of the SCA-C stimuli pairs were taken directly from the CSVQ (Eder, 1990) and contain statements reflecting one of nine psychological dimensions based on Tellegen's (1982) Differential Personality Questionnaire (achievement, aggression, alienation, harm avoidance, social closeness, social potency, stress reaction, traditionalism, well-being). An additional 16 "fun" stimuli pair (e.g., "I want to go to Disneyland" and "I don't want to go to Disneyland") were included to boost task engagement and are not included in analyses. Stimuli are presented in a fixed but randomized order across each part of the SCA-C, and stimuli assessing the same psychological dimension are never presented consecutively. Male participants completed a male version showing male students, and female participants completed a female version showing female students (stimuli pairs are the same across male and female versions).

Session 2

The *balloon-popping story* (Geers, Tobey, Moog, & Brenner, 2008) was administered to participants at the beginning of Session 2 to assess narrative ability. In this task, participants look closely at a sequence of six pictures depicting an event with a small boy and a balloon, and then tell a story about what the pictures depict. Participants are instructed to not point to pictures when telling their story, and to use words only. Stories were video recorded and then transcribed and coded based on Geers et al.'s (2008) guidelines (see Scoring Guidelines).

During Session 2, participants also completed the second part of the SCA-C (part "b" or "a" according to counterbalancing condition). This task was administered as during Session 1.

Scoring Guidelines

All scoring was conducted by raters blind to hypotheses and participants' age and sex.

Episodic thinking interview. Narratives were transcribed and then scored for (a) number of generation prompts and (b) episodicity. Since participants included temporal information in their event narratives, it was impossible to maintain true blindness to experimental condition. However, raters were not informed of the predicted effects of these conditions.

The *number of generation prompts* was tallied by two raters, K and L, for 19% of narratives. An interrater reliability analysis revealed Spearman's $\rho = .98$, $p < .001$. Rater L tallied prompts for the remaining 81% of narratives, and her tallies were used for analyses.

The *episodicity* of each narrative was scored using a 6-point scale adapted from a scale developed by Piolino et al. (2003) for which similar versions have been successfully used in studies with children (Coughlin et al., 2014; Piolino et al., 2007). A score of 0 was given when participants were unable to provide an event narrative. A score of 1 was given when a participant reported a vague event, one that was repeated or continuous with little or no detail of time or space (e.g., "I will go there."). A score of 2 was given when a participant reported a generic event, one that was repeated or continuous but situated in time, space, or both (e.g., "I will go to school on Friday"). A score of 3 was given when a participant reported a specific event (isolated and situated in time, space, or both) without any other contextual detail (e.g., "I will go to school on Friday for my graduation"). A score of 4 was given when a participant reported a specific event with one contextual detail such as imagery, emotions, or thoughts (e.g., "I will go to school on Friday for my graduation, and will hear them announce my name through the loudspeaker"). And, a score of 5 was given when a participant provided a specific event with more than one contextual detail (e.g., "I will go to school on Friday for my graduation, and will feel excited when I hear them announce my name through the loudspeaker"). This scale allows for assessing different levels of episodic prospection success, and scores narratives not solely on the number of episodic details which may be confounded with language ability in developmental populations. Forty-two percent of all event narratives were scored by three raters, A, C, and K. An interrater reliability analysis revealed Spearman's $\rho > .80$, $p < .001$. Rater K scored the remaining 58% of narratives, and her scores were used for analyses.

Self-Concept Assessment for Children. To compute self-concept coherence, each SCA-C trial was first scored using a 4-point Likert scale; a score of 0 was given for endorsing the student at the low end of the psychological dimension *a lot*, a score of 1 for endorsing that same student *a little*, a score of 2 for endorsing the student at the high end of the psychological dimension *a little*, and a score of 3 for endorsing that same student *a lot*. We then computed the standard deviation of the participant's responses across all statement pairs reflecting each of the nine psychological dimensions; a high standard deviation would indicate that the participant is providing inconsistent responses across conceptually related items (e.g., seeing himself or herself as similar to a student endorsing a high aggression statement for one stimuli pair, but then similar to a student endorsing a low aggression statement for another stimuli pair). Because we are interested in assessing participants' general self-concept coherence, not the coherence of their self-conceptions within specific psychological dimensions, we computed the mean of the nine dimension-specific standard deviations to obtain an overall index of self-concept coherence. However, because higher scores on this index represent *lower* self-concept coherence, we performed a linear transformation on these scores to reverse the scale corresponding to the linear regression: $X'_i = a + bX_i$, where X'_i = the transformed score, $a = 1.45$ (the maximum raw score observed in the sample), $b = -1$, and X_i = the raw score. The results to be reported are identical regardless of whether or not the raw or linearly transformed scores are used for analyses.

Balloon-popping story. Based on Geers et al.'s (2008) coding scheme, each story was scored for reference cohesion (range = 0–6), reference specification (range = 0–4), expressed temporal links between propositions and events (range = 0–5), and mental state references (range = 0–5). These ratings were then summed to create an overall narrative score ranging from 0 (*low narrative ability*) to 20 (*high narrative ability*). All narratives were scored by two independent raters, J and S. Interrater reliability was achieved (Spearman's $\rho = .96$, $p < .001$). Score discrepancies were resolved via discussion and mutual agreement between the two raters.

Results

Two preliminary analyses were conducted. First, we verified there was no effect of condition order (whether the future condition was presented before or after the past during the interview) on mean number of generation prompts and episodicity scores, $Fs(1, 147) \leq 1.46$, $ps \geq .23$, $\eta^2_p \leq 0.01$. Second, we confirmed that scores for past and future events did not differ depending on whether we examined the first two versus the last two trials within each condition, $Fs(1, 152) \leq 0.13$, $ps \geq .72$, $\eta^2_p \leq 0.01$. This allowed us to reasonably compare the past and future conditions to the make-believe condition for which there were two trials.

Main analyses examined age-related differences in the mean number of generation prompts and episodic content of future event narratives, and compared these differences to those observed in past and make-believe event narratives. Mean number of generation prompts and episodicity scores were computed within each mentalizing condition, respectively. Age-related differences in self-concept coherence and narrative ability were then assessed. Final analyses examined unique predictors of episodic prospection across child development.

Developmental Differences

Episodic Thinking Interview

Participants' performance on the episodic thinking interview was analyzed using separate 5 (age group: 5- vs. 7- vs. 9- vs. 11-year-olds vs. adults) × 3 (mentalizing condition: past vs. future vs. make-believe) repeated-measures analyses of variance (ANOVAs) on (a) mean number of generation prompts and (b) episodicity scores.

Generation prompts. Analysis of generation prompts revealed significant main effects of age, $F(4, 151) = 19.08$, $p < .001$, $\eta^2_p = 0.34$, and mentalizing condition, $F(2, 302) = 62.93$, $p < .001$, $\eta^2_p = 0.29$, that were qualified by an Age × Mentalizing Condition interaction, $F(8, 302) = 2.98$, $p = .003$, $\eta^2_p = 0.07$ (Figure 2a). Simple effect analyses showed that for future events, 5-year-olds required more prompts than 7- to 9-year-olds ($ps < .001$), who in turn required more prompts than 11-year-olds and adults ($ps < .04$). This contrasted with that observed across the past and make-believe conditions, for which there were fewer age-related differences. For past events, 5-year-olds required more prompts than all other age groups ($ps < .04$), and 7-year-olds required more prompts than adults ($p = .003$); no age differences were observed between 9-year-olds, 11-year-olds, and adults ($ps \geq .20$). For make-believe events, 5-year-olds again required more prompts than all other age groups ($ps \leq .004$), and no differences were observed across the other age groups ($ps > .24$). The effect size of age on mean prompts was also reduced in both the past ($\eta^2_p = 17$) and make-believe ($\eta^2_p = 12$) conditions compared to the future condition ($\eta^2_p = 28$). Overall, 5-, 7-, 9- and 11-year-olds required disproportionately more prompts for future versus make-believe events ($ps < .001$, $0.52 < \eta^2_p < 0.55$) compared to adults ($p < .001$, $\eta^2_p = 0.40$), despite the fact that both types of events require mental simulation.

Episodicity scores. Analyses of episodicity scores revealed main effects of age, $F(4, 152) = 18.04$, $p < .001$, $\eta^2_p = 0.32$, and mentalizing condition, $F(2, 304) = 28.74$, $p < .001$, $\eta^2_p = 0.16$, that

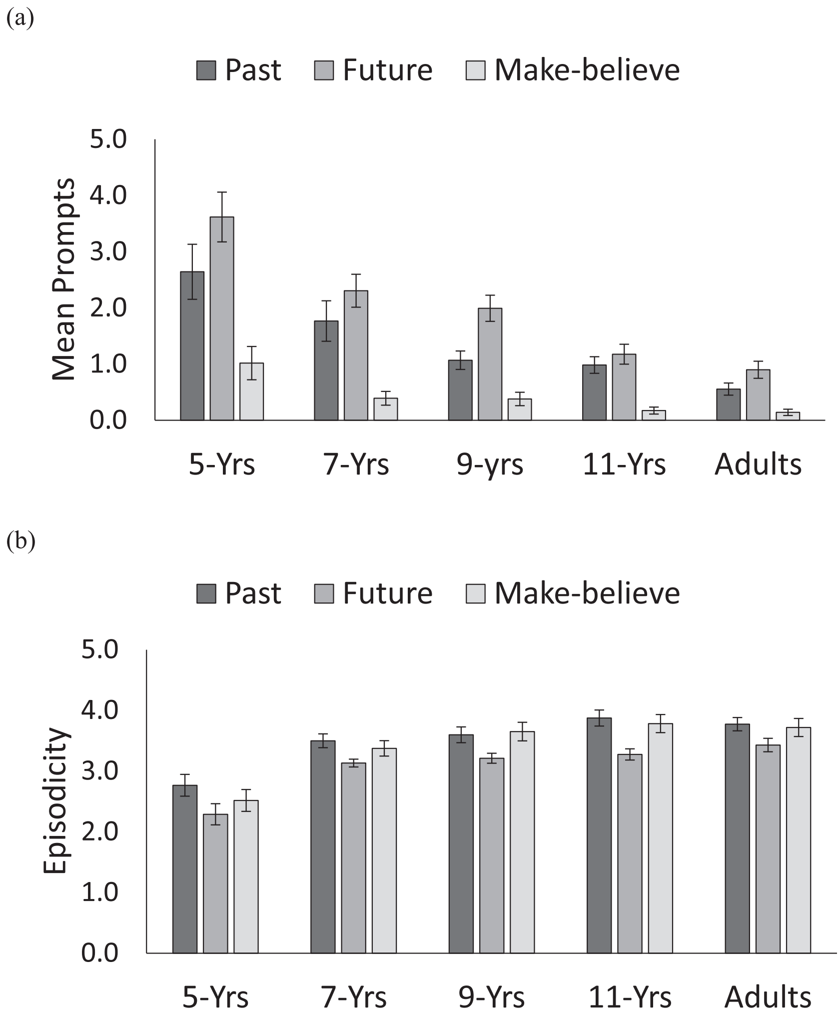

Figure 2. **Mean (a) generation prompts (± *SE*) and (b) episodicity scores (ranging from 0 to 5, ± *SE*) by age and mentalizing condition.**

were not qualified by an Age × Mentalizing Condition interaction, $F(8, 304) = 0.70$, $p = .69$, $\eta_p^2 = 0.02$ (Figure 2b). Main effect contrasts showed that 5-year-olds scored lower than all other age groups (*p*s < .001), and that 7-year-olds scored lower than 11-year-olds and adults (*p*s = .046). In addition, future events received lower episodicity scores than both past and make-believe events (*p*s < .001), which did not differ from one another ($p = .17$). Including mean number of generation prompts as a covariate did not change the effect of age, $F(4, 150) = 6.54$, $p < .001$, $\eta_p^2 = 0.15$, or mentalizing condition, $F(2, 300) = 11.04$, $p < .001$, $\eta_p^2 = 0.07$.

Self-Concept Coherence

A one-way ANOVA was used to examine the effect of age on self-concept coherence score. Results revealed an effect of age, $F(4, 152) = 16.67$, $p < .001$, $\eta_p^2 = 0.24$ (5-year-olds: $M = .32$, $SD = .19$; 7-year-olds: $M = .45$, $SD = .19$; 9-year-olds: $M = .52$, $SD = .12$; 11-year-olds: $M = .56$, $SD = .13$; adults: $M = .61$; $SD = .11$). Five-year-olds' scores were lower than all other age groups' (*p*s ≤ .001), 7-year-olds' scores were lower than 11-year-olds and adults' (*p*s ≤ .003), and 9-year-olds' scores were lower than adults' ($p = .01$). Thus, significant age-related increases in self-concept coherence were observed across childhood.

Narrative Ability

A one-way ANOVA also revealed an effect of age on overall narrative score, $F(4, 137) = 12.61$, $p < .001$, $\eta_p^2 = 0.27$. Five-year-olds scored lower than all other age groups (*p*s ≤ .002), and 7- to 11-

year-olds scored lower than adults ($ps \leq .007$). Significant age-related increases in narrative ability were thus also observed across childhood.

Predictors of Episodic Prospection in Children

We next examined predictors of future episodicity scores in children using simultaneous multiple-regression analyses. We restricted these analyses to children given our primary interest in factors that contribute to children's episodic prospection ability. We examined whether self-concept coherence and narrative ability significantly predicted episodic prospection after accounting for age, mean number of future event generation prompts, and episodic content in narratives about the past. This latter variable was included given the known association between recollection and prospection (Schacter & Addis 2007; Addis, et al., 2007). Interaction terms for self-concept coherence and narrative ability by age were included to examine whether the potential influence of these variables differed as a function of age.

The overall regression model was significant, $F(7, 109) = 26.50$, $p < .001$, adjusted $R^2 = .61$ (Table 1). Mean future generation prompts ($\beta = -.17$, $p = .02$), past event episodicity ($\beta = .51$, $p < .001$), and narrative ability ($\beta = .17$, $p = .02$) significantly predicted future event episodicity scores. The interaction terms for self-concept coherence by age ($\beta = -.19$, $p = .003$) and narrative ability by age ($\beta = -.15$, $p = .02$) also emerged as significant predictors. This was driven by the fact that self-concept coherence and narrative ability each positively predicted future event episodicity in younger, but not older children. Age ($\beta = .02$, $p = .85$) and self-concept coherence alone ($\beta = .13$, $p = .07$) did not significantly predict episodic prospection, and multicollinearity analysis revealed tolerance values > .50 for all predictors. To confirm that these results were not driven by extreme values, we reran this analysis after first winsorizing potential outliers using a 3 *SD* cutoff (bringing eight data points to this cutoff). Results remained the same: the model was significant, $F(7, 109) = 28.10$, $p < .001$, adjusted $R^2 = .62$, and mean future generation prompts, past event episodicity, narrative ability, self-concept coherence by age, and narrative ability by age emerged as significant predictors ($|\beta| \geq .16$, $p \leq .003$), whereas age and self-concept coherence alone did not ($\beta \leq .11$, $p \geq .12$). Again, self-concept coherence and narrative ability each positively predicted future event episodicity in younger, but not older children (Figure 3a and b).

While including past event episodicity scores as a predictor allowed us to control for the general ability to produce narratives about plausible and personal events, we also examined whether main results would change if we instead controlled for the ability to episodically simulate novel events using the episodicity scores for make-believe events. Regression results remained nearly identical, with the only difference being that the main effect of narrative ability was no longer statistically significant ($\beta = .12$, $p = .09$). We also performed two final regressions examining whether the predictors of future event episodicity would also predict past and make-believe event episodicity. These analyses were identical to those described earlier except that future event episodicity replaced past event episodicity as a predictor, mean generation prompts for past (or make-believe) events replaced mean generation prompts for future events as a predictor, and past (or make-believe) event episodicity replaced future event episodicity as the dependent variable. The only significant predictors of past event

Table 1

	Zero-Order *r*							
	1	2	3	4	5	DV	β	*SE B*
1. Age (in months)	—	−0.45***	0.43***	0.48***	0.40***	0.48***	0.02	0.08
2. Future generation prompts		—	−0.36***	−0.18*	−0.23**	−0.46***	−0.17*	0.07
3. Past event episodicity			—	0.13	0.29**	0.67***	0.51***	0.07
4. Self-concept coherence				—	0.08	0.30***	0.13	0.07
5. Narrative ability					—	0.41***	0.17*	0.07
6. Age X self-concept coherence							−0.19**	0.06
7. Age X narrative ability							−0.15*	0.06
M	103.06	2.24	3.42	0.47	2.26	2.97		
SD	27.22	1.85	0.87	0.18	2.44	0.74	Adjusted $R^2 = 0.61$	

Note. Episodic memory and episodic prospection are assessed using past and future event episodicity scores. DV = dependent variable.
*$p < .05$. **$p < .01$. ***$p < .001$.

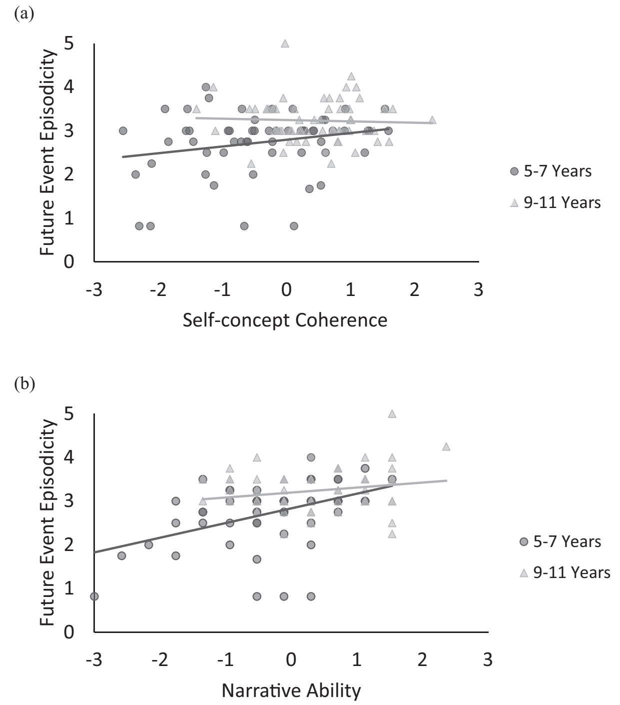

Figure 3. Correlations between future event episodicity scores ranging from 0 (*low*) to 5 (*high*), and (a) standardized self-concept coherence scores and (b) standardized narrative scores in younger compared to older children. Circles indicate 5- to 7-year-olds and triangles indicate 9- to 11-year-olds. Darker colors indicate overlapping observations.

episodicity were age, future event episodicity, and past generation prompts ($|\beta s| \geq .18$, $ps \leq .04$). The only significant predictors of make-believe event episodicity were future event episodicity and make-believe generation prompts ($|\beta s| \geq .19$, $ps \leq .02$). All significant predictors were positive with the exception of generation prompts, and neither self-concept coherence nor narrative ability predicted past or make-believe episodicity as a main effect or as an interaction with age.

Discussion

The present study examined age-related differences in episodic prospection during middle and late childhood, as well as factors that may contribute to improvements in episodic projection during these periods. We addressed these goals by comparing the episodic content in past, future, and make-believe event narratives, quantifying the prompts required to generate event narratives within each of these conditions, and assessing the influence of self-concept coherence and narrative ability. Our results show that episodic prospection may present unique challenges across development, and especially during the event generation phase for younger children. They also indicate that self-concept coherence and narrative ability support episodic prospection in younger children.

Developmental Differences in Episodic Prospection

Analyses of episodicity showed that participants' narratives of future events were less episodic than those of past events across age groups, aligning with prior work suggesting that episodic prospection is particularly challenging across development (Abram, Picard, Navarro, & Piolino, 2014; Gott & Lah, 2014). Analyses of episodicity scores also revealed that 5-year-olds scored lower than all other age groups, and that 7-year-olds scored lower than 11-year-olds and adults, reflecting developmental limitations in the capacity to imbue event mentalizations with rich contextual detail.

Despite differences in the episodic content of future versus past events, the capacity to recollect past events emerged as the most robust predictor of episodic prospection across development. This aligns with prior empirical work (Addis et al., 2007; Hassabis et al., 2007; Madore, Gaesser, & Schacter, 2014) and theoretical accounts (e.g., the constructive episodic simulation hypothesis; Schacter & Addis, 2007) supporting a functional relation between these two abilities. It also suggests that improvements in episodic memory contribute to the development of episodic prospection during middle and late childhood. The relation between episodic memory and episodic prospection held after controlling for age, mean future generation prompts, self-concept coherence, and narrative ability. Thus, it could not have been driven by their joint association with any of these variables.

Factors Underlying the Development of Episodic Prospection

When examining factors that might underlie the development of episodic prospection, we considered the extent to which developmental differences may be due to children's difficulty with event generation, as well as event construction and elaboration (i.e., episodic simulation).

Event Generation

We predicted that developmental differences in episodic prospection may be partly attributable to the demands of generating a novel event that is both personal and plausible. Analyses of prompts provided support for this prediction: 5- to 9-year-olds required a greater number of prompts for future events than adults, and 11-year-olds fell somewhere in-between the two groups. In addition, mean number of future generation prompts negatively predicted future event episodicity scores, showing that children who needed the most help generating a future event continued to be the least successful at episodic prospection. Our findings draw attention to event generation as a critical initial step which should likely be considered as distinct from subsequent episodic simulation occurring once individuals have identified a plausible future event. The comparison of age differences between prompts necessary to generate future versus both past and make-believe events bolsters the case that future event generation poses a unique challenge for children.

Comparing generation prompts across the three mentalizing conditions provides insight into why future event generation may be particularly difficult. Fewer prompts were needed for make-believe compared to past events, and fewer prompts were needed for past compared to future events. Both past and future events are constrained by reality, whereas make-believe events are not. Thus, difficulties with future event generation and to a lesser extent past event generation may be due to the demands of having to come up with an event that fits within one's plausible future or past reality. Along with others, we suggest that developmental limitations in semantic knowledge (Abram et al., 2014; Martin-Ordas et al., 2014; Willoughby et al., 2012) may make it especially difficult for children to meet these demands. As discussed in a later section, semantic knowledge about the self may be particularly critical.

Event Simulation

In addition to potential difficulties with event generation, we considered that developmental differences in episodic prospection may be due to difficulty with the construction and elaboration of a *novel event*. If children's limitations with episodic prospection derive from a general difficulty with the episodic simulation of something novel, then their difficulty should have extended to make-believe events. Across all ages, narratives about future events earned lower episodicity scores compared to make-believe events, suggesting that the simulation of a novel event in and of itself is not the main limiting factor in episodic prospection, but rather the simulation of something *plausible*. This is not to say that demands on flexible retrieval are not important, since strong age differences are evident in episodicity across all conditions, but that additional variables may also be important—two of which garnered support in the present study.

Role of Self-Concept Coherence

Results supported our prediction that self-concept coherence would contribute to episodic prospection. Indeed, self-concept coherence emerged as a positive predictor of episodic prospection in younger children. To our knowledge, this is the first demonstration of a connection between children's self-concept coherence and their developing ability to engage in episodic prospection. This finding extends previous literature showing that self-related processes influence the selective retrieval of memories that align with one's personal goals and autobiographical knowledge base (Conway & Pleydell-Pearce, 2000; Conway et al., 2004; Howe & Courage, 1997), suggesting that they might also influence the generation and episodic simulation of personal and plausible future events. The finding that self-concept coherence uniquely contributed to younger children's future event episodicity controlling for past or make-believe event episodicity scores (but not vice versa) supports the notion that future event generation may be especially demanding due to the need to come up with something plausible for the future self. However, we also note that the observed relation between self-concept coherence and episodic prospection may be in the opposite direction or bidirectional: While self-concept coherence may support the imagination of plausible future events, so might imagining one's personal future contribute to developmental gains in self-concept coherence.

It is noteworthy that self-concept coherence predicted episodic prospection in younger but not older children despite continued improvements in self-concept coherence. It is possible that older children have reached a level of coherence that is adequate for producing the type of future event narratives examined in the present study. Indeed, children start to extrapolate higher order information about who they are and begin to view themselves as extended in time during middle childhood (Harter, 1999, 2006; Jacobs, Bleeker, & Constantino, 2003); these changes likely contribute to increases in self-concept coherence during the age range for which we observed a relation between self-concept coherence and episodic prospection. Another possibility is that self-concept coherence relates to the semantic content of episodic prospection specifically, such that its influence on episodic prospection is only evident when high levels of episodicity have yet to be achieved. Future research investigating the mechanisms underlying the observed association between self-concept coherence and episodic prospection is warranted.

Narrative Ability

Results also provided support for a positive predictive relation between narrative ability and future event episodicity in younger children, aligning with prior work showing a relation between language ability (assessed via vocabulary measures) and future thinking in young children (Atance & Jackson, 2009; Hanson et al., 2014). We may not have observed a similar predictive relation in older children because they had achieved a suitable level of narrative competence, or perhaps because they approached the episodic thinking interview differently than younger children (who may have relied more on generic story-telling than episodic simulation per se). Although narrative ability was assessed primarily as a control variable, its relevance to episodic prospection (i.e., the integration of temporal and contextual details into a coherent picture) and documented relation with autobiographical memory development (Farrant & Reese, 2000; Fivush, 2011) suggest that future work may benefit from considering the potential relevance of narrative ability to episodic prospection development.

Conclusion

Together, the results provide novel insights into the development of episodic prospection during middle and late childhood, and show that episodic memory, self-concept coherence, and potentially narrative ability contribute to changes during this period. Analysis of generation prompts suggest that children's difficulty with episodic prospection may be partly attributable to limitations in event generation, suggesting that future work would benefit from conceptualizing event generation as a critical initial step in the mentalization of personal future events—complete with its own unique challenges. In addition, analysis of self-concept coherence suggests that this factor is a unique contributor to younger children's episodic prospection success. Future work aimed at further differentiating the components of episodic prospection and their relation with self-concept, language, and additional factors could therefore provide additional insight into the development of this important ability.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's website:

Table S1. Summary of Generation Phase Prompts Used During the Episodic Thinking Interview.