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Verbal Explanations and Item Choices as Joint Indices of Children's Episodic Foresight

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ABSTRACT

The ability to project oneself forward in time and imagine a future episode, known as episodic foresight (EpF), is an important aspect of future thinking. EpF tasks often involve children choosing an item for a future episode, yet the degree to which future projection is required to succeed – versus memory or semantic associations – has been debated. Using existing data (N = 158 3-to 5-year-olds) that included two popular measures of EpF (the "Spoon" and Picture-book tasks), we systematically examined the extent to which an ostensibly future-directed action (i.e., selecting the item with future utility) mapped onto future orientation, episodicity, and self-projection (assessed through pronoun use) in children's verbal explanations. For each task, we examined the effect of item choice (i.e., whether the item selected could be utilized in the future scenario or not) and age on children's verbal explanations. Results showed that children's explanations were more future-oriented and included more personal pronouns on the Picture-book task compared to the Spoon task but did not differ in episodicity or frequency of impersonal pronoun use. Further, age and item choice were significant predictors of future orientation and episodicity in children's Picture-book task explanations (but results varied by trial). On the Spoon task, age and item choice significantly predicted children's future orientation, while item choice significantly predicted episodicity. Our study highlights the correspondence between Canadian children's item choices and explanations, while also showing that verbal explanations provide unique insight into the processes involved in EpF (e.g., future orientation, episodic processes, and self-projection).

Thinking about the future is a frequent daily occurrence (e.g., D'Argembeau, Renaud, & Van der Linden, 2011) and an essential skill that develops across the lifespan (Abram, Picard, Navarro, & Piolino, 2014). For example, whereas most adults can easily imagine that warm clothing and ski gear will be needed for an upcoming ski trip, children tend to experience more difficulty and may erroneously predict a later need for inappropriate items (e.g., stickers) that will not address future needs. The capacity to mentally project oneself into the future and act with that imagined future in mind is known as *episodic foresight* (EpF; Suddendorf, 2010). EpF first emerges in early childhood and generally improves with age (Atance & Meltzoff, 2005; Suddendorf & Busby, 2005). However, researchers have debated whether some measures of EpF truly capture future self-projection or whether

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they capture other abilities (e.g., semantic or script knowledge, retrospective memory, associative learning; Atance, Celebi, Mitchinson, & Mahy, 2019; Atance & Sommerville, 2014; Dickerson, Ainge, & Seed, 2018; Hudson, Mayhew, & Prabhakar, 2011). The main motivation for the current study was to determine the degree to which two well-known EpF tasks – Spoon and Picture-book – capture processes critical to EpF including future orientation, episodicity, and self-projection. Our secondary aim was to explore factors (e.g., age, the item children select to address a future need) that might affect children's tendency to think in a future-oriented and episodic manner on such tasks.

The ability to mentally travel forward in time to consider the future is proposed to arise from episodic (remembering) and semantic (knowing) memory (Tulving, 1972, 1984). Semantic memory is thought to develop earlier than episodic memory and stores information about the world from past events not tied to a specific experience (Tulving, 2005; Tulving, Addis, & Schacter, 1985), such as knowing that beaches have sand. In contrast, episodic memory is a later developing system, which processes information about personal events (e.g., what happened and where it occurred) including temporal markers (e.g., when it occurred; Tulving, 1984, 2005), such as remembering the trip you took to the beach last week. A defining feature of episodic memory, however, is autonoetic (self-knowing) awareness allowing for the placement of oneself in a past or future time (i.e., self-projection) and thus a sense of self that is continuous in time.

Research supports the earlier development of semantic (vs. episodic) memory; for example, in one study 3- and 5-year-olds provided more information when generally describing an event (i.e., a script; "What *happens* . . . ") than when describing an episodic memory of the same event ("What *happened* . . . "). Young children also tend to provide general knowledge of events for both scripts and episodic episodes (Hudson & Nelson, 1986). Thus, both these distinct memory systems are speculated to play a role in future thinking (e.g., Atance & O'Neill, 2005; Wheeler, Stuss, & Tulving, 1997). However, episodic memory is particularly thought to aid in constructing and recombining details from one's past experiences in a novel way (see the *constructive episodic simulation hypothesis*; Addis & Schacter, 2008; Schacter & Addis, 2007) to envision the self in the future. In fact, neuroimaging studies report a common neural network (i.e., default mode network) involved in recalling one's past and imagining one's future (e.g., Schacter & Addis, 2007).

EpF is argued to first emerge in children as young as 3 years old and develops across childhood and into early adulthood (Abram et al., 2014; Atance & Meltzoff, 2005; Suddendorf & Busby, 2005). In children, the development of EpF may be gleaned from a variety of verbal and non-verbal measures. For example, in one verbal task, children answered questions about events that will occur in the future (e.g., "What are you going to do at bedtime tonight?"), events that occurred in the past ("What did you do at bedtime last night?"), and events more generally (i.e., scripts; "What do you do at bedtime?"; Quon & Atance, 2010). Three-and 4-year-olds provided less accurate responses overall and relied more on semantic memory (i.e., showed greater use of scripts) compared to 5-year-olds. Generally, then, young children (e.g., 3-year-olds) may use their semantic knowledge to support their EpF, which may be limited to considering routine events, in simple contexts. In contrast, advancements in EpF may be evidenced by more independent thinking about the future across complex and novel events, possibly as a function of improvements in other cognitive abilities (e.g., memory, executive function, language; Hudson et al., 2011).

In recent years, researchers have argued for the importance of testing children's EpF using non-verbal measures, since verbal measures can either underestimate or overestimate children's competence (see Suddendorf & Busby, 2005 for discussion). Two of the most popular means to do so include the "Spoon" task (e.g., Suddendorf, Nielsen, & Von Gehlen, 2011) and the Picture-book task (e.g., Atance & Meltzoff, 2005). The Spoon task (Suddendorf & Busby, 2005) evaluates children's ability to solve a novel problem in the future, such as selecting an appropriate tool for future use. In a typical Spoon task, children encounter a problem in one room (e.g., a puzzle board without puzzle pieces, a locked box) and are then brought to another room for a brief delay after which they are presented with an array of items including one (e.g., puzzle pieces, a key) that can solve the problem or fulfil a future need in the previous room (e.g., bringing puzzle pieces to avoid boredom or a key to open a locked box to retrieve an object; Suddendorf & Busby, 2005; Suddendorf et al., 2011). Research using the Spoon task and its variants show age-related improvements in children's ability to select the item that will fulfill physiological (Caza & Atance, 2019) and psychological (e.g., Atance & Sommerville, 2014; Caza & Atance, 2019; Suddendorf & Busby, 2005) future needs.

The Picture-book task is another commonly used measure of EpF that assesses children's ability to anticipate their future needs in a specific novel location. In the original version of the task, 3- to 5-year-olds imagine visiting a desert, rocky stream, dirt road, snowy forest, mountain, and waterfall in the future (Atance & Meltzoff, 2005). For each location, children select an item to bring with them. Whereas the correct item addresses a future need or state likely to be experienced in the location (e.g., sunglasses to keep the sun out of one's eyes in the sunny desert), the distractor items (e.g., soap) or semantic associate (e.g., seashell) do not. Results tend to show that 5-year-olds select the correct item more often than 3- and 4-year-olds. Further, 3-and 4-year-olds' errors are often due to selecting the semantic associate over the correct item. Overall, studies using the Picture-book task consistently report developmental improvements in children's ability to select the correct item for the future (e.g., Atance & Jackson, 2009; Hanson, Atance, & Paluck, 2014; Mahy, Grass, Wagner, & Kliegel, 2014; Mazachowsky, Atance, Mitchinson, & Mahy, 2020; Mazachowsky & Mahy, 2020).

In addition to selecting an item for future use (non-verbal component), in both the Spoon and Picture-book tasks, children are sometimes asked to explain their item choices. On the Spoon task, Suddendorf et al. (2011) reported a relation between performance on the non-verbal choice component and children's verbal explanations for their choice; more specifically, the majority of children who selected the correct item also referred to its future use in their explanations (e.g., selecting the key "to get stickers"). Atance and Sommerville (2014) also reported correspondence between children's item choices and explanations such that children's explanations for their item choice frequently referenced the problem encountered or action they would take in the previous room when they chose the correct item (i.e., 46% of 3-year-olds, 79% of 4-year-olds, and 81% of 5-year-olds). Using a more naturalistic method, children's spontaneous utterances on an adapted version of the Spoon task have also been examined (Caza & Atance, 2019). In this case, children who correctly placed an item where it would be needed in the future also made more future and past spontaneous remarks during the task than those who failed the task. Thus, research seems to suggest a correspondence between children's success on the item choice component of the Spoon task and temporally focused explanations (i.e., references to the future or past).

Children's explanations for their item choices have also been measured and examined in the Picture-book task as an indicator of EpF (e.g., Atance & Jackson, 2009; Atance & Meltzoff, 2005; Atance & O'Neill, 2005; Hanson et al., 2014; Mahy et al., 2014; Mazachowsky et al., 2020; Mazachowsky & Mahy, 2020). However, only some studies have examined verbal and non-verbal components separately (e.g., Atance & Meltzoff, 2005; Atance & O'Neill, 2005; Mazachowsky et al., 2020). For example, Atance and Meltzoff's (2005) analysis of children's explanations revealed that 5-year-olds tended to refer to the future (e.g., "It's *gonna* be hot") and future states (e.g., "I *will* get *hungry*") they would likely experience in the locations significantly more than younger children. Other studies examining children's verbal explanations on the Picture-book task have found that children tend to provide more present than future-oriented references on the task (e.g., Atance & O'Neill, 2005; Mazachowsky et al., 2020) and refer to semantic and episodic details approximately equally (Mazachowsky et al., 2020). Thus, based on this previous research, EpF tasks, including Picture-book, may not engage children's future thinking as intended (see also Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Hudson et al., 2011; Martin-Ordas, Atance, & Caza, 2014). Further, engagement in EpF may vary in older and younger children given the earlier emergence of semantic memory, as compared to episodic memory (e.g., Wheeler et al., 1997). Importantly, previous studies have yet to systematically examine the correspondence between item choice performance and explanations with the explicit goal of determining whether these tasks are drawing on episodic and future-oriented processes, as well as self-projection (i.e., whether children make self-reference using personal pronouns in their explanations).

As with the Picture-book task, the extent to which the Spoon task succeeds in tapping EpF has been questioned (Atance et al., 2019; Dickerson et al., 2018; Martin-Ordas, 2017; Moffett, Moll, & FitzGibbon, 2018). For example, Atance and Sommerville (2014) found that 3- to 5-year-olds' success in selecting the correct item for the future was accounted for by children's memory for the past problem (i.e., what object was in the first room) and not by age-related improvements in future thinking. This finding suggests that selecting the correct item in the Spoon task may not capture future self-projection but, rather, other underlying processes, such as episodic memory. However, in Suddendorf et al.'s (2011) version of the task, children choose between various keys, thus limiting their ability to select the correct item based on the semantic association between lock and key (Martin-Ordas, Atance, & Louw, 2012). More broadly, Suddendorf et al. (2011) argue that Spoon tasks engage EpF since they consist of: (1) single trials to avoid stimulus-reward relationships, (2) novel problems to avoid reliance on previous learning, and (3) varied temporal and spatial contexts that require future action. Hudson et al. (2011) also suggest that EpF tasks should involve a specific future event, the *self* in this future event, and a specific moment in time. Yet, the extent to which existing measures capture the processes involved in EpF has not been systematically explored, nor compared, but could be accomplished by analyzing whether children's explanations in EpF tasks are future-oriented, episodic, and elicit self-projection. Thus, exploration of children's explanations, in conjunction with children's item choices, would shed further light on whether episodic and future-oriented processes are engaged in the Picture-book and Spoon tasks; and, also, whether these processes may differ between the two tasks.

The current study

The main goal of the current study was to use a naturalistic approach to explore children's explanations that accompanied their item choices on two EpF tasks: Spoon and Picture-book. Explanations were coded for temporal focus (future-oriented or non-future-oriented) and episodicity (episodic or non-episodic) to compare children's engagement in episodic and future-oriented thinking between tasks. We also coded for self-projection indexed by children's use of personal (e.g., "I," "my") versus impersonal (e.g., "you," "she") pronouns, since the use of pronouns may provide insight as to whether children were considering themselves during the tasks (i.e., the extent to which they were engaging in self-projection). If children are using self-projection more on one task versus the other, then we might expect differences in reference to the self in their explanations (i.e., the use of more personal pronouns on the task). We predicted that children's explanations for their item choices on the Spoon task would be more future-oriented, episodic, and contain more personal pronouns compared to the Picture-book task given arguments that the Spoon task might better engage EpF and rely less on semantic associations and scripts.

Our secondary goal was to examine the contributions of age and item choice performance on children's use of future orientation and episodicity in their explanations separately for each task. We hypothesized: (1) an effect of age such that older children's explanations would be more future-oriented and episodic compared to younger children's explanations, and (2) an effect of item choice performance such that children who selected the correct item should correspondingly provide more future-oriented and episodic explanations than children who selected the incorrect item. We also explored the interaction between age and item choice performance, although we did not make any specific hypotheses for this interaction. In addition, for children who made the correct item choice (i.e., passed the non-verbal component of the task), we separately examined whether age would predict children's use of episodicity and future orientation in their explanations.

Finally, given Atance et al.'s (2021) finding that conflict impacted children's item choice performance on the Spoon and Picture-book tasks, we were also interested in exploring whether children's explanations would be affected by the level of conflict (i.e., whether the task requires children to reason about a future need or desire that conflicts with a present need or desire inherent to the task).

Method

Participants

One hundred and sixty-five 3-to 5-year-old children participated in the study. Seven children were excluded for failure to complete the entire experiment (n = 4), experimenter error (n = 1), uncooperativeness (n = 1), and falling outside of the age range at time of test (n = 1). The final sample consisted of 158 children (52 3-year-olds: M_{age} = 42.87 months, SD_{age} = 2.66, 50% female; 53 4-year-olds: M_{age} = 53.68 months, SD_{age} = 3.38, 49% female; 53 5-year-olds: M_{age} = 65.30 months, SD_{age} = 3.40, 49% female). The majority of children were White (65%; 17% mixed ethnicity, 11% identified as another ethnicity, and 7% provided no response) and from families earning more than $80,000 annually (75%). All children were fluent in English (89% reported English as their first language).

Measures

Spoon task

In the Spoon task (adapted from Atance & Sommerville, 2014; Suddendorf et al., 2011), children visited a room ("the Rainbow Room") with a locked transparent box containing Smarties and marshmallows. The experimenter showed children that the box containing these treats was locked before proceeding to the testing room. After a delay period of approximately 10 minutes that involved completing several cognitive measures in the testing room (two theory of mind tasks and two executive function tasks not reported here), children were told they were going back to the Rainbow Room and could select one of four items to bring with them. In what was called the "low-conflict" condition, the distractor items were less desirable for the child's current-self (i.e., scissors, eraser, and ruler) compared to the correct item (i.e., a key). In the "high-conflict" condition, two of the distractor items were highly desirable for the child's current-self (i.e., a Smartie and a marshmallow) compared to the correct item (i.e., a key) and another distractor item (i.e., ruler).[1] Following their item selection, children explained their choice ("*How come you chose the* __?"), which was the focus of the current study. Children then returned to the Rainbow Room where they obtained the treats regardless of their item choice.

Picture-book task

In the Picture-book task (adapted from Atance & Meltzoff, 2005), children imagined visiting four novel locations in the future (e.g., a long dirt road, a steep mountain, a waterfall, and a rocky stream) and were asked by the experimenter to select one of the three provided items to take with them to the future location. One of the items was the correct choice (e.g., Band-Aids), which would address a future need at the location (i.e., useful if one were to slip and fall on the rocks), while the other two items were the distractors (e.g., pillow, toothpaste). After making an item selection, children were asked to explain their choice ("*Why do you need to bring the*__?"). In the low-conflict condition, the distractor items were less desirable to a child's current-self (e.g., pillow, toothpaste), while in the high-conflict condition, the items (e.g., teddy bear, game) were more desirable to the child's current-self. The focus of the current study was the explanations children provided for their item choices at the end of the task (for details on the item choices for each location and analysis of children's item choice performance, see Atance et al., 2021).

[1]In Atance et al. (2021), children were randomly assigned to a high- (n = 80) or low- (n = 78) conflict condition (between subjects). The conflict conditions differed according to the item choices children were provided within the Spoon and Picture-book task. Children also completed the Spoon and Picture-book tasks from the perspective of the self and another person (within-subjects) resulting in four different protocol versions. The current study only examined children's explanations on the Spoon and Picture-book tasks from the self-perspective condition. However, we ran chi-squared analyses to check that the protocol version did not affect the temporal focus or episodicity of children's explanations. Our chi-square analyses showed no significant difference in episodicity (episodic vs. non-episodic) or temporal focus (future vs. non-future) between the four protocol versions on the Spoon and Picture-book task, $\chi^2(3) = 0.33–4.15$, $ps = .25–96$.

Despite conflict impacting children's item choice performance in Atance et al. (2021), when included in our model, conflict was not a significant predictor of the temporal focus or episodicity of their explanations on the Spoon (temporal focus: *Wald* $\chi^2(1) = 2.19$, $p = .14$, Exp(B) = 0.59; episodicity: *Wald* $\chi^2(1) = 3.04$, $p = .08$, Exp(B) = 0.57) or Picture-book task (temporal focus: *Wald* $\chi^2(1) = 0.09$, $p = .77$, Exp(B) = 0.91; episodicity: *Wald* $\chi^2(1) = 0.43$, $p = .51$, Exp(B) = 0.81) and was dropped from our analysis.

Procedure

Children were individually tested in a 45-minute session at the University of Ottawa. The Rainbow Room used for the Spoon task was adjacent to the testing room. Parents provided consent and children provided verbal assent before completing a battery of future thinking and other cognitive measures (which were part of a larger study by Atance et al., 2021, but are not discussed here) in a fixed order including the two EpF measures (the Picture-book task followed by the Spoon task). After the session, children received a small toy and parents received complimentary parking. All procedures were approved by the research ethics board at the University of Ottawa and Brock University. Data for this study were collected as part of a larger, previously published study by Atance et al. (2021) in which children's explanations were not analyzed.

Coding of children's explanations

See Table 1 for example explanations and the corresponding coding categories.

Temporal focus

First, children's explanations were coded for temporal focus across several dimensions (adapted from Mahy, 2016; Mazachowsky et al., 2020): (1) *future*-oriented if the explanations referenced the future or future uncertainty (e.g., *will, going to, get, could, should, might, in case*, etc.), (2) *present*-oriented if the explanations referenced the present, a general convention, or current state (e.g., *want to, have to, it's, do, am*, etc.), (3) *general preference* if the explanations referenced the child's preference for something (e.g., *love, like, prefer, healthy*), (4) *other* if the explanations did not fit the previous categorizations (e.g., referenced the past, provided a single word response), or (5) *no response* if children did not provide an explanation for their choice (e.g., no response, "don't know," "because"). If children's explanations included "I don't know" as well as further explanation (e.g., "because I don't know, I wanna choose"), the second part of the explanation was still coded according to one of the four categories above. Some explanations contained multiple parts or clauses and were assigned to multiple categories (e.g., "I like teddy bears [general preference] because they gonna keep you warm [future-oriented]"). Explanations were coded by two independent coders and disagreements were later resolved by discussion. Agreement for temporal focus coding was very high, $\kappa = .87$.

Table 1. Examples of children's explanations on the Picture-book and Spoon tasks and corresponding coding category.

Example explanation (Task)	Coding Category
Temporal Focus	
"because if it gets rainy" (Picture-book: Waterfall)	Future
"because I am so tired" (Picture-book: Stream)	Present
"because I like crunchy stuff" (Spoon)	General preference
"because I was getting thirsty there" (Picture-book: Dirt road)	Other
Episodicity	
"because when I hungry I gonna eat there" (Picture-book: Mountain)	Episodic
"because it looks different" (Spoon)	Semantic
"so I can go under it so I can be a good boy" (Picture-book: Waterfall)	Both
"to drink" (Picture-book: Dirt road)	Other

Episodicity

Second, children's explanations were coded for indications of episodic details (internal focus) related to the specific, future event (i.e., visiting a location in the Picture-book task, or visiting the other room/retrieving candy from the box in the Spoon task) or semantic details (i.e., external details or details about an unrelated event). Children's explanations were coded as (adapted from Levine, Svoboda, Hay, Winocur, & Moscovitch, 2002; Mazachowsky et al., 2020): (1) *episodic* if the explanations referenced specific details about the event (e.g., happenings during the event, time of day, perceptual details, etc.), (2) *semantic* if the explanations referenced general knowledge about the location (e.g., "because roads are long"), factual details, or details not central to the main event (e.g., "I like cutting paper"), (3) *both semantic and episodic* if the explanations referred to both episodic and semantic details, or (4) *other* if the explanations were too vague or unclear, or if children did not provide a response (e.g., "don't know," "because"). Agreement was very high between two independent coders, $\kappa = .89$.

Future event referenced in Spoon task

For the Spoon task, explanations were further coded for exploratory purposes to determine the future event children referred to most frequently in their explanation: (1) opening the box (jar, container, etc.), (2) going to the other room or the door to the other room, or (3) another event or "uncodable." Agreement for future event coding by the two independent coders was almost perfect, $\kappa = .96$.

Pronoun use

Finally, the use of personal/first-person pronouns (e.g., *I, me, we, ourselves, myself*, etc.) and impersonal pronouns (e.g., second or third person; *you, he, their, hers, its, it, yourself*, etc.) were counted in each explanation. Explanations of "I don't know" received a personal pronoun count of zero. Each use of the pronoun was counted even if it was used multiple times throughout the explanation. Agreement by the two independent coders was almost perfect for personal ($\kappa = .98$) and impersonal ($\kappa = .99$) pronoun use.

Results

Table 2 shows frequencies of coding categories for the Picture-book (by location) and Spoon task explanations.

Preliminary analyses

Before performing our main analyses, we further refined our coding categories for interpretability and to reduce infrequently used categories. For temporal focus, first, given that a small number (3–5%) of children's explanations included multiple clauses and the majority of these included a future-oriented clause, we assigned these explanations to one category only. Specifically, for the multiple-clause explanations, if at least one clause was future-oriented the explanation was assigned to the *future* category, while explanations that included at least one present-oriented clause (but not a future-oriented clause) were assigned to the *present* category. Then, because our main interest was whether children

Table 2. Coding category descriptives for the Picture-book task (by location) and the Spoon task explanations.

Coded category	Dirt Road	Mountain	Waterfall	Stream	Picture-book Average	Spoon task Average
Temporal Focus						
Future	50.6%	56.3%	63.9%	67.7%	59.6%	25.3%
Present	30.4% (3.8%)	25.3% (3.2%)	21.5% (2.5%)	18.4% (3.2%)	23.9% (3.2%)	42.4% (9.5%)
Other	1.9%	2.5%	1.9%	1.3%	1.9%	7.6%
No response	10.1%	7.6%	8.9%	5.7%	8.1%	11.4%
Multiple	3.2%	5.1%	1.3%	3.8%	3.4%	3.8%
Episodicity						
Episodic	46.8%	47.5%	59.5%	62.7%	54.1%	50.6%
Semantic	37.3%	37.3%	21.5%	23.4%	29.9%	30.0%
Both	1.9%	1.9%	2.5%	1.3%	1.9%	0.0%
Other	13.9%	13.3%	16.5%	12.7%	14.1%	19.4%
Pronoun use						
Personal	.88 [1.19]	.82 [.86]	.63 [.78]	.86 [1.30]	.80 [.78]	.49 [.62]
Impersonal	.48 [.77]	.39 [.79]	.62 [.78]	.68 [1.09]	.54 [.66]	.56 [.71]
Future Event						
Opening box	-	-	-	-	-	44.9%
Going to other room	-	-	-	-	-	11.4%
Other	-	-	-	-	-	43.7%

N = 158. Percentage of explanations that referenced a general preference in brackets. Standard deviations in square brackets.

were focused on the future in their explanations, or not, we collapsed the *present, general preference, other*, and *no response* categories to create a *non-future* category. Thus, the temporal focus categories examined in the main analyses were *future* and *non-future*.

For episodicity, because a small number of explanations included *both episodic and semantic* details (i.e., 2% for the Picture-book task, none for the Spoon task), this category was collapsed into the *episodic* category. Then, we collapsed the *semantic* and *other* categories together to create a *non-episodic* category. Thus, the episodicity categories examined in the main analysis were *episodic* and *non-episodic*.

Effect of task

First, we examined whether explanations would be more *future*-oriented (versus *non-future* -oriented) and *episodic* (versus *non-episodic*) on the Spoon, compared to the Picture-book task (collapsed across locations). Further, we were interested in whether the use of personal versus impersonal pronouns would differ between tasks. For the Picture-book task, we took the average pronoun use across the four locations.

Next, to compare the four Picture-book location trials to the single trial of the Spoon task, the number of future or episodic explanations for each of the four locations was summed (i.e., range of 0 to 4). Children who provided a future-oriented or episodic explanation on three or more trials were given a score of 1 (*future* or *episodic*), or a score of 0 (*non-future* or *non-episodic*) if they provided a future-oriented or episodic explanation on two or fewer trials. Using this coding, children received credit for providing a future-oriented explanation on the Picture-book task overall if they provided a future-oriented explanation on at least 75% of trials.

Temporal focus

Using logistic regression, we entered task type (Spoon and Picture-book) as a within-subjects predictor of temporal focus of children's explanations (*future* or *non-future*). Our analysis indicated that task type significantly predicted temporal focus, *Wald* $\chi^2(1) = 35.54$, $p < .001$, Exp(B) = 3.41. The odds of children on the Picture-book task providing an explanation that was future-oriented over one that was not were 3.41 times greater than on the Spoon task. This pattern of results was consistent when each Picture-book location was compared to the Spoon task separately to predict temporal focus, *ps* < .001.

Episodicity

Next, we ran a logistic regression with task type (Spoon and Picture-book) as a within-subjects predictor of episodicity of children's explanations (*episodic* or *non-episodic*). We found that task type did not predict the episodicity of children's explanations, *Wald* $\chi^2(1) = 1.18$, $p = .28$, Exp(B) = 0.80.

However, when the Spoon task was compared to each Picture-book location separately, task type emerged as a significant predictor of episodicity for the waterfall, *Wald* $\chi^2(1) = 5.31$, $p = .02$, Exp(B) = 1.59, and stream locations, *Wald* $\chi^2(1) = 8.24$, $p = .004$, Exp(B) = 1.73, such that children were only more apt to provide episodic versus non-episodic explanations on the waterfall and stream locations of the Picture-book than on the Spoon task.

Pronoun use

Finally, using paired-samples t-tests, we compared the number of personal (e.g., "I," "we" etc.) and impersonal (e.g., "you," "they") pronouns in children's explanations on the Spoon and Picture-book task (averaged across the four locations). We found that children used significantly more personal pronouns in their Picture-book task explanations ($M = 0.80$, $SD = 0.78$) compared to their Spoon task explanations ($M = 0.49$, $SD = 0.62$), $t(157) = 4.73$, $p < .001$. The pattern of results for personal pronoun use was consistent when the Spoon task was compared to each Picture-book location separately, *ps* < .05.

Children's use of impersonal pronouns on the Picture-book ($M = 0.54$, $SD = 0.66$) and Spoon tasks ($M = 0.56$, $SD = 0.71$) did not significantly differ, $t(157) = -.18$, $p = .86$. When the Spoon task was compared to each Picture-book location separately, we found that children used significantly fewer impersonal pronouns on the Picture-book task mountain location ($M = 0.39$, $SD = 0.79$) compared to the Spoon task, $t(157) = -2.06$, $p = .04$.

Effect of age and item choice performance

Next, we conducted logistic regressions to investigate predictors of temporal focus and episodicity separately for the Spoon and Picture-book tasks (see the Appendix for a summary of significant predictors of episodicity and temporal focus across tasks). When reporting the effects of the individual predictors or interactions, all other variables in the model were held constant. Thus, taking a hypothesis-based approach to our analyses, age in months (centered at the mean), item choice performance (whether children selected the "correct" or "incorrect" item to take with them to a future location; see Atance et al., 2021) were entered as predictors simultaneously into block 1 of the regression, while the two-way age by choice interaction was entered stepwise in block 2 as a predictor of temporal

focus (i.e., *future, non-future)* or episodicity (i.e., *episodic, non-episodic*) categories. For the Picture-book task, each location was analyzed separately so item choice performance reflected performance on the individual location trial only. Only significant results are reported.

Spoon task

Temporal focus. On the Spoon task, children's age significantly predicted their temporal focus. For every one-month increase in children's age, the odds of providing a *future*-oriented explanation increased by 6%, *Wald* $\chi^2(1) = 7.16$, $p = .007$, Exp(B) = 1.06. Item choice performance was also a significant predictor of the temporal focus of children's explanations. The odds of children who selected the correct item providing a *future* explanation was 2.53 times greater than children who selected the incorrect item, *Wald* $\chi^2(1) = 4.08$, $p = .04$, Exp(B) = 2.53.

Episodicity. Item choice performance was a significant predictor of the episodicity of children's explanations. The odds of children who selected the correct item providing an *episodic* explanation was 21.14 times greater than children who selected the incorrect item, *Wald* $\chi^2(1) = 37.14$, $p < .001$, Exp(B) = 21.14.

Picture-book task

First, we examined whether coding proportions differed across the four locations on the Picture-book task: temporal focus coding categories (*future* vs. *non-future*) and episodicity coding categories (*episodic* vs. *non-episodic*) differed by location, $\chi^2(3) = 11.29$, $p = .01$, and $\chi^2(3) = 12.56$, $p = .006$, respectively. Thus, we ran our analyses for the Picture-book task separately for each location.

Temporal focus. Children's age in months significantly predicted the temporal focus of their explanations across all locations, except for the dirt road location. For every one-month increase in age, the odds of children providing a *future*-oriented explanation increased by 14% for the mountain location, *Wald* $\chi^2(1) = 29.95$, $p < .001$, Exp(B) = 1.14, 8% for the waterfall location, *Wald* $\chi^2(1) = 12.93$, $p < .001$, Exp(B) = 1.08, and 11% for the stream location, *Wald* $\chi^2(1) = 15.27$ $p < .001$, Exp(B) = 1.11. Item choice performance was also a significant predictor of temporal focus for all locations. The odds of children who selected the correct item providing a *future*-oriented explanation was 4.31 times greater for the dirt road location, *Wald* $\chi^2(1) = 12.09$, $p < .001$, Exp(B) = 4.31, 3.65 times greater for the mountain location, *Wald* $\chi^2(1) = 5.46$, $p = .02$, Exp(B) = 3.65, 4.36 times greater for the waterfall location, *Wald* $\chi^2(1) = 13.73$, $p < .001$, Exp(B) = 4.36, and 6.87 times greater for the stream location, *Wald* $\chi^2(1) = 19.71$, $p < .001$, Exp(B) = 6.87, compared to children who selected the incorrect response.

Episodicity. Children's age significantly predicted the episodicity of their explanations for the mountain, waterfall, and stream locations. For every one-month increase in age, the odds of providing an e*pisodic* explanation increased by 6% for the mountain location, *Wald* $\chi^2(1) = 8.89$, $p = .003$, Exp(B) = 1.06, 6% for the waterfall location, *Wald* $\chi^2(1) = 6.53$, $p = .01$, Exp(B) = 1.06, and 9% for the stream location, *Wald* $\chi^2(1) = 14.46$, $p < .001$, Exp(B) = 1.09. Item choice performance was also a significant predictor of episodicity for the dirt road,

waterfall, and stream locations. The odds of children who selected the correct item providing an *episodic* explanation was 5.34 times greater for the dirt road location, *Wald* $\chi^2(1) = 13.60$, $p < .001$, Exp(B) = 5.34, 20.37 times greater for the waterfall location, *Wald* $\chi^2(1) = 38.53$, $p < .001$, Exp(B) = 20.37, and 8.54 times greater for the stream location, *Wald* $\chi^2(1) = 24.86$, $p < .001$, Exp(B) = 8.54, compared to children who selected the incorrect item.

Finally, we explored whether age would predict use of temporal focus and episodicity in children's explanations, but only for children who selected the correct item on the non-verbal component of the Spoon or Picture-book task. To do so, we entered age in months into our model. On the Spoon task, children's age significantly predicted their temporal focus, *Wald* $\chi^2(1) = 6.23$, $p = .01$, Exp(B) = 1.06, but not episodicity. On the Picture-book task, age continued to significantly predict the temporal focus of children's explanations across a majority of the locations [i.e., mountain, *Wald* $\chi^2(1) = 25.61$, $p < .001$, Exp (B) = 1.14; waterfall, *Wald* $\chi^2(1) = 5.46$, $p = .02$, Exp(B) = 1.06; stream, *Wald* $\chi^2(1) = 7.66$, $p < .006$, Exp(B) = 1.10] and the episodicity of children's explanations for two of the four locations [i.e., mountain, *Wald* $\chi^2(1) = 8.14$, $p = .004$, Exp(B) = 1.06; stream, *Wald* $\chi^2(1) = 10.58$, $p = .001$, Exp(B) = 1.10)].

Discussion

The overall goal of the current study was to systematically compare children's verbal explanations across two commonly used EpF tasks (i.e., Spoon and Picture-book) to determine the extent to which these tasks tap into future-oriented and episodic processes, as well as self-projection. Although previous research has examined the future orientation and episodicity of children's explanations in the Picture-book task (e.g., Atance & Meltzoff, 2005; Atance & O'Neill, 2005; Mazachowsky et al., 2020, but see Suddendorf et al., 2011 for examination of future orientation on the Spoon task), the current study is the first to compare engagement in the processes involved in EpF (e.g., future orientation, episodicity, self-projection) across two different tasks.

From the findings of the current study, two main conclusions can be drawn: (1) non-verbal (i.e., item choice) and verbal performance generally correspond on these EpF tasks, where verbal explanations that accompany correct item choices seem to engage future-oriented and episodic processes; and (2) verbal explanations may tap into future-oriented and episodic processes to varying degrees across different EpF tasks. More specifically, in contrast to our prediction that children's explanations would be more future-oriented and elicit more self-projection on the Spoon task, we found that children were more apt to provide a future-oriented explanation and used more personal pronouns on the Picture-book task. Episodicity and impersonal pronoun use did not differ between the tasks. Consistent across the Spoon and Picture-book tasks (except for the dirt road location), age significantly predicted temporal focus, such that children provided more future-oriented than non-future-oriented explanations with increasing age. Further, on both tasks, children who made a correct item choice tended to provide a future-oriented explanation. A slightly different pattern of findings emerged for the episodicity of children's explanations. Across most Picture-book locations (except the dirt road), explanations were more episodic than non-episodic with age. Yet, age did not predict the episodicity of

children's explanations on the Spoon task. In addition, on the Spoon and Picture-book tasks (except the mountain location), children who made the correct item choice were more apt to provide episodic than non-episodic explanations.

Comparing the Picture-book and Spoon tasks

One of the main goals of the current study was to use children's explanations to explore whether EpF tasks differentially engage future-oriented, episodic, and self-projection processes. Importantly, children's verbal explanations, like those used in the current study, can be utilized to complement performance-based, non-verbal components to understand the temporal capacities these tasks recruit. Previous literature has argued that children may perform well on EpF tasks, like Picture-book, by relying on semantic knowledge, and thus without projecting themselves in the future. In contrast, the Spoon task is argued to better engage episodic future thinking (e.g., Suddendorf et al., 2011). Interestingly, however, our results showed that children were more likely to provide future-oriented explanations and use more first-person pronouns for their item choices on the Picture-book task than on the Spoon task. While item-choice tasks, like the Picture-book, have been criticized because they may not require future projection and instead rely on learned associations (e.g., Martin-Ordas et al., 2014; Suddendorf et al., 2011), our findings suggest that children are referring to the future and referencing themselves in this imagined future. Finally, we also found that children's use of episodic versus non-episodic details (i.e., semantic or other details combined) did not differ across both tasks. Descriptively, children provided more episodic details and fewer semantic details across both tasks. This finding suggests that children may recruit both episodic and semantic memory when generating future events or scenarios (e.g., see the constructive episodic simulation hypothesis; Schacter & Addis, 2007, and the semantic scaffolding hypothesis; Irish & Piguet, 2013). In sum, episodicity and future orientation gleaned from children's explanations may each provide unique insight into children's future reasoning across different EpF tasks.

Our findings from children's explanations suggest that the Picture-book task better aligns with Hudson et al.'s (2011) EpF criteria, which include considering the self in a specific event and at a specific moment in time. We offer several possibilities for why the Spoon task (at least the verbal component) did not emerge as a more sensitive measure of EpF compared to the Picture-book task as we initially expected. First, our findings could be due to the version of the Spoon task used in the current study where children could select the appropriate item by drawing on their memory for the past event (i.e., selecting the key to open the locked box in the previous room). Comparatively, children were relatively less likely to have recently walked along a long dirt road, or underneath a waterfall (etc.) that they could draw on in the Picture-book task. Accordingly, less reliance on memory for a past event could have prompted engagement in future orientation on the Picture-book versus Spoon task. Indeed, research has shown that: (1) performance on the Spoon task is worse after longer delays between the past event and item selection (i.e., finding a locked chest and selecting an item 24 hours later vs. 15 minutes later; Scarf, Gross, Colombo, & Hayne, 2013) and (2) after controlling for memory for the past event, age-related development in future thinking no longer predicts item choice performance on the Spoon task (Atance & Sommerville, 2014). These past findings support the idea that the Spoon task may rely more on memory as opposed to EpF.

Previous research also supports that the abstract nature of the Picture-book task, which requires children to imagine a distant and novel future scenario, may evoke greater reliance on future projection. In comparison, the Spoon task requires thinking about a more immediate and real future event that has previously occurred (Atance & Sommerville, 2014; McColgan & McCormack, 2008). Further, we found that children referred to the future event of unlocking the box (45%) no more often than other, unrelated or unclear events (44%) on the Spoon task, suggesting the specific future event may have been ambiguous in this task. Descriptively, our coding of episodicity across the two EpF tasks showed that 13–19% of children provided an explanation that fell into the "other" category (i.e., did not fit the coding criteria for an episodic or semantic explanation) and this frequency was higher on the Spoon (19.1%) than the Picture-book task (14.1%). These descriptive findings may support the more ambiguous nature of the future event in the Spoon task compared to the Picture-book task, which could have made it difficult for children to justify their item choice. Thus, when researchers are considering children's EpF, they should be mindful of the different degrees to which EpF may be engaged between various tasks and make concerted efforts to modify these tasks to best capture the targeted cognitive ability.

Development of future orientation and episodicity

Age-related development in children's future talk has been reported in several studies, suggesting that children talk about the future or use future temporal terms in the early preschool years, and do so increasingly as they get older (e.g., Atance & O'Neill, 2005; Busby & Suddendorf, 2005; Grant & Suddendorf, 2011; Hayne et al., 2011; Mazachowsky et al., 2020). We similarly found that older children referenced the future in their explanations more frequently than younger children on the Spoon and Picture-book tasks. Descriptively, our findings also suggest that preschool-aged children frequently explained their item choices using temporally focused references (i.e., children's explanations were most frequently initially categorized as "future" or "present"). Further, the impact of age on the temporal focus of children's explanations was consistent across Picture-book task locations, except for the dirt road location. Other research using the Picture-book task (or an earlier version: The Trip task) has descriptively reported variance in children's use of future references across different locations or after the selection of certain items (e.g., Atance & Meltzoff, 2005; Atance & O'Neill, 2005). For example, Atance and O'Neill (2005) found that children most frequently referred to future uncertainty when discussing the use of a band-aid on a trip (i.e., to avoid injury) and less so when discussing the future use of a teddy bear (i.e., to provide comfort). The salience or novelty of certain situations may also elicit more hypothetical future talk than more familiar situations (Atance & O'Neill, 2005). It may be that children's familiarity with certain situations impacted their use of future orientation or episodicity over and above age. For example, the item that addressed the future need for the dirt road location of the Picture-book task was water to quench thirst after walking along the dirt road, which may have been easier for even the younger preschool children to imagine given the regularity with which they experience thirst. Accordingly, future research should continue to examine why certain locations or item choices may prompt greater focus on the future or present.

In contrast to our prediction, the episodicity of children's explanations in the Spoon task was not predicted by children's age (nor was the episodicity of children's explanations on the dirt road location of the Picture-book task). These results contrast with previous work showing that children use more episodic details in their narratives or verbal explanations across childhood (e.g., Coughlin, Lyons, & Ghetti, 2014; Mazachowsky et al., 2020). Yet, these findings align with other research suggesting that both episodic and semantic memory may play a role in future thinking (e.g., Irish & Piguet, 2013). As with temporal focus, the extent to which a child may episodically project into an event and recruit episodic processes (versus non-episodic processes, such as semantic processes or other knowledge), over and above development in those processes, may be dependent on the context or the type of event. Further, in the current study, age did not predict whether children provided more episodic than non-episodic explanations for the dirt road location, which may have been affected by children's past experience and general knowledge of thirst that they could then draw upon in their rationale for needing water in the future. Overall, our results indicate that in the early preschool years children rely on both episodic and semantic processes to justify their future choices and may use more future orientation as they get older depending on the task, or scenario presented within the task.

Item choice performance

As expected, item choice performance consistently predicted the temporal focus and episodicity of children's explanations on both EpF tasks (except for the mountain location of the Picture-book task). These findings support the correspondence between children's ability to select an appropriate item for the future and their ability to project into the future and draw on episodic processes to explain their choice. For example, our Spoon task findings align with Suddendorf et al. (2011) who reported a relation between correct tool selection and reference to its future utility in 3-and 4-year-olds' explanations for their tool selection. Thus, it seems that children who are more successful in identifying future needs are also more apt to rationalize their choice using future-oriented and episodic references on EpF tasks. Notably, examining both verbal and non-verbal task components can provide more nuanced information pertaining to the processes involved in EpF (e.g., episodic and semantic memory, self-projection).

Limitations and future directions

Studies using verbal measures of future thinking in the preschool-age group have proposed that children's responses may be limited by their vocabulary or verbal ability and understanding of temporal terms (e.g., Hudson et al., 2011). For example, Grant and Suddendorf (2011) found that 3- to 5-year-olds gradually produce and begin to correctly utilize temporal terms, with some terms (e.g., later, soon) emerging earlier than others (e.g., yesterday, tomorrow). Accordingly, future research should administer a measure of verbal and narrative ability alongside EpF measures to account for differences in children's explanations (but see Atance & O'Neill, 2005; Hayne et al., 2011, who found no relation between children's general language ability and their ability to talk about the future).

Similarly, future research should examine alternative ways of determining children's self-projection in their explanations. In the current study, we cannot determine whether children who used multiple first-person pronouns in their explanations were indeed engaging in greater self-projection than children who used only one. Additionally, the lack of effect between item choice and episodicity for the mountain location of the Picture-book task could have been due to a lack of variability in children's item choice performance, since children were generally performing close to ceiling on the task (Atance et al., 2021). Finally, despite our finding that children may better engage episodic and future-oriented thinking during the Picture-book task compared to the Spoon task, it is not clear whether this finding only applies to children's verbal explanations or item choices as well. It may be the case that children use semantic knowledge to select the appropriate item on the Picture-book task but then use future-oriented and episodic processes when generating their explanations for their choice.

Conclusion

Our results show that verbal explanations are an important component of EpF tasks that may complement information gleaned from children's item choices and offer unique insight into children's engagement in future thinking and episodic processes. Importantly, children's ability to explain the future need for an item using episodic and future-oriented references relies on age-related development and whether the item selected was the correct choice to fulfill the future need in the first place. Overall, we can draw several important conclusions from our in-depth examination of children's explanations: (1) there is convergence between the item choice and verbal components of EpF tasks, and (2) verbal components capture the processes involved in EpF, including future orientation, episodic processes, and self-projection. Thus, our findings extend beyond the two tasks used in the current study to show that children's explanations can be used to not only complement non-verbal indicators of EpF, but to uniquely capture and provide insight into the processes children engage to complete EpF tasks. Further, differences between EpF tasks or between trials on the same task suggest that children's past experience with an event might affect performance. Future research should continue to determine the degree to which the various EpF tasks used with young children require projection of the self into a future time, as well as their reliance on other abilities such as script knowledge, semantic associations, and memory.

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Data availability statement

The data that support the findings of this study are available from the author, Dr. Cristina Atance, upon reasonable request.

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Appendix

Significant predictors of temporal focus (future vs. non-future) for the Picture-book (by locations) and Spoon tasks using logistic regression

Task	Age	Item Choice	Age x Item choice
Picture-book			
Dirt Road		*	
Mountain	*	*	
Waterfall	*	*	
Stream	*	*	
Spoon	*	*	

Significant predictors of episodicity (episodic vs. non-episodic) for the Picture-book (by locations) and Spoon tasks using logistic regression

Task	Age	Item Choice	Age x Item choice
Picture-book			
Dirt Road		*	
Mountain	*		
Waterfall	*	*	
Stream	*	*	
Spoon		*	

* Designates significant predictor at $p < .05$.