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The effect of episodic future thinking on young children's future-oriented decision making

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Running Head: FUTURE THINKING AND DELAY OF GRATIFICATION

**The Effect of Episodic Future Thinking on Young Children's Future-Oriented Decision
Making**

Abstract

We investigated whether the developmental emergence of episodic future thinking (EFT) is associated with performance on a type of delay of gratification task: a delay choice task that involved choosing between a small reward now or a larger reward the next day. In Study 1, 4-to-5-year-olds' ($N = 99$) EFT as measured by a tool saving task was significantly associated with performance on the delay choice task, but this was not the case for other EFT measures. Study 2 compared the performance of 4-to-5-year-olds ($N = 130$) on the delay choice task when cued to think about either a future, past, or habitual event versus a no-cue baseline. Overall, cueing impaired performance on the delay choice task. While EFT does show a relation to performance in a delay choice task in pre-schoolers, deliberately engaging in thought about future events may be too taxing in young children to reliably enhance the ability to make future-oriented decisions.

Keywords: delay of gratification, episodic future thinking, temporal discounting, mental time travel.

The Effect of Episodic Future Thinking on Young Children's Future-Oriented Decision Making

Mature thinkers can mentally transcend the present by revisiting the past in episodic memory and pre-experiencing the future in episodic future thinking (EFT). It has been argued, albeit controversially, that the ability to travel forward in time and pre-experience future events is a uniquely human ability, one that is both ontogenetically and phylogenetically relatively late developing (Suddendorf & Corbalis, 2007). However, opinions differ as to the nature of the adaptive benefits of EFT (Atance & Meltzoff, 2005; D'Argembeau, Lardi, & Van der Linden, 2012; D'Argembeau, Renaud, & Van der Linden, 2011; Szpunar, 2010). In the present study, we investigated the suggestion that the primary adaptive function of EFT is to aid future-oriented decision-making (Boyer, 2008). We approached this from a developmental perspective by examining the effect that the emergence of EFT has on young children's propensity to choose a larger reward at a later time point over a smaller immediate reward.

EFT and future-oriented decision-making

Boyer (2008) influentially argued that in situations where the costs or benefits of particular courses of action are not immediately felt, EFT assists individuals in making more prudent decisions. He claimed that EFT does this by allowing the delayed costs or benefits of a decision to be felt in the present: the vicarious experiencing of temporally distant events allows people to bypass current motivations by previewing future outcomes and thus ameliorates the discounting of future rewards. Subsequent studies have examined the link between EFT and decision-making in intertemporal choice tasks (Benoit et al., 2011; Daniel, Said, Stanton, & Epstein, 2015; Peters & Büchel, 2011; Sasse, Peters, Büchel, & Brassen, 2015), revealing that the tendency to choose smaller immediate rewards can be attenuated by

cueing participants to episodically simulate future events. For example, in the context of a typical temporal discounting task, Benoit et al. cued participants to imagine consuming a delayed reward in a specific context e.g., “£35 in 180 days in a pub” immediately prior to making a decision between £25 now and £35 in 180 days. Participants made significantly more patient choices in the imagine condition than in a control condition. This and similar findings have been interpreted as supporting the idea that EFT reduces the extent to which rewards in the future are discounted relative to those in the present, and hence impacts on decision-making (see Bulley, Henry, & Suddendorf, 2016, for review).

Delay of gratification in children

From a developmental perspective, an ameliorative effect of EFT on intertemporal choice is of great interest given the well-documented difficulties young children have with delaying gratification (Mischel, Ebbesen, & Raskoff Zeiss, 1972; Mischel & Metzner, 1962; Shoda, Mischel, & Peake, 1990). Delay of gratification (DoG) tasks have been widely used as a measure of effortful control, with individual differences often taken as an index of broader differences in the ability to self-regulate (Duckworth & Kern, 2011; Zhou, Chen, & Main, 2012). Much has been made of the predictive validity of early DoG with regard to various developmental outcomes (Eigsti et al., 2006; Funder, Block, & Block, 1983; Mischel, Shoda, & Peake, 1988; Paulus et al., 2015; though see Watts, Duncan, & Quan, 2018). There is already wide variation in children’s willingness to delay gratification in the preschool years (Lemmon & Moore, 2007; Mischel et al., 1988), and there are substantial age-related improvements (Garon, Johnson, & Steeves, 2011; Prencipe & Zelazo, 2005; Schwarz, Schrag, & Lyons, 1983). These improvements have been attributed to a growing competence for effortful control and self-regulation, with the difficulty that young children have in delaying gratification sometimes seen as symptomatic of a broader problem with inhibition and executive functioning (Moore, Barresi, & Thompson, 1998).

There are two reasons why it is not straightforward to conceptualize the development of delay of gratification in this way. First, children's performance on DoG tasks can dissociate as a function of task type. There are three distinct ways in which delay of gratification is typically measured in preschool children (Garon, 2016): the delay maintenance task (Mischel, 1966), the temptation task (e.g., Kochanska, Murray, & Harlan, 2000), and the delay choice task (Mischel & Metzner, 1962; Prencipe & Zelazo, 2005). The marshmallow task is the classic example of a delay maintenance task: children are given the choice of an immediate reward that remains available to them over a period of time, and of interest is whether children terminate their waiting after a certain amount of time and instead take the smaller reward. A related type of task is the temptation task, in which children are asked to wait until an adult gives them permission to access a reward (e.g., eat a snack or open a gift); the measure of interest is also whether children terminate their waiting after a certain amount of time, although in this instance termination of waiting does not result in a smaller reward but rather (potential) social sanctions. The delay choice task differs from both these tasks in that it does not involve continuously maintaining behavioral control in the face of a tempting reward. In the delay choice task participants make a binding choice between a smaller reward now or a larger reward later (e.g., 1 sticker now or two stickers tomorrow), typically completing a number of trials of this sort. After they have made each choice, they do not revisit it; the measure of interest is how many times children decide to take the deferred reward across trials. The delay choice task can be seen as a very simplified version of the temporal discounting task used with adults, which also involves a series of binding choices. Perhaps surprisingly, studies have shown that the relation between children's performance on delay choice tasks and delay maintenance/temptation tasks is generally weak or absent (Allan & Lonigan, 2011; Duckworth & Kern, 2012; Toner, Holstein, & Hetherington, 1977), suggesting that such tasks may load on different processes.

The second reason why it is difficult to straightforwardly conceptualize developmental change in DoG in terms of improvements in executive control is that children's performance on DoG tasks does not consistently correlate either with measures of executive function (such as tasks tapping inhibitory control) or with questionnaire measures of effortful control (Duckworth & Kern, 2012; Duran & Grissmer, 2020; Hongwanishkul, Happaney, Lee, & Zelazo, 2005; Garon, 2016). The distinction between 'hot' and 'cold' executive functions (Zelazo & Muller, 2011) has been used as a way of dealing with the mixed pattern of results observed, in line with the suggestion that DoG tasks engage with affective/motivational processes in a way that is not the case for all measures of executive function (e.g., Garon, 2016; Kim, Nordling, Yoon, Boldt, & Kochanska, 2013; Zelazo & Muller, 2011). However, there is still much disagreement about whether the distinction between hot and cold executive functions is viable, and how the two sets of processes are supposed to interact developmentally (Allan & Lonigan, 2014; Kim et al., 2013; Welsh & Peterson, 2014); this disagreement is part of a larger and long-standing debate about the structure of executive functions in children and their relation to effortful control (Murray & Kochanska, 2002; Wiebe et al., 2011; Zhou et al., 2012).

When compared with each other, the findings of existing studies also suggest that different types of DoG tasks may relate differentially with measures of executive functioning or effortful control. Those studies that have found positive links between DoG and performance on executive function tasks have typically used temptation tasks rather than the delay choice task (e.g., Olson, Schilling, & Bates, 1999; Masten et al., 2012; Sulik et al., 2010; though see Moore et al., 1998). Notably, Allan and Lonigan's (2011) large study of pre-schoolers found evidence that while performance on a DoG temptation task was related to performance on a variety of executive function tasks, as well as questionnaire-based measures of effort control, performance on a delay choice task was not (see also Olson et al.,

1999). Indeed, Duran and Grissmer (2020) report a *negative* relation between performance on a delay choice task and a measure of inhibitory control, as well as between delay choice performance and teachers' ratings of behavioral control, in a population of older children of color from low income families. Duran and Grissmer (2020) argue that in a population in which there is a high level of uncertainty about the future, choosing an immediate rather than deferred reward may actually be adaptive (see also Bulley et al., 2018).

Taken together, existing findings suggest that developmental changes in DoG, as measured by the delay choice task, may be linked to quite different processes than DoG tasks that specifically involve maintaining a resistance to temptation over a period of time. This may be because the delay choice task, analogous to the intertemporal choice tasks used with adults, can be seen as tapping *future-oriented decision making*, whereas temptation or maintenance tasks may be better viewed instead as measuring the ability to control one's actions through refraining from temptation in order to stay committed to an initial decision (e.g., to refrain from reaching out and eating the single marshmallow) (Duran & Grissmer, 2020).

The fact that performance on delay choice DoG tasks does not seem to be related to measures of executive function or effortful control in young children means that we may need to look elsewhere to pinpoint the nature of the cognitive changes that impact on pre-schoolers' future-oriented decision making. One possibility is that the ability to imagine and care about one's future self is a critical component of such changes (Garon, 2016; Garon, Longard, Bryson, & Moore, 2012; Lemmon & Moore, 2001), particularly in the preschool period when such abilities are first emerging. Indeed, such a suggestion fits very well with Boyer's hypothesis regarding the role of EFT in supporting prudent choice.

The development of EFT

Boyer's (2008) thesis suggests that a delimiting factor in children's ability to choose prudently in a delay choice task is a difficulty in imagining future rewards. This idea seems particularly plausible when the developmental profile of EFT is considered. It is generally accepted that EFT emerges between ages 3 to 5 (Atance & Meltzoff, 2005; Busby & Suddendorf, 2005; Busby Grant & Suddendorf, 2009; Perner, 2001; Quon & Atance, 2009), around the time that significant improvements are made in delay choice tasks (Garon et al., 2012; Lemmon & Moore, 2007; Moore et al., 1998). However, despite the plausibility of the hypothesis that EFT plays a role in explaining such improvements, no studies have directly addressed this specific issue.

The most relevant study is that of Atance and Jackson (2009), who presented 3-to-5-year-olds with a number of tasks measuring future thinking, including a DoG and EFT tasks, as well as prospective memory and planning tasks. Although the zero order correlations between DoG and all the other tasks were significant, none of these correlations remained significant after controlling for age and receptive vocabulary. However, the lack of a relation may be due to the choice of DoG task: Atance and Jackson employed a delay maintenance task rather than the delay choice task and, as we have pointed out, a delay choice task seems to be the more appropriate way to test Boyer's hypothesis. Separately, we note that their DoG task involved a delay in the order of a few minutes, whereas EFT might be expected to be more important in tasks involving long delays that involve considering one's future self at a quite different time point. In the current studies, we utilized a delay choice DoG task and a much longer delay period than that used by Atance and Jackson in order to examine the relation between EFT and children's future-oriented decision making.

Designing such studies, though, brings to the fore the issue that there is no consensus on how best to measure EFT in very young children. Studies using variants of Tulving's (2005) 'spoon test' have in common the requirement for individuals to save a tool for a future

need in the absence of any current use for the tool (Russell, Alexis, & Clayton, 2010; Suddendorf & Busby, 2005; Suddendorf, Nielsen, & von Gehlen, 2011). A second approach is to ask individuals to select an object that will meet some future physiological state. In their Picture Book task, Atance and Meltzoff (2005) asked children to imagine unfamiliar future scenarios (e.g., walking in a snowy landscape) that were likely to arouse particular physiological states (e.g., cold) and to choose an item to take on their journey. A third approach involves asking children to describe future events they will experience and then coding their responses for episodic details (Busby & Suddendorf, 2005; Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011; Quon & Atance, 2010). Performance on all three types of tasks shows significant improvements between 3 and 5 years, but in fact very little is known about whether performance is correlated across the three tasks. Because of this uncertainty, we employed all three types of tasks in our first study.

The current studies

To examine whether emerging EFT helps explain developmental improvements in future-oriented decision making in the preschool years, we conducted two studies. We used a delay choice task in which, over a series of trials, children decided whether to take an immediate small reward or wait until the next day for a larger reward. In Study 1, we assessed whether individual differences in children's EFT ability predicted performance on the delay choice task, using each of the three types of EFT tasks described above. We also measured subjective time estimates, specifically how far away the next day felt to children (Burns et al., 2019), because it has been suggested that differences in how far away the future feels might affect the discounting of delayed rewards (Kim & Zauberman, 2009). Subjective time estimates were taken twice, once before the delay choice task and once after, because we were also interested in whether these estimates changed once children knew they had to wait to get a future reward. In Study 2, we asked whether, prior to a choice, cueing young children

to think episodically about the future increases the likelihood they would opt for the delayed reward.

Study 1

Method

Participants. Ninety-nine children (51 males) between 48–70 months of age were recruited from schools and preschools local to the lead author’s institution¹. Based on the sample sizes used in previous studies examining the relation between EFT and other cognitive skills in pre-schoolers (Atance & Jackson, 2009; Hanson, Atance, & Paluk, 2014; Unal & Hohenberger, 2017), we aimed to recruit at least 90 children. The exact sample size was determined by the number of parents who returned permission slips to their child’s school/nursery. Due to the demographics of the local population, the large majority of children were White and of low to middle socio-economic status. Data collection took place across three sessions, each lasting 15-20 minutes. Of the 99 participants, five provided partial data due to either absenteeism (4) or experimenter error (1). Ethical approval for Study 1 was received from the Psychology Research Ethics Committee, Queen’s University Belfast, (reference number 13-2016-17; Study title “The emergence of episodic thinking and its link to delay of gratification”). Written parental consent was obtained for all participants and children assented to their participation through the use of a red/green traffic light assent procedure.

¹ An additional 10 3-year-olds were also tested but were excluded from analysis based on reviewers’ comments that these children may be too young to have even rudimentary EFT skills that might contribute to delay choice performance. The overall results are very similar when these younger children are included in the analysis, with the exception that Picture Book performance does not remain significantly correlated with delay choice when controlling for age and IQ. After removing these younger children, the sample size remained larger than that used in the previous studies.

Measures. Pictures of the materials associated with each task are given in Supplemental Materials.

Delay Choice task. The task began with a training session, the aim of which was to allow children to experience the length of the delay period in real time (this precaution was used because of potential difficulties of using the term ‘tomorrow’ with very young children). Children were introduced to a pictorial timeline representing a typical 24-hour cycle in the life of children. They were told that the pictures showed them lots of things that might happen to them later. Each picture of the timeline was described in turn (e.g., “Here you are in class now. After class it will be time to go home. This is you going home from school...”). Two boxes were placed at each end of the 24 hr timeline, one at the left end labelled ‘now’ and one at the right end labelled ‘next day’. Children were introduced to two puppets and were told that they were going to play a game in which they would get to choose some treats. They were told that sometimes the puppets could get the treats that they chose straight away (experimenter pointed to the ‘now’ box at the left end of the timeline) and sometimes they would have to wait a while to get their treat (pointed to the ‘next day’ box at the right end of the timeline). The experimenter then told children that each puppet was going to be given a choice between one marble right now (pointed to the ‘now’ box) or two marbles when he came back in a day’s time (pointed to the ‘next day’ box). The first puppet selected the immediate reward and the second puppet selected the delayed reward.

Data collection was conducted in a second session on the day following the demonstration. The experimenter and participant sat facing one another across a desk. The 24 hr timeline was positioned in front of the child and the two boxes for the delay choice task were positioned at either end of the timeline. The experimenter reintroduced the two puppets from the previous day’s demonstration. Children were reminded of each puppet’s choice and observed the puppet who had chosen to delay receiving two marbles. Each participant

completed four delay choice trials: sweets (1 versus 5), stickers (1 versus 5), 2-minute long cartoon clips (1 versus 3) and stationery sets (plain versus princess or superhero). Trial order was counterbalanced across participants. Each trial began with the experimenter introducing the rewards, and then saying “I’m going to give you a choice, you can either get [low value reward] right now (placed low value reward in ‘now box’) or you can wait and get [high value reward] when I come back again in a day’s time (placed high value reward in ‘next day’ box). If you take this [low value reward] you get it right now but you won’t get the [high value reward]. If you want to wait for the [high value reward] you don’t get anything right now but you will get the [high value reward] when I come back again in a day’s time.” Two check questions were then presented: the experimenter pointed to each box in turn and asked children to indicate when they would get the reward in that box should they select it. If they responded incorrectly the experimenter corrected them and then repeated the delay choice instructions and check questions. When children answered the check questions correctly they were asked the test question: “What would you like to do? Point to the box which shows me which you would like.” This procedure was repeated for each trial. On each trial children were given a score of 1 for selecting the delayed reward and 0 for selecting the immediate reward.

Tool saving task. The tool saving task was a modified version of that used by Russell et al. (2010). It employed a specially constructed table-like apparatus, on top of which three different games could be played (yielding three trials). The table top was made of wood and its dimensions were 740 mm x 540 mm; it was 600 mm in height. On each of three trials participants played a game on one side of the table with an apparatus that required the use of a specific tool. During the course of each game, participants were brought to the other side of the table and shown a slightly different version of the game for which the tool they were currently using was demonstrated to be ineffectual. The experimenter then demonstrated that

a different tool was required to play the game on this side of the table. After completing the original game participants were then led away from the table such that it was out of view and told that in a day's time they would play the type of game they had just played again but on the other side of the table. They were then presented with three tools: the one demonstrated to work for tomorrow's version of the game, the tool they had used in today's game, and a novel distractor tool. They were asked to place one tool in a bag for use the next day.

For the first game (doors), two doors were positioned side by side across the centre of the table. The doors were locked and faced opposite directions. There were three colored keys of different shapes: one which opened door 1, one which opened door 2, and a distractor key. A ramp ran from the foot of each door to the table end and a series of small rectangular tiles could be placed on the ramp to make a path. Children built a path up a ramp to allow a character to open door 1 with the appropriate key.

The second game (fishing) was played on four small circular 'ponds' two at each end of the table. Two of the ponds at one end of the table contained small metal fish and two at the other end of the table contained small Velcro fish. There were three fishing rods, one with a magnet 'bait' for catching metal fish, one with a Velcro 'bait' for catching the Velcro fish and a third distractor fishing rod with a red plastic 'bait'. Children fished for metal fish using the magnet bait rod.

The third game (slide) was played using a trough placed in the centre of the table top and two slides, one wide and one narrow, positioned back to back on the trough. At the base of the wide slide were a number of large wooden balls while at the base of the narrow slide there were a number of small wooden balls. A large rake with a wide grooved head could be used to push the large wooden balls up the wide slide and deposit them in the trough; this head did not fit in the narrow slide. A small rake could be used to push the small wooden

balls up the narrow slide. A third rake with a non-functional head acted as a distractor item. Children used the large rake to push the large wooden balls up the wide slide.

The three games were played in the same order (doors, fishing and slide) for all participants. Given the 1 in 3 odds of selecting the target item by chance on any given trial a conservative criterion for passing the task was imposed: children selecting the target item on all three trials were scored 1, failure to select the target item on 1, 2 or 3 of the trials was scored 0.

EFT interview. This task was similar to that used by Quon and Atance (2010). Children were asked to think in turn about three events: the next time they would be “going to a play park”, “visiting a friend’s house”, and “going to a birthday party”. The experimenter said: “I want you to think about the next time you will be [event]. You might be [event] very soon. Can you tell me about the next time you will be [event]?” If participants gave no response they were provided a prompt: “let’s think really hard about the next time you will be [event]. What can you tell me about the next time you will be [event]?” Once children gave a response they were provided with an open-ended follow-up prompt, “can you tell me any more about [event]?” Participants were then asked five specific follow-up questions: “Can you tell me more about what will happen?”; “Can you tell me more about who will be there?”; “Can you tell me more about where this will be?”; “Can you tell me more about when this will be?” and “Can you tell me more about how you will feel?” Children then rated the clarity of the event they were thinking about using a 5-point clarity scale (Coughlin, Lyons, & Ghetti, 2014). The scale depicted five pictures of the same mountain in decreasing pixilation from ‘not clear at all’ (scored 1) through to ‘very clear’ (scored 5) with ‘not very clear’, ‘a little bit clear’ and ‘fairly clear’ as the intermediate descriptions.

The experimenter introduced the clarity scale and described each point on the scale. Participants were told, “When we think about things that will happen we often have a picture

of it in our head. When you thought about [event], how clear did the picture of it in your head look? Point to the picture that shows how clear [event] looked to you in your head.”

Interviews were recorded on digital recorders and transcribed for the purpose of analysis.

Since many children produced little detail to the open questions, analysis was based on participants’ responses to both the open and follow-up questions. These responses were scored for episodicity using a scale described by Coughlin et al. (2014). Scores ranged from 0-4, where 4 indicated a description of a specific event isolated in space and time and accompanied by contextual detail, such as imagery or emotions. Transcribed responses were scored blind to the participant’s age or gender. A second independent rater coded the responses of a random selection of 30 participants. The interrater reliability between the coders was calculated using a two-way, random, consistency, average-measures intraclass correlation (ICC) (McGraw & Wong, 1996). The resulting ICC score was high, $ICC = 0.858$, 95% CI [0.785, 0.907], indicating good agreement between the raters. Clarity ratings were scored on a scale from 1-5 with 5 indicating very clear. The mean episodicity and clarity scores across the three events were calculated and used in subsequent analyses.

Picture Book task. On each of three trials participants were presented with a photograph of a scene (farm, seaside, and mountain in that order) on a laptop and were asked to identify the scene. Participants were then told, “Let’s pretend you are going to the farm / seaside / mountain. It’s time to get ready to go. Which of these do you need to bring with you?” The experimenter presented photographs of three further items to participants, labelling them in turn. A toothbrush (distractor), pair of boots (target) and picture of a pig (semantic associate) for the farm scene; a bunch of flowers (distractor), starfish (semantic associate) and towel (target) for the seaside scene; a coat (target), a rock (semantic associate) and a balloon (distractor) for the mountain scene. As with the tool saving task we imposed a

strict pass criterion: children selecting the target item on all three trials were scored 1, children who made errors were scored 0.

Subjective Time Estimation task. The time estimation task employed a 10-point scale depicting a long straight path with a cartoon character standing at the beginning, looking along the path. There were 10 red markings evenly spaced along the length of the path. The experimenter introduced the 10-point time estimation scale and told children that they would use this picture to show how far away some things are that will happen to them in the future. Participants were given the following instructions: “things that will happen soon are near to us (pointed to the start of the scale), things that will happen a long time from now are far from us (pointed to end of scale) and things that will happen in an in-between amount of time are not near and not far from us (pointed to middle of scale). You are going to use this picture to show me how far away some things are that are going to happen. I want you to think about when I come back again in a day’s time (pointed to end of 24-hour timeline). We will play some more games when I come back again in a day’s time. How far away does that feel? Use your pencil to circle the red bit on the picture that shows how far away it feels.” In our analyses, we examined the relation between subjective time estimates taken before the delay choice task and delay choice scores. In order to assess the effect that the decision to delay for a reward has on future time estimates we took a second subjective time estimate after the delay choice task had been completed and compared the change in time estimates from before to after across those that delayed on at least one trial to those that never delayed.

IQ. The Block Design and Vocabulary subtests of the Wechsler Preschool and Primary Scale of Intelligence, Fourth Edition (WPPSI-IV; Wechsler, 2012) were administered.

Procedure. The study was completed across three sessions on three consecutive days. Testing took place in a separate resource area within participating schools and nurseries. The

training session for the delay choice task was administered to children in a group on session 1, after which children completed the IQ measures separately. The delay choice task was administered at the beginning of session 2. Prior to the first delay choice trial, participants made a subjective time estimate. After completing the final trial participants made a second subjective distance judgment using the same time estimation scale. The tool saving task was completed immediately after the delay choice task. Session 3 began with the EFT interview after which children completed the Picture Book task. Any rewards owing to children from the delay choice task were then given to children at the end of session 3.

Results

Analyses were conducted with both SPSS Statistics (IBM Corp, 2015) and *R* (R Core Team, 2015). All analyses in Study 1 were planned in advance of data collection. Descriptive statistics for each of the dependent measures are reported in Table 1. Preliminary analysis revealed no effect of gender on performance on the delay choice task or any of the episodic future thinking or IQ measures (all p values $> .23$), therefore the effect of gender was not considered further. A series of McNemar tests with Bonferroni corrections for multiple comparisons revealed that children were significantly more likely to choose the delayed option for the stationery reward than for either the sticker reward or the cartoon reward (p values $< .05$); this is possibly because this reward lends itself less well to immediate consumption. However, the measure that included all four trial types showed acceptable levels of reliability (Cronbach's Alpha = .714). A paired samples t -test was used to examine whether children's subjective time estimates made before they completed the delay choice task differed from those made after they had completed the task, in order to examine the possibility that having to wait for a reward had an effect on how long away tomorrow felt. We excluded from this analysis any children who never chose to wait for rewards the next day ($N = 24$). Subjective time estimates made before the delay choice task did not differ

significantly from those made after the task, $t(73) = 1.70$, $MD = .80$, $p = .094$, 95% $CI [-.138, 1.733]$.

Table 2 presents both the zero-order and partial correlations (controlling for age and IQ measures) for the delay choice scores and the other measures. Age and IQ measures all correlated with each other; age correlated with each of the remaining variables (with the exception of subjective time estimation scores). Delay choice scores were significantly positively correlated with performance on the tool saving task and the Picture Book task but not with scores from the EFT interviews. Performance on the Picture Book task was also significantly positively correlated with that on the tool saving task. After controlling for age and IQ scores both tool saving and Picture Book performance remained significantly correlated with delay choice scores but the relation between Picture Book performance and that on the tool saving task did not reach significance ($p = .06$). Episodicity scores from the future thinking interview did not correlate with any of the other EFT measures or with performance on the delay choice scores.

To examine whether tool saving or Picture Book performance were uniquely predictive of delay choice scores, we performed a hierarchical linear regression. The dependent measure was delay choice score with age, vocabulary and block design entered as predictor variables at step 1 and tool saving and Picture Book entered as predictors at step 2 using the forward method. Table 3 presents a summary of the final regression model. The model with initially just age and IQ measures had an R^2 value of .185 and an adjusted R^2 value of .158. Of the variables entered at step 2 only tool saving was retained. The addition of tool saving significantly improved the model fit, $F(1, 88) = 4.39$, $p = .039$, $\Delta R^2 = .039$. The final model had an R^2 value of .224 and an adjusted R^2 value of .189, with participants' age and performance on the tool saving task as the only significant predictors.

Discussion

The results of Study 1 indicate that a version of a task widely used to measure episodic future thinking in the developmental literature - tool saving - is significantly related to delay choice scores in a sample of 4-to-5-year-olds. This relationship holds even when controlling for the contribution of age, vocabulary and block design scores from the WPPSI. The same was true of performance on the Picture Book task. However, in a regression analysis only tool saving and age were significant independent predictors of performance on the delay choice task. The different measures of EFT were not strongly associated with one another, in line with the findings of Atance and Jackson (2009), although those authors used a different set of EFT tasks. Only tool saving and the Picture Book task were significantly correlated; however, this correlation did not remain significant when controlling for the common variance associated with age and IQ. We return to these findings in more detail in the General Discussion.

Study 2

One interpretation of the findings from Study 1 is that the delay choice task may be viewed as one that loads on at least some aspects of EFT skills. One possible alternative explanation is that the EFT tasks and the delay choice task are related because they both load in some way on effortful control or inhibitory processes. This seems unlikely in the face of existing research findings regarding both EFT and delay choice performance. We did not include a measure of effortful control/executive functioning in our study in the light of the findings discussed in the Introduction that indicate that performance on such tasks is not predictive of delay choice performance, and we note that previous studies have also failed to find any relation between EFT and measures of inhibitory control in preschoolers when controlling for age and IQ (Hanson et al., 2014; Unal & Hohenberger, 2017).

However, the finding that there is a correlation between children's EFT, at least on some measures, and performance on a delay choice task does not in itself indicate a causal role for EFT in enhancing children's future-oriented choice. More convincing evidence would come from a demonstration that manipulating the likelihood that children engaged in EFT had an effect on performance on a delay choice task. Indeed, most of the existing evidence regarding the role of EFT in facilitating prudent choice comes from studies that have used interventions encouraging adults to engage in EFT immediately prior to making intertemporal choices (Bulley et al., 2016). In Study 2, we examined whether cueing children to think about the future increased their propensity to delay gratification in the delay choice task. Studies with adults and adolescents have shown that asking participants to imagine future personal events attenuates temporal discounting (Benoit et al., 2011; Bromberg, Lobatcheva & Peters, 2017; Lin & Epstein, 2014; Peters & Büchel, 2010), but it is not known whether parallel effects can be observed with regard to delay choice in young children.

Two relevant studies with pre-schoolers have examined whether talking about their future has an impact on children's delay choice performance. Chernyak, Leech, and Rowe (2017) examined the effects of getting pre-schoolers to discuss some future events with an adult over a 5 min time period, before completing a series of tasks, one of which was a delay choice task in which children chose between one sticker now or two at the end of the day. Relative to discussing events from other time periods, discussion of future events did not enhance delay choice performance in this group. Leech, Leimgruber, Warneken, and Rowe (2019) also examined the effect of getting children to talk about their future selves on performance on a delay choice task with six trials in which pre-schoolers chose between getting one sticker now and two stickers once the testing session was completed. Again, relative to other types of discussion, they found that discussion about the future self did not significantly affect performance on their delay choice task. A key difference between these

procedures and the procedure used with adults is that children were not cued to imagine a future event immediately prior to making each intertemporal choice. In Chernyak et al.'s study, the delay choice task was always completed last after four other different tasks, so it is very possible that if there was a cueing effect it may have dissipated over the session. After their cueing period, Leech et al. first provided children with instructions for their prospective memory task before children completed the delay choice task, and indeed, due to task order counterbalancing, half of the sample received a further intervening task before the delay choice task. Although cueing effects were found on the prospective memory task, such effect may again have dissipated by the time participants completed the delay choice task.² By contrast, in the typical temporal discounting studies with adults and adolescents, participants receive an EFT cue on every trial, immediately before choice. Providing cueing on every trial is likely to enhance the likelihood that the effects of cueing do not dissipate over an intervening period, because participants engage in EFT at the time of making each choice.

Thus, Study 2 examined whether using a cueing technique similar to that which has been used with adults is an effective means of altering young children's choices in a delay choice task. Convincingly demonstrating the effectiveness of such a manipulation hinges on choosing the correct control conditions. Studies with adults have employed a variety of control conditions. Most common is a non-intervention baseline condition (e.g., Bromberg et al., 2017; Kwan et al., 2015; Peters & Buchel, 2010) but others have alternatively employed a semantic judgment control condition (Benoit et al., 2010) or an episodic memory control condition (Daniel, Sawyer, Dong, Bickel & Epstein, 2016). The choice of control condition brings into sharp focus the issue of the mechanism of the EFT cue effect. One can distinguish three levels of specificity by which EFT cues may have their effects. It may be that effective

² We note this interpretation assumes that the cueing effect enhanced prospective memory because of how instructions were encoded, since the prospective task itself was completed at the end of the session.

cues are those that encourage participants to simulate personal events that co-occur with the availability of the delayed reward, in which case only an EFT cue will be effective.

Alternatively, it may be that it is sufficient to encourage participants to simulate any personal events that are not in the present, in which case even an episodic memory cue would also attenuate discounting. Finally, it may be that simply cueing participants to construct events – even those that are not temporally specific – is sufficient to attenuate discounting. In this case, we would expect even a semantic control (see below) to have an ameliorative effect on discounting. To properly assess the potential impact of an EFT intervention on delay choice performance, we therefore included three additional control conditions: an episodic memory condition in which children were cued with details of personally relevant past events, a semantic memory condition in which participants were cued to think about events as they usually happen, and a no intervention baseline condition. Inclusion of this full range of control conditions meant that findings could be more reliably interpreted in terms of a specific role for EFT.

Method

Participants. One hundred and thirty-four 4-to-5-year-olds were recruited. Four children were removed from the final sample: two due to unresponsiveness during testing, one who declined to participate and one due to absenteeism. The final sample comprised 130 participants (66 females) between the ages of 53–71 months ($M_{age} = 64$ months, $SD = 4.48$ months). Participants were randomly assigned to the *past* ($N = 33$), *future* ($N = 33$), *semantic* ($N = 33$) and *baseline* conditions ($N = 31$). Ethical approval for Study 2 was received from the EPS Faculty Research Ethics Committee, Queen’s University Belfast (reference number EPS 18_68; study title “Can delayed gratification be enhanced in young children through encouraging future thinking?”). Written parental consent was obtained for all participants and

children assented to their participation through the use of a red/green traffic light assent procedure.

Materials. The delay choice task used the same pictorial display of the 24-hour cycle that was used in Study 1. Four types of rewards were used: sweets (1 versus 3), stickers (2 versus 5), novelty pencils (1 versus 3) and stationery sets (a plain set versus a princess or superhero set). A white square piece of card with three squares arranged horizontally onto which cards depicting various events could be placed was used in the pre-interview training task. In order to examine the nature of children's event descriptions, a subset of interviews was recorded on a digital device and transcribed for analysis.

Procedure. The study was completed across three sessions on three consecutive days. We employed the same group training procedure for the delay choice task on Day 1 as we had previously employed in Study 1. Children were tested individually on Day 2 and sat at a small table directly opposite the experimenter. The session began with one of the puppets from Day 1 receiving a delayed reward.

Time period training. We used a further training procedure to ensure that children understood the time periods that were being referred to in the cue generation part of the task (see also Chernyak et al., 2017), because this was crucial for the experimental manipulation. The card with three horizontal squares was then placed in front of participants. The experimenter explained that they were going to put things into each of the squares, with things that are happening 'right now' going into the middle square, things that have already happened going into the left hand square from the child's perspective and things that haven't happened yet going into the right hand square. The experimenter then produced a card with the word 'now' written on it, sounded out the word for children and explained that this means everything that is happening right now. They then gave children two examples: (i) their

playing the game with the experimenter and (ii) whichever activity their class mates were currently participating in. The experimenter placed the 'now' card in the middle square and then pointed to the left hand square and explained that 'things that have already happened go into that square there', and gave the example of the child coming to school that morning and going to bed the night before. Finally, the experimenter pointed to the right hand square and explained that things that haven't happened yet go into that square there, such as going home from school today and going to bed tonight. Children were then asked two check questions, "Which square do we put things in that have already happened?" and "Which square do we put things in that haven't happened yet?" They were corrected if they responded incorrectly to either question. Children were then presented with four cards depicting characters engaged in various tasks (skateboarding, trampolining, visiting the seaside and visiting a mountain). For each card, children were told that the character depicted had performed that activity or visited that place yesterday or would perform that activity or visit that place tomorrow. Children then sorted each of the cards in turn. Errors were corrected and only data from children who sorted three of the four cards correctly were included in the final analyses.

Interview task. Children were randomly assigned to one of four conditions (*past*, *future*, *semantic* and *baseline*). Participants in the past condition were asked about 3 events that happened to them yesterday (getting up, playing at break and going home from school). In the future condition participants were asked about the same three events located in the following day and in the semantic condition, they were asked about the same events as they usually occur. In the baseline condition children simply colored in for 5 minutes (approximately the length of time of each interview). In both the semantic and baseline conditions the card used in the sorting task was removed; however, it remained present in the past and future conditions and was used to orient children appropriately to past or future. For each of the three events, a cartoon picture of a same gender child participating in that event

was presented to children. In the past and future conditions, this picture was sorted, with help from the experimenter, into the left or right hand square depending on tense, whereas in the semantic condition it was placed on the table in front of the child.

Across the three interview conditions, children were given closely matched instructions (“Can you tell me about when you were getting up yesterday / when you will get up tomorrow / when you get up. What did you do when you got up yesterday / What will you do when you get up tomorrow / What do you do when you get up?”). Children who were unresponsive were prompted, “let’s think really hard” and were then re-asked the question. Children’s initial responses were followed up with a general prompt for more information (“Can you tell me anything more about what happened / what will happen / what happens when you got up yesterday / get up tomorrow / get up?”). They were then asked three specific what, where and who follow-up questions (“Can you tell me anything more about what happened / will happen / happens when you got up yesterday / get up tomorrow / get up? Can you tell me more about where this was / will be / is? Can you tell me more about who was / will be / is there?”). Throughout the interview the experimenter made written notes of each child’s responses and subsequently selected two propositions generated for each event. These propositions were orally presented to the participant in the subsequent delay choice task.

Delay choice task. The task was similar to that of Study 1. One change from Study 1 precipitated by the training children received was that we referred to ‘tomorrow’ rather than ‘next day’ throughout the task. Children completed four trials in which they chose between a small immediate reward and a larger reward available after 1 day’s wait. The order of presentation of rewards was counterbalanced across trials, between participants. Each trial began with the experimenter showing the rewards to the participants and distributing them to the appropriate trays. The experimenter continued with, for example, “Here are some pencils. You can get one pencil right now or you can wait and get one, two, three, pencils when I

come back again tomorrow. If you take this one pencil here, you get it right now, but you won't get the other three pencils. If you want to wait for the three pencils, you don't get any pencils right now but you get the three pencils when I come back again tomorrow". Two check questions were asked to make sure children understood when the rewards were available. If children responded incorrectly they were corrected and the questions were repeated.

For the first delay choice trial in the interview conditions, prior to offering children a choice between rewards they were asked to think again about when they will get up tomorrow/when they got up yesterday/when they get up. The experimenter repeated back to them two propositions that they had previously generated for that event and then asked them to 'think really hard about that'. They were reminded once more about the same two propositions, after which they were asked to make their choice. Prior to the second and third trials they were cued with information taken from the 'playing at break time' and 'going home from school' events. For the fourth trial they were reminded of all the things that will happen to them tomorrow/that happened to them yesterday/that usually happen to them, and were presented with one proposition from each event in turn. Children in the baseline condition completed the delay choice task without being asked to think about any intervening events.

Results

All analyses was conducted in *R* (R Core Team, 2015) and all analyses was planned in advance of data collection with the exception of the linear regression comparing delay of gratification scores in the control against scores in the three intervention conditions collapsed. Thirteen children failed the check questions on the initial training task (three assigned to past condition, three to future, four to semantic and three to control). Their data were removed from all further analysis. Preliminary analysis revealed a non-significant effect of gender on

delay choice scores $t(115) = 1.80, p = .074$, Cohen's $d = .33$, however, as there was a trend for females ($M = 1.71$) to delay more than males ($M = 1.22$) ($MD = 0.48, 95\% \text{ CI } [-0.04, 1.02]$) we conservatively chose to include gender as a covariate in subsequent analysis. There was no effect of age on delay choice scores, $r = .088, p = .347$, so age was not considered further. To assess the effect of trial number on children's choice a General Estimating Equation (GEE) analysis with a binary logistic distribution was conducted. Across the four trials there was no effect of trial number on delay choice performance Wald $\chi^2(3) = 1.87, p = .60$. Figure 1 displays the mean delay choice scores across the four conditions; it can be seen from the figure that children were no more likely to delay in the future condition than in the baseline condition (or indeed any of the other conditions). To examine the effect of condition we conducted a one-way Analysis of Covariance (ANCOVA) with gender as a covariate. There was no effect of condition on delay choice scores, $F(3, 112) = 1.95, p = .125, \text{partial } \eta^2 = .05$. Thus, encouraging children to engage in EFT did not enhance scores.

Inspection of Figure 1 suggests an unexpected pattern of results – that children's performance was better in the control condition than in any of the intervention conditions. In order to examine whether this was the case, we collapsed scores across the three intervention conditions and compared them to the baseline condition. As this analysis was post hoc (our original hypothesis was that performance in the future condition, and only that condition, would *exceed* that on the baseline condition) we applied a Bonferroni correction to p values ($\alpha = .025$). To control for the marginal effect of gender we performed a hierarchical linear regression on DoG scores with, gender entered at step 1 and intervention (no intervention vs. intervention) entered at step 2. There was a significant main effect of intervention at step 2, $F(2, 114) = 4.58, p = .012$. The final model is presented in Table 4. Intervention was a significant predictor after applying a Bonferroni correction, $\beta = -.216, t = -2.40, p = .018$.

Children were significantly less likely to delay in the intervention conditions ($M = 1.29$, 95% CI [0.99, 1.59]) than in the baseline condition ($M = 2.04$, 95% CI [1.45, 2.62]).

Finally, we examined a sub-set of children's descriptions in the past and future conditions to examine the extent to which participants were typically producing episodic descriptions in the past and future conditions. Using the same episodicity scale as in Study 1, two independent raters coded transcribed interviews from the subset of the participants ($N = 39$, 65% of past and future conditions) whose interviews had been recorded. The interrater reliability between the two raters was high, $ICC = .811$, 95% CI [0.687, 0.885].

Disagreements were resolved by discussion between the two raters. An independent samples t -test revealed a significant effect of tense, $t(37) = 3.00$, $p = .005$, Cohen's $d = 0.96$, with past events ($M = 2.81$, 95% CI [2.46, 3.16]) producing higher episodicity scores than future events ($M = 2.08$, 95% CI [1.72, 2.45]).

Discussion

An EFT cue did not increase the propensity of 4-to-5-year-olds to delay gratification in the delay choice task, either relative to other types of cue or relative to a no-cue baseline condition. On the contrary, and unexpectedly, children were overall less likely to choose the delayed option when cues of any kind were used. One possible interpretation is that asking children to hold in mind information about personally relevant events while simultaneously presenting them with a choice is too taxing on their limited cognitive resources. There is a well-established link between working memory and delay discounting among adults (Bickel, Yi, Landes, Hill, & Baxter, 2011; Shamosh et al., 2008); moreover, loading working memory during performance of a concurrent discounting task increases discounting of future monetary rewards in adults (Hinson, Jameson, & Whitney, 2003) and children (Fabio et al., 2020). Hinson and colleagues claim that taxing working memory leads to a tendency to choose a

smaller reward immediately rather than a delayed reward because working memory is required to “establish anticipatory affective reactions” (p. 305). Thus, one possible explanation of our findings is that engaging in thought about other times taxed children’s working memory and this had a knock-on effect on children’s delay choice performance.

A difficulty with this explanation is that there is limited evidence to suggest that either EFT or performance on delay choice tasks load heavily on pre-schoolers’ working memory. There is some existing evidence for a link between working memory and DoG performance in early childhood, but developmental studies that examined the two have tended to use the delay maintenance task rather than the delay choice task (Carlson, White, & Davis-Unger, 2014; Yu, Kam, & Lee, 2016); moreover studies with adults suggest that the correlation between DoG performance and working memory may be in part mediated by IQ (Duckworth, Tsukayama, & Kirby, 2013). Hongwanishkul et al. (2005) did measure working memory alongside delay choice in pre-schoolers, and found no relation between these measures. Moreover, EFT abilities themselves do not appear to be related to pre-schoolers’ working memory (Hanson et al., 2014; Unal & Hohenberger, 2017). Thus, as it stands, it is difficult to know to what extent the current results can be explained in terms of the idea that performance on the delay choice task is impaired because imagining other events that are not currently happening is taxing specifically on young children’s working memory. Further studies are needed that test this hypothesis. We return to this issue in the General Discussion.

General Discussion

The two studies here provide the first detailed investigation of whether the emergence of EFT in early childhood is associated with an improvement in the ability to make prudent choices in a delay choice task. The design of Study 1 was correlational while in Study 2 we sought to enhance performance on a delay choice task through intervention. In Study 1,

performance on the tool saving task and the Picture Book task was significantly correlated with children's performance on a task in which they had to decide whether to delay gratification for 24 hrs, even after controlling for the contribution of age and IQ. However, this was not true of a verbal EFT measure and there was also no association between a novel measure - children's subjective judgment of how far away tomorrow felt - and delay choice scores. Although performance on both the tool saving task and the Picture Book task was correlated with delay choice scores, in a regression analysis, only performance on the former task uniquely predicted delay choice scores. In Study 2, cueing children to think about future events that occurred on the same day as the delayed reward had no selective effect on their scores. Rather, asking children to imagine a familiar event (either episodically or semantically) while simultaneously participating in a DoG task *decreased* the likelihood of choosing a delayed reward. Before discussing these findings in more detail, we initially consider the implications of the wider pattern of results with regard to the issue of how to measure EFT in young children.

Measuring the development of EFT

The developmental emergence of EFT is a relatively recent topic of study and there is as yet no consensus over how best to measure it (Hudson, Mayhew, & Prabhakar, 2011; McCormack & Hoerl, 2020). Because of this, we employed three different tasks that have previously been used independently to assess EFT in early childhood, which had the added benefit of allowing us to properly examine, for the first time, the relations between all these measures. The findings provide little reason to believe that all these tasks measure the same type of skill (see also Hanson, Atance, & Paluck, 2014). The significant correlation between the tool saving and the Picture Book tasks did not survive controlling for age and IQ, and, strikingly, episodicity scores on the interview task were unrelated to the other tasks.

Why were episodicity scores not related to the other EFT measures? The narratives produced by participants in both studies were relatively impoverished. Coughlin et al. (2014) suggested the additional use of a ‘strict’ episodicity criterion, according to which only scores of 4 are considered as proper evidence of episodic prospection. Applying this strict coding, we see evidence of a floor effect: across the studies only 8% of the EFT narratives qualified as fully episodic (in addition to the responses in Study 1, a subset of children’s verbal responses from Study 2 were coded in order to explore whether children produced episodic descriptions). We based our task on that of Quon and Atance (2010), but one might argue that the use of EFT cues that refer to familiar events (e.g., next visit to a friend’s house) might reduce the likelihood that participants would produce episodic information. However, it is extremely difficult, if not impossible, to generate a set of EFT narratives that can be scored for individual differences in episodicity with children of this age using any other technique. One alternative would have been to only use a time period cue such as ‘tomorrow’, but findings from previous studies suggest that a notable proportion of 4- to 5-year-olds would fail to generate any information. Moreover, many children would produce descriptions of familiar events (e.g., ‘going to school’) in response to such a cue and, crucially, most children in this age range would not be able to describe more than one event (Atance & Jackson, 2009; Busby & Suddendorf, 2005). Another alternative would be to use cue words, e.g., ‘pet’ and ‘cake’, but Coughlin et al. obtained very similar episodicity data from 5-year-olds using such a technique.

Although children’s episodicity scores were relatively low, a lack of correlation between these scores and the other EFT measures cannot be explained in terms of lack of variability in the measure. Episodicity scores were strongly related to participants’ language abilities in Study 1; this is the largest correlation reported in Table 1. Clearly, generating EFT narratives places high demands on children’s language skills; indeed, this is part of the reason

that alternatives such as the tool-saving task have been explored. It may be that fine-grained scoring of the content of EFT narratives is too strongly reflective of language skills at this age to give an adequate picture of EFT ability.

This leaves us with the issue of whether the Picture Book task and the tool saving task should be considered to be better measures of EFT in this age group. Although both these tasks involve choosing an object from a set of three for non-current use, performance was much better in the Picture Book task (and in fact close to ceiling), which in all likelihood reflects the extent to which correct answers on this task – compared to the tool saving task – rely at least in part on semantic memory (Hayne et al., 2011). However, versions of the tool saving task have not been immune from the criticism that passing the task need not require EFT (Dickerson, Ainge & Seed, 2018). The particular task that we used was based on that of Russell et al. (2010; see also Ünal & Hohenberger, 2017), and is distinctive in that it (i) involves children choosing a tool for use in the distant future rather than for immediate use, which more closely aligns it with Tulving's (2005) conception of 'spoon' tasks and the tasks used in animal studies (McCormack & Hoerl, 2020; Scarf, Smith, & Stuart, 2014), and, (ii) involves children having to select a tool other than the one that they had been using recently. Arguably, both of these features mean that it is more likely to draw on EFT than some other tool saving tasks used with children (see Russell et al. for a different case for the advantages of this task). In particular, if children were choosing the tool most strongly associated with playing the game (Dickerson et al., 2018) they would be likely to choose incorrectly. Given that this tool saving task was also an independent predictor of delay choice scores in a regression analysis, we would suggest that it is more promising than our other two EFT tasks, at least in the context of a correlational study.

EFT and delay of gratification

To what extent do our findings support the hypothesis that EFT is adaptive in facilitating prudent choice? On the face of it, the results of our two studies might seem to be in tension with one another. Study 1 shows a developmental link between EFT, at least as measured by tool saving, and delay choice. Yet Study 2 finds no evidence that experimentally manipulating EFT in this age group affects decisions in a delay choice task. The only similar pair of studies conducted in a developmental context have been those of Bromberg and colleagues with adolescents. These studies produced a consistent pattern of findings: Bromberg, Wiehler, and Peters (2015) reported that individual differences in adolescents' delay discounting were predicted by levels of detail produced in an EFT interview task and Bromberg et al. (2017) found that cueing EFT reduced adolescents' temporal discounting. Daniel, Said, Stanton, and Epstein (2015) report a similar finding with 9-14 year-olds. Our failure to find a beneficial effect of EFT cueing on delay choice performance in pre-schoolers also contrasts with the findings of the large body of studies with adults indicating that EFT reduces temporal discounting.

One might resolve the apparent tension between the findings of our two studies by focusing on the distinction between correlation and causation, and by arguing that the correlational findings from Study 1 do not establish that EFT is important for delay of gratification in young children. Clearly, it is not possible, even when carefully controlling for IQ, to be sure that the association between tool saving and Picture Book performance and delay choice is specifically a result of shared demands on EFT. We have already argued that any such relation is unlikely to be due to shared demands on inhibitory processes, but there may be other cognitive skills that are important for performance on both tasks that have not yet been identified.

Alternatively, one might accept the findings of Study 1 as positive evidence for the hypothesis that EFT plays a role in delay choice, and instead argue that the ineffectiveness of

EFT cueing in Study 2 should not be interpreted as evidence against this hypothesis. There are two distinct variants of such an argument. First, it may be that the cueing technique used in Study 2 was not successful in actually encouraging children to engage in EFT. That is, children's narratives may not have been a result of attempts to actually imagine the future, but were drawn simply from semantic memory. It is true that children's future narratives in Study 2 had relatively low episodicity scores. However, there is a good reason to doubt that children were simply reporting information from semantic memory: their episodicity scores were significantly lower in the future than the past cueing conditions (consistent with findings from older children; Coughlin et al., 2014). This suggests that children were indeed at least trying to think about the future, even if they were not very good at generating rich episodic descriptions of future events.

A second possible argument, mentioned in the Discussion of Study 2, is that although EFT might be important for delay choice, cueing does not work in this age group due to their cognitive limitations. Indeed, children performed best in the baseline condition suggesting that engaging in any concurrent imaginative activity affected delayed choice in this age group. But what is the nature of such limitations? One possibility, considered above, is that pre-schoolers do not have sufficient working memory resources for EFT cueing to be beneficial for delay choice performance (Hinson et al., 2003; Lin & Epstein, 2014). However, a lack of evidence suggesting that either delay choice performance or EFT place heavy demands on pre-schoolers' working memory make it difficult to be confident about this specific conclusion without further studies. An alternative possibility is that the results might be interpretable within the wider framework of the notion of 'ego depletion' (Hagger, Wood, Stiff, & Chatzisarantis, 2010). Demonstrations of ego depletion typically involve initially administering a task that requires effort or control and then demonstrating that completing such a task impairs subsequent performance on other tasks that require similar resources

(Baumeister, Bratslavsky, Muraven, & Tice, 1998; Hagger et al., 2010). There is some recent evidence to suggest that ego depletion effects can be observed in children as young as five years (Oeri & Roebbers, 2020; Powell & Carey, 2017). However, we note that the robustness of ego depletion effects, and their mechanism of action, is the subject of considerable debate (Carter, Kofler, Forster, & McCullough, 2015; Hagger et al., 2016; Inzlicht, & Schmeichel, 2012). An ego depletion explanation of the current findings would also hinge on being clearer about in what sense EFT and delay choice tasks require effort or control, given that, as we have pointed out, there is very limited evidence of a link between pre-schoolers' performance on either of these types of tasks and tasks measuring executive functions. We note, though, that ego depletion need not necessarily be equated with depletion of commonly measured aspects of executive functions such as inhibitory control. Baumeister et al. conceptualize ego depletion broadly in terms of the limited resources of an 'active self' that is involved in initiating processing and making decisions. It seems plausible to argue that imagining the self's actions at another time and performance on the delay choice task both rely on an active self, understood this way.

This consideration of the processing demands of the delay choice task returns us to the issue, discussed in the Introduction, of the extent to which this type of delay of gratification task can be seen as a task involving effortful control in pre-schoolers. As we argued above, there are good reasons to believe it does not draw on the same type of inhibitory or effortful control processes as delay maintenance or temptation tasks. We believe that the delay choice task, unlike the delay maintenance or temptation tasks, is best conceptualized as a future-oriented decision making task (whereas the latter tasks involve sticking to a decision in the face of ongoing temptation). Nevertheless, by definition, the delay choice task taps the extent to which children make prudent choices, and, if effortful control is conceived of in Baumeister et al.'s (1998) broad sense of processes involving the

self actively making decisions, then the task can, in this sense, be seen as one involving effortful control. That is, there need not be a tension between viewing the delay choice task as one tapping future-oriented decision making and one involving some type of effortful control. An advantage, though, of looking at delay choice performance through the lens of future-oriented decision making is that it brings into focus the ways in which future thinking skills, such as EFT, may contribute to helping children make prudent choices. The findings of Study 1 provide some initial evidence that EFT may indeed make such a contribution.

Although we did not find that asking children to engage in EFT impacted on delay choice performance, research with adults on intertemporal choice suggests that performance on such tasks might be expected to be highly malleable and affected by other sorts of task manipulations (see Rung & Madden, 2018, for review and meta-analysis). This existing research suggests that whether participants engage in EFT may be only one of many factors that affect the decision participants make. Indeed, one advantage of viewing the delay choice task as a decision making task, rather than, for example, simply as an index of impulsivity, is that it makes salient the fact that relatively subtle aspects of how the decision is framed and the decisional context might systematically affect performance.

For example, in our study, on each trial, the experimenter said “If you take this [low value reward] you get it right now but you won’t get the [high value reward]. If you want to wait for the [high value reward] you don’t get anything right now but you will get the [high value reward] when I come back tomorrow”. We used this method as an attempt to ensure that children clearly understood the nature of the choice that they faced. We note, though, that our description of the implications of each choice explicitly includes the information that children will not get the large reward if they take the small reward right now, and that they will get nothing right now if they wait for the large reward. That is, children were not simply asked “Do you want (e.g.) one sticker now or two stickers tomorrow?” Research on

intertemporal choice with adults using the temporal discounting task has indicated that making the consequences of each option explicit in this way increases the likelihood that participants will wait for the larger reward – the ‘explicit zero’ effect (Magen, Dweck, & Gross, 2008). Although there are various interpretations of this effect, one possibility is that making it explicit that taking a reward now means no reward in the future serves to direct participants’ attention away from the present moment in time and towards the future (Radu, Yi, Bickel, Gross, & McClure, 2011). To the best of our knowledge, studies with children have not examined whether framing choices in this way has an impact on their performance on delay choice (though see Imuta, Hayne, & Scarf, 2014 and Mahy et al., 2020, for other types of framing manipulation with young children). If young children did show an explicit zero framing effect, and such an effect was correctly interpretable in terms of directing attention over time, it might provide some preliminary evidence that it is possible to alter delay choice in children by encouraging them to focus on the future. Such a finding would not demonstrate that EFT impacts on preschoolers’ delay choice performance, but it might suggest a basic role for some type of future-directed thought, and so it would be interesting to conduct such a study.

Conclusion

Although questions remain over how best to interpret the findings of Study 2, our overall pattern of results suggest that not only does EFT improve substantially with development but that the extent to which children can make use of what EFT resources they have also increases developmentally. Although the evidence suggests that by early adolescence EFT cueing does facilitate prudent choice, we do not yet know when children have sufficiently well-established EFT resources such that cueing assists them in future-oriented decision making. However, the findings from Study 1 provide a reason to believe there is some relation between some aspects of EFT and future-oriented decision making

developmentally. The relation that we found between performance on EFT tasks and performance on the delay choice task was specific to object selection tasks (Picture Book and Tool Saving); unlike a verbal EFT task that requires generating descriptions of events, these tasks also involve choosing for the future. However, they differ from the delay choice task in that they involve choosing an appropriate object for future use, rather than delaying gratification to a future time point. The findings suggest that choosing to delay gratification may draw on more generic abilities to prepare for the future as measured by these EFT tasks.

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Table 1. *Descriptive statistics of each of the measures taken.*

Measures	<i>N</i>	<i>Mean</i>	<i>SD</i>	Range
Age (months)	99	60.25	6.70	48-70
Vocabulary (WISC)	95	19.79	7.80	4-36
Block Design (WISC)	95	24.08	4.71	16-40
Delay of Gratification	99	1.84	1.43	0-4
Time Estimation (Before)	99	6.53	3.55	1-10
Time Estimation (After)	98	6.17	3.61	1-10
Tool saving	98	0.26	-	0-1
Picture book	94	0.80	-	0-1
Episodicity	94	2.04	1.09	0-4
Clarity	94	4.52	0.67	2.33-5

	2	3	4	5	6	7	8	9
1. Age	.58**	.50**	.36**	.28**	.31**	.41**	.28**	.03
2. Vocabulary	-	.41**	.26*	.18	.33**	.63**	.12	-.14
3. Blocks		-	.28**	.32**	.33**	.27**	.18	-.20
4. Delay choice			-	.28**	.28**	.11	.17	-.11
5. Tool saving			.23*	-	.29**	.04	.03	-.12
6. Picture Book			.22*	.21	-	.14	.06	.17
7. Episodicity			-.08	-.18	-.14	-	.03	.01
8. Clarity			.05	-.07	.00	-.07	-	-.03
9. Distance (before)			-.09	-.11	.22*	.10	-.01	-

Table 3. *Final model for linear regression predicting delay of gratification in Study 1 based on age, IQ measures and performance on the tool saving task.*

Variable	B (SE)	β	f^2	t	p	95% CI for B
(intercept)	-3.03 (1.33)			-2.28	.025	-5.67 – -0.39
Age	0.07 (0.03)	.35	.07	2.80	.006	0.02 – 0.13
Vocabulary	0.00 (0.02)	-.01	.00	-0.05	.957	-0.04 – 0.04
Blocks	0.01 (0.03)	.04	.00	0.34	.732	-0.06 – 0.08
Tool saving	0.68 (0.33)	.21	.04	2.09	.039	0.04 – 1.33
$R^2 = .224$		Adjusted $R^2 = .189$				

Table 4. *Final model for the linear regression predicting delay of gratification in Study 2 based on gender and intervention.*

Variable	B (SE)	β	f^2	t	P-value	95% CI for B
constant	1.28 (0.57)			2.26	.02	0.16 – 2.40
Gender	-0.49 (0.27)	-.17	.03	-1.85	.07	-1.02 – 0.03
Intervention	-0.75 (0.31)	-.22	.05	-2.40	.02	-1.36 – 0.13

$R^2 = .07$ Adjusted $R^2 = .06$

Figure 1. *Mean delay of gratification scores across condition. Error bars represent standard error. Individual data points are presented jittered.*