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Pain in the Past and Pleasure in the Future: The Development of Past–Future Preferences for Hedonic Goods

Ruth Lee,[a] Christoph Hoerl,[b] Patrick Burns,[a] Alison S. Fernandes,[c] Patrick A. O'Connor,[a] Teresa McCormack[a]

[a]*School of Psychology, Queen's University Belfast*
[b]*Department of Philosophy, University of Warwick*
[c]*Department of Philosophy, Trinity College Dublin*

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Abstract

It seems self-evident that people prefer painful experiences to be in the past and pleasurable experiences to lie in the future. Indeed, it has been claimed that, for hedonic goods, this preference is absolute (Sullivan, 2018). Yet very little is known about the extent to which people demonstrate explicit preferences regarding the temporal location of hedonic experiences, about the developmental trajectory of such preferences, and about whether such preferences are impervious to differences in the quantity of envisaged past and future pain or pleasure. We find consistent evidence that, all else being equal, adults and children aged 7 and over prefer pleasure to lie in the future and pain in the past and believe that other people will, too. They also predict that other people will be happier when pleasure is in the future rather than the past but sadder when pain is in the future rather than the past. Younger children have the same temporal preferences as adults for their own painful experiences, but they prefer their pleasure to lie in the past and do not predict that others' levels of happiness or sadness vary dependent on whether experiences lie in the past or the future. However, from the age of 7, temporal preferences were typically abandoned at the earliest opportunity when the quantity of past pain or pleasure was greater than the quantity located in the future. Past–future preferences for hedonic goods emerge early developmentally but are surprisingly flexible.

Keywords: Temporal; Time; Development; Hedonic; Preferences

Correspondence should be sent to Ruth Lee, Department of Psychology, University of York, Heslington, York Y010 5DD, UK. E-mail: ruthjlee@googlemail.com

1. Introduction

Imagine being in hospital for painful surgery. You need to be awake during this surgery, so anesthetics are not possible, but patients are given a postoperative drug that causes them to forget the last few hours. You wake up in hospital, unsure of whether you have yet had the operation, and ask for information. The nurse cannot remember whether you are the patient who had the operation yesterday, in which case it lasted 10 h, or the patient who will have the operation tomorrow, in which case it will last 1 h. The nurse goes to find out. What would you hope the nurse's answer will be? The philosopher Derek Parfit (1984), who proposed this thought experiment, claims that people will prefer to be the patient who had the 10-hour painful operation yesterday rather than the one who will have the 1-hour painful operation tomorrow. People's preference for unpleasant experiences to lie in the past and, conversely, for pleasant experiences to lie in the future has been described as a temporal bias (Hare, 2007; Sullivan, 2018).

1.1. Past–future hedonic preferences

We will refer to a preference over whether a pleasant or unpleasant experience is in the past or future as a "past–future hedonic preference." There is already a lively debate about the origins and significance of past–future hedonic preferences in philosophy (e.g., Dougherty, 2015; Fernandes, 2019; Sullivan, 2018; Tarsney, 2017), where it has been taken as self-evident that people exhibit them. The purpose of Parfit's thought experiment is to demonstrate not just temporal bias, but the idea that the bias is so strong that there is a preference for considerably worse things in the past over less bad things in the future. Such preferences can be seen as analogous in some respect to preferences involving the temporal locations of rewards in the future (e.g., Berns, Laibson, & Loewenstein, 2007; Loewenstein, Read, & Baumeister, 2003). People's preferences for a smaller more immediate reward over a larger one a greater distance in the future have been studied extensively, and they indicate that the value of a future reward is discounted as some function of its distance away in time. Similarly, it has been suggested that the extent to which individuals have preferences regarding the past versus future locations of pleasant or unpleasant experiences can be thought of in terms of the degree to which past experiences are discounted (Suhler & Callender, 2012; Sullivan, 2018).

Sullivan (2018, p. 58) has argued that "In the case of 'pure' experiences of pains and pleasures, it seems that our discount functions are absolute: For any amount of time that has elapsed, we assign no value to a merely past painful experience or pleasurable experience." However, studies of inter-temporal choice tasks involving monetary rewards at various distances in the past indicate that the value of such rewards declines systematically as a function of elapsed time (e.g., Bickel, Yi, Kowal, & Gatchalian, 2008; Yi, Gatchalian, & Bickel, 2006). Although these studies examined monetary rewards rather than purely hedonic goods, it is at least plausible that similar discount functions might indeed obtain for the latter type of reward.

Several studies have suggested that future events are more valued and evoke more emotion than past events. Caruso, Gilbert, and Wilson (2008) demonstrated that people allocate more compensation for hypothetical tasks that lie in their future than for equivalent tasks that they have already performed, and they report stronger emotions when contemplating imagined future versus imagined past events (Caruso, 2010; Van Boven & Ashworth, 2007). Even children show these patterns of judgments (Burns et al., 2019), which have been referred to as temporal asymmetries in value or in emotion judgments.

In these previous studies, though, participants were not asked to choose whether they would prefer a pleasant or unpleasant experience to be in the past or the future (i.e., they were not making an inter-temporal choice). Rather, they had to assign values either to past or to future events. One reason for doubting that these studies allow us to straightforwardly draw conclusions about past–future hedonic preferences stems from participants' own attitudes toward judgment patterns. Temporal asymmetries in value judgments are only observed when separate groups of participants make judgments about the value of past events and future events; when participants were asked to give values for both past and future events simultaneously, they assigned equal values to them (Caruso et al., 2008). This suggests that people believe assigning equal monetary value to past and future events to be normatively correct. By contrast, it is typically assumed that people believe past–future hedonic preferences are rational: Hare (2013, p. 519) argues that "We are all future biased with respect to our own bad experiences [and] it seems to us that it *makes sense* to be biased." Thus, conclusions about past–future hedonic preferences cannot be drawn from the findings of existing studies that have examined the monetary values independently assigned to past versus future events. What is required is to study past–future hedonic preferences and the parameters governing such preferences directly.

To our knowledge, only one published empirical study has done so. Greene, Latham, Miller, and Norton (2020) presented adults with one future and one past event, manipulating its nature (hedonic or non-hedonic), valence (positive or negative), and whether it was said to happen in the life of the participant or in the life of a stranger (first or third person). They found that adults demonstrated past–future hedonic preferences for both pleasurable and painful hedonic events, regardless of whether they were said to be experienced by the participant or by someone else, although the past–future preferences for non-hedonic events were less clear-cut. Greene et al.'s results provide some initial compelling evidence that adults do indeed have past–future preferences regarding positive and negative hedonic events. However, their study involved a single vignette concerning a very specific event far removed from people's everyday experience (an astronaut awaking from a dream during a 10-year voyage from Earth). The contrived nature of the vignette was driven by these researchers' concern to ensure that participants' judgments were not affected as a result of imagining that they could intervene, for example, to prevent a future negative experience. While there are advantages in using a complex scenario that limits the extent to which participants' judgments might be affected in this way, a disadvantage is that it is not clear how generalizable the findings are, or how they align with findings from studies addressing other types of intertemporal choice. In the current study, we focus on everyday pains and pleasures, and we address additional questions

concerning the absolute nature of discounting of the past as well as the developmental origins of past–future preferences.

1.2. Measuring past–future hedonic preferences

Our experiments described below initially explored whether past–future hedonic preferences really are as ubiquitous as typically assumed, by eliciting preferences for simple experiences such as eating delicious food or getting a painful injection. We then examined the strength of any temporal bias, by establishing whether there is a trade-off point at which participants will switch their preferences. If preferences are absolute (Sullivan, 2018), then participants should demonstrate them regardless of the duration or intensity of the experiences. Parfit's thought experiment is supposed to demonstrate that this is the case by showing that people would prefer 10 h of past pain over 1 h of future pain. However, not only is this merely a thought experiment, but it hinges on the unusual assumption that the person making the choice has permanent amnesia about the relevant past events. It has been argued that assuming such amnesia is crucial in this context, because it ensures that people's choices are affected solely by the temporal location of the experience in question and not also, say, by the presently occurring memories of past pain (Sullivan, 2018). However, it is difficult to see how exactly memories of past pain might mask people's temporal preferences.

On the assumption that such memories of past pain are themselves painful, one might expect people to prefer a situation in which they are without such memories, and hence a situation in which the pain has not yet occurred, masking a purely temporal preference for pain to be in the past. Thus, although it is true that the possibility of presently experienced memories thus introduces a potential confound, it is not clear that this can be used to argue that past–future differences in judgments might fail to track genuine past–future hedonic preferences. Conversely, the assumption of amnesia, too, introduces a confound of a related kind. If the patient in Parfit's story finds out that they have already had the operation, this, at the same time, serves as confirmation that the amnesia-inducing drug has worked and that they will not have to live with the memories of their operation, whereas they do not already have similar assurances with respect to an operation to be carried out in the future. Thus, if in Parfit's scenario, people express a preference for the situation in which the operation has already occurred, this, too, could be due to factors other than purely temporal ones. At any rate, we note that past–future hedonic preferences have been taken to be of interest precisely because they are believed to be both ubiquitous and strong (Suhler & Callender, 2012); this means it should be possible to observe such preferences even if they cannot be studied in complete isolation from other factors. Indeed, in Greene et al.'s (2020) study, although they used a contrived scenario, it was not one involving permanent total amnesia (rather, the character is momentarily confused having woken from a dream), and they nevertheless found clear past–future preferences. In the current study, we used even simpler scenarios on the assumption that if past–future hedonic preferences are robust, straightforward cases that do not involve forgetting should also be able to provide evidence for them.

In fact, such preferences are assumed to be sufficiently pervasive that some theorists have suggested they should be explained in evolutionary terms (Maclaurin & Dyke, 2002; Suhler & Callender, 2012) and as a manifestation of a more general tendency to care more about the future than about the past. On this view, this pattern of preferences derives from more a fundamental past–future asymmetry of control: While people can act on and in some sense control aspects of the future, they cannot control the past, and it is therefore usually adaptive to care more about the future than the past (Caruso, 2010; Maclaurin & Dyke, 2002; Suhler & Callender, 2012; Sullivan, 2018). Thus, past–future hedonic preferences are assumed to be just one example of an adaptive tendency to be future oriented.

1.3. Developmental considerations

Claims about the origins of past–future preferences raise interesting developmental issues. If past–future hedonic preferences are indeed a manifestation of an inbuilt adaptive tendency, we might expect to see them emerge relatively early in development. However, it is not clear that children of all ages will indeed show the same preferences as adults. In the most relevant developmental study to date, Burns et al. (2019) found evidence that temporal asymmetries in other types of judgments have a developmental profile: 4- to 5-year-olds judged that events in the future felt closer than those an equivalent distance in the past, but it was not until children were aged 6–7 that they reported feeling stronger emotions when thinking about the future versus the past, and not until 9–10 years that children appeared to accord greater value to future than past events.

Although Burns et al. (2019) provide evidence regarding the developmental profile of a variety of temporal asymmetries in judgments, the relevant developmental mechanisms for these changes are poorly understood. There is, though, good evidence that there are substantial changes in children's temporal cognition. Preschool children use tensed language appropriately (Harner, 1976; Weist, Wysocka, & Lyytinen, 1991) and are able to episodically remember the past and imagine the future (Coughlin, Lyons, & Ghetti, 2014; Hayne, Gross, McNamee, Fitzgibbon, & Tustin, 2011). However, children of this age are just starting to get to grips with the way events are ordered in time (Friedman, 2005; Hoerl & McCormack, 2019), and with the causal significance an event's being located in the past versus the future has for the present (Grant & Suddendorf, 2010; Zhang & Hudson, 2018). Preschoolers frequently make errors when locating and ordering events within time, particularly when reasoning about future, as opposed to past events (McColgan & McCormack, 2008; McCormack & Hanley, 2011), and the ability to think hypothetically about the future and counterfactually about the past continues to develop in important ways into middle childhood (Beck, Robinson, Carroll, & Apperly, 2006; Rafetseder, Cristi-Vargas, & Perner, 2010). There are further substantial developmental improvements into adolescence in the ability to imagine past and future personal experiences (Abram, Picard, Navarro, & Piolino, 2014; Gott & Lah, 2014) and to locate and order events in time (Friedman, 1989, 2005). Taken together, this evidence suggests that we cannot be confident that children of all ages will show the same sort of temporal preferences

regarding hedonic experiences as more mature thinkers. If indeed such preferences are strong and ubiquitous in adults but not in children, it would constitute a very striking developmental difference.

1.4. The current study

In Experiments 1a–c, adults and children were asked about simple temporal preferences for painful and pleasurable hedonic experiences when those experiences were of equal intensity. We framed the task as one in which participants had to judge whether they would prefer to be someone who had already experienced, for example, a painful injection, or someone who was going to experience such an injection in the future. We also elicited judgments about whether greater happiness or unhappiness is associated with past versus future pain/pleasure; for example, participants were asked to judge who would be more unhappy: someone who had already had a painful injection or someone who had yet to experience it. This allowed us to examine the extent to which participants also showed patterns of emotion prediction that were consistent with any past–future hedonic preferences that they demonstrated. On Suhler and Callender's (2012) evolutionary account of such preferences, differential strengths of emotions produced when thinking about the past and future play a key role in explaining temporally asymmetric patterns of judgments. Specifically, the idea is that people experience stronger emotions when thinking about future versus past events, and it is these stronger emotions that explain why, for example, people assign greater value to future than past events (see also Caruso, 2010; Caruso et al., 2008). Our emotion prediction task examined whether adults and children do indeed predict the strength of emotions associated with hedonic experiences to vary dependent on whether those experiences are in the past or future.

In Experiments 2 and 3, we then investigated whether people preferred to switch their preferences when the amount of past pain or past pleasure on offer exceeded that located in the future, and, if so, what difference in magnitude of past versus future pain/pleasure would elicit such a switch. In those two experiments, we also asked what another person would prefer. This allowed us to examine the extent to which people assume the pattern of preferences they hold themselves is indeed universal. Hare (2013) claimed that people believe it simply makes sense to have past–future hedonic preferences; if this is correct, we might expect to see no differences between participants' own preferences and those they expect another person to have. Alternatively, it could be that considering another's perspective rather than one's own reduces the level of affect and sense of proximity associated with the future experience, potentially reducing temporal bias (Caruso et al., 2008; Greene & Sullivan, 2015; Hare, 2013). Indeed, Greene et al. (2020) found that past–future hedonic preferences were less marked when participants considered another person's perspective.

2. Experiment 1a

Experiments 1a (adults) and 1b (children) examined past–future hedonic preferences for a set of unpleasant and a set of pleasurable experiences. The design and procedure for

the experiments were very similar, differing primarily in terms of the specific unpleasant and pleasurable experiences used with each sample. Given their similarity, the results for Experiments 1a and 1b are reported together. In both experiments, there was an initial check to ensure that the experiences in question did indeed have the appropriate hedonic values to participants.

2.1. Method

2.1.1. Participants

Thirty-nine adults (M = 26.86 years, SD = 8.74, range: 18–62 years, 9 males) participated in the experiment at the first author's university. Participants were recruited by offering voluntary participation immediately after university classes and received no compensation. The study was completed in various quiet spaces at the university. Ethical approval for this and all other experiments was received from the research ethics committee of Queen's University Belfast, protocol number EPS 18_19.

2.1.2. Design, materials, and procedure

Participants completed four trials: two Temporal Preference trials and two Emotion Prediction trials, in each case one about pain and one about pleasure. Trials of the same type (Temporal Preference or Emotion Prediction) were always encountered consecutively. The order of presentation of trials of the same type was counterbalanced, as were the order of presentation of questions about pleasure and about pain and the type of trial associated with each specific painful or pleasurable experience. The experiment comprised an initial Hedonic Value Check during which participants evaluated the relevant experiences, and then the past–future task with the Temporal Preference and Emotion Prediction trials.

2.1.3. Hedonic Value Check

Participants rated the pleasantness or otherwise of four experiences on a 7-point visual Likert scale, labeled from 1 (*Extremely unpleasant*) to 7 (*Extremely pleasant*) and using red thumbs-down and green thumbs-up pictures of varying sizes (Fig. 1). The two painful experiences were having a painful injection and having a painful dental procedure. The two pleasurable experiences were eating a free meal at an excellent restaurant and watching one's favorite comedian perform live.

2.1.4. Temporal Preference trials

Each trial involved two line drawings of faces with a neutral expression: Females saw female faces, and males saw male faces. A short piece of written text introduced the characters, stating that one of them experienced an event yesterday, although s/he is not experiencing it now, and that the other will experience the event tomorrow, although s/he is not experiencing it now. Event descriptions referred to the events introduced during the Hedonic Value Check. For instance, on a trial about the painful injection, the text was

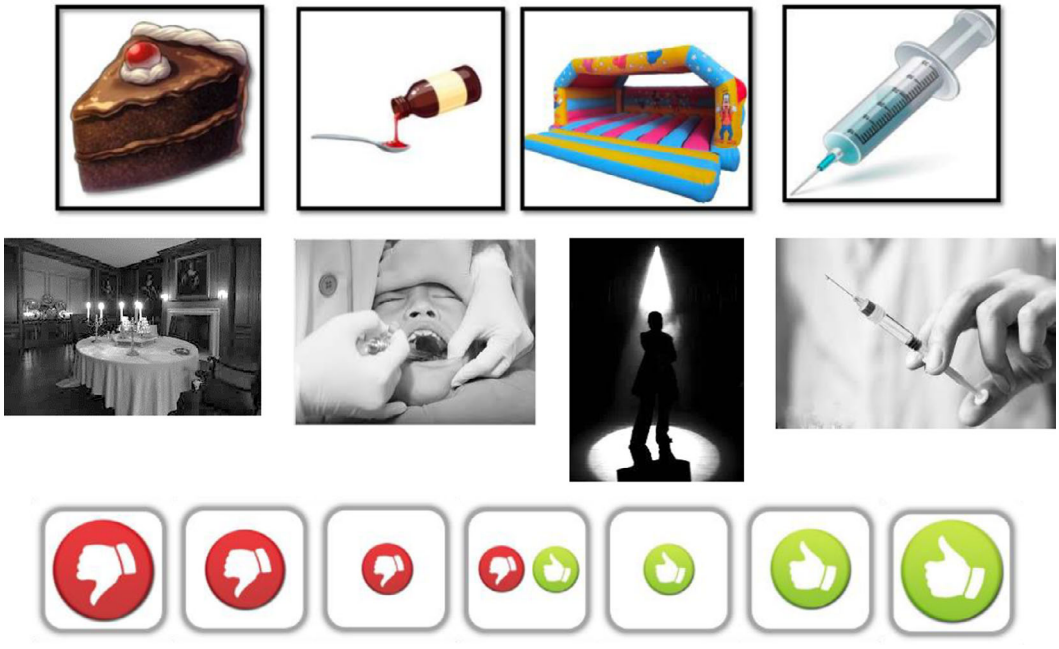

Fig. 1. Depictions of events used during the Hedonic Value Check with child (above) and adult (below) participants in Experiments 1a, 1b, and 1c, alongside the visual rating scale used with both child and adult participants. Stimuli depict the events described during the subsequent temporal preference and emotion prediction trials.

"This is Annie, and this is Betty. Both of them are fine now—they don't have any pain. Annie had a painful injection yesterday, although she is not in pain today. Betty will have a painful injection tomorrow, although she is not in pain today." Participants then responded to the preference question—"Who would you rather be? Annie, who had a painful injection yesterday, or Betty, who will have a painful injection tomorrow?"—by checking a box. Participants were then asked, "Why would you rather be that person?" and given two printed lines on which to give a free-text response.

2.1.5. Emotion Prediction trials

These trials paralleled the design of the Temporal Preference trials, except that rather than being asked about their own preference (who they would rather be), participants were asked about the two characters' current emotional state. For pleasurable experiences, participants were asked, "Who is more happy right now?" and for painful experiences, they were asked, "Who is more unhappy right now?"

2.1.6. Data scoring and analysis

Participants' choices on the Hedonic Value Check task were assigned a score from −3 (lowest point on the 7-point scale) to 3 (highest point on the scale). Choosing the

midpoint resulted in a score of 0. On rare occasions when a score of 0 or lower was given for a pleasurable experience or 0 or higher for an unpleasant experience, only the trial involving that experience was dropped, and other data from the same participant were retained; this yielded slightly different *n*s across trials for the analyses below. Pain ratings were multiplied by −1 prior to analysis, such that all scores reflected only the degree, and not the valence, of participants' liking or dislike for the painful and pleasurable experiences with which they were presented. Participants' choices on the Temporal Preference task were assigned a score of 1 if their preference was for the expected temporal location (future for pleasure; past for pain), and a score of 0 if they displayed the opposite preference (past for pleasure; future for pain). Similarly, their judgments on the Emotion Prediction trials were scored 1 if their prediction was in the expected temporal location, and 0 if they displayed the opposite judgment.

3. Experiment 1b

3.1. Method

3.1.1. Participants

One hundred and sixteen children (48 males) between the ages of 4 and 11 were recruited from schools local to the lead author's institution. The sample was split by age: 36 4- to 5-year-olds (M = 63.53 months, SD = 2.77, range: 58–71 months), 32 7- to 8-year-olds (M = 96.97 months, SD = 5.1, range: 89–105 months), 24 9- to 10-year-olds (M = 118.33 months, SD = 3.68, range: 112–125 months), and 24 10- to 11-year-olds (M = 131.96 months, SD = 3.80, range: 126–138 months) participated. Testing took place in various quiet spaces within participating schools.

3.1.2. Design, materials, and procedure

The design of the study was identical to that of Experiment 1a. The materials and procedure were very similar, but there were some modifications to ensure the task was suitable for a child population. Rather than children completing a paper questionnaire, the task was administered by an experimenter and children gave verbal responses or pointed at their answers. The two painful experiences were a painful injection and taking medicine, and the two pleasurable experiences were eating cake and playing on a bouncy castle.

During the Hedonic Value Check task, children were presented with colorful laminated pictures representing events and the same rating scale as the one that was used with adults (Fig. 1). The points on the scale were described as ranging from "really, really not nice" to "really, really nice." Children were then asked a series of questions to assess their understanding of the scale. If children responded incorrectly, the experimenter explained the scale a second time and repeated the questions. Children then used the scale to indicate how nice they found two pleasurable and two painful experiences:

"eating a delicious slice of cake," "playing on a fun bouncy castle," "taking some horrible-tasting medicine," and "having a painful injection."

The Temporal Preference trials were identical to those used with adults, except that children pointed to or named the appropriate character in giving their answer. The procedure for Emotion Prediction trials was slightly different than that used with adults in order to ensure that children understood they were being asked to make relative emotion judgments: Instead of judging who was happier or sadder, participants were asked to place a small laminated picture of a mouth onto one of two laminated line drawings of faces, each of which featured a small piece of Velcro in place of the mouth. Children were first shown how to place a neutral ("not-happy not-sad") mouth onto one of the pictures, and tried this themselves. The experimenter then revealed four more pictures of mouths, placing them in a vertical line between the two face pictures. ("This is the very happy mouth. This is the little bit happy mouth. This is the little bit sad mouth. And this is the very sad mouth.") The experimenter then turned over the two mouth pictures that would not be required for the current trial, leaving only two mouths visible to the child (little bit happy and very happy for Pleasure trials, and little bit sad and very sad for Pain trials). The experimenter asked, for example, "I want you to think about who is more sad right now? Emma who had a painful injection yesterday or Fiona who will have a painful injection tomorrow? Put the very sad mouth on the person who feels more sad right now and put the little bit sad mouth on the person who feels less sad right now." For both types of trials, children were asked to explain their answers and the experimenter noted their explanations.

3.1.3. Data scoring and analysis

Data scoring and analysis were carried out in an identical manner to Experiment 1a.

3.2. Results of Experiments 1a and 1b

All analyses were performed separately on adult and child data. Tables S1 and S2 of Appendix S1 (available online) report data for the Hedonic Value Check task. These ratings indicate that the experiences had the appropriate hedonic value.

Results from the Temporal Preference and Emotion Prediction tasks are reported in Table 1, where they are shown as a proportion of participants who demonstrated temporal location judgments in the expected direction. The final column on the table gives the number (and %) of participants in each age group who provided a consistent response across Temporal Preference and Emotion Prediction tasks (i.e., consistently preferring the past or future events), separately for pleasant and unpleasant experiences. We first examined participants' temporal location judgments against chance levels using two-tailed binomial tests. Adults preferred pleasurable experiences to lie in the future and painful experiences to lie in the past at a rate above chance, and they also predicted that someone would be sadder with their pain in the future. However, adults' judgments when deciding whether someone else whose pleasure lay in the past versus the future would be happier were only marginally significantly different from chance. Nine- to ten- and 10- to

Table 1
Results of two-tailed binomial tests against chance, Experiments 1a and 1b. Frequencies and percentages represent participants who demonstrated temporal location preferences in the expected direction

Age Group, Trial	Valence	Frequency (%)	95% CI	*p*	Consistent Across Trial Type (%)[a]
4–5 (N = 36)					
Pleasure	Temporal Preference (n = 36)	12 (33)	0.19, 0.50	.065	2 (5.71)
	Emotion Prediction (n = 35)	8 (23)	0.10, 0.40	.002[#]	
Pain	Temporal Preference (n = 23)	13 (57)	0.34, 0.77	.678	4 (11.43)
	Emotion Prediction (n = 27)	10 (37)	0.19, 0.58	.248	
7–8 (N = 32)					
Pleasure	Temporal Preference (n = 30)	25 (83)	0.65, 0.94	<.001	19 (67.86)
	Emotion Prediction (n = 30)	25 (83)	0.65, 0.94	<.001	
Pain	Temporal Preference (n = 28)	22 (79)	0.59, 0.92	.004	13 (52)
	Emotion Prediction (n = 27)	18 (67)	0.46, 0.83	.122	
9–10 (N = 24)					
Pleasure	Temporal Preference (n = 24)	20 (83)	0.63, 0.95	.002	17 (70.83)
	Emotion Prediction (n = 21)	19 (79)	0.58, 0.93	.007	
Pain	Temporal Preference (n = 19)	17 (89)	0.67, 0.99	.001	13 (76.47)
	Emotion Prediction (n = 18)	15 (75)	0.51, 0.91	.041	
10–11 (N = 24)					
Pleasure	Temporal Preference (n = 24)	24 (100)	0.86, 1	<.001	17 (80.95)
	Emotion Prediction (n = 21)	17 (81)	0.58, 0.95	.007	
Pain	Temporal Preference (n = 17)	16 (94)	0.71, 1	<.001	13 (76.47)
	Emotion Prediction (n = 18)	18 (100)	0.81, 1	<.001	
Adults (N = 39)					
Pleasure	Temporal Preference (n = 39)	36 (92)	0.79, 0.98	<.001	24 (61.54)
	Emotion Prediction (n = 39)	26 (67)	0.50, 0.81	.053	
Pain	Temporal Preference (n = 38)	38 (100)	0.91, 1	<.001	36 (92.31)
	Emotion Prediction (n = 37)	36 (97)	0.86, 1	<.001	

Note: Participant numbers vary across trials because data from participants who did not report the appropriate hedonic value for a specific experience were removed on the relevant trial.
[#]Significantly different to chance in the direction opposite to that expected.
[a]Percentages represent proportion of participants who completed both trial types.

11-year-olds preferred pleasurable experiences to lie in the future and painful experiences to lie in the past at a rate above chance, and they also predicted at a rate above chance that someone would be happier if their pleasure was in the future and sadder if their pain was in the future. Seven- to eight-year-olds' pattern of performance was identical to that of the older children, except that judgments about whether someone would be sadder with their pain in the past or in the future were not significantly different from chance. Four- to five-year-olds' preferences for the temporal location of their own pain was at chance, and for their own pleasure, there was a trend toward a preference in the opposite direction to that expected: that is, toward a preference for their own pleasure to lie in the past. Four- to five-year-olds also predicted at a rate above chance that someone would be happier if their pleasure was in the past than the future. Their judgments did not differ from

chance regarding whether someone would be sadder if their pain was in the future or the past.

The consistency of participants' responses across Temporal Preference and Emotion Prediction trials varied with age group. The youngest group was highly inconsistent across the two judgment types, whereas for all the older groups, consistency varied between 52% and 100%.

To investigate the effect of valence (pain or pleasure) and, in the case of children, age group within trials of the same type (Temporal Preference trials and Emotion Prediction trials), we submitted the data to generalized estimating equation (GEE) analyses with binomial distributions, logit-log link functions, and independent covariance structures. These analyses were selected to accommodate the binary nature of the dependent variable and the presence of a within-subject factor (valence) in the data.

No meaningful analysis was possible on the data from adults on Temporal Preference trials due to ceiling performance. We were able to examine adults' data on Emotion Prediction trials, using valence as a predictor of judgment and rating on the Hedonic Value check task as a covariate. At the same levels of rating, there was a decrease in the odds of making a judgment in the expected direction when adults considered pleasure, rather than pain (Wald $\chi^2(1) = 5.73$, $p = .017$, $b = -2.89$, 95% CI [−5.26, −0.52], $SE = 1.20$, Exp(B) = 0.055, 95% CI [0.06, 0.59]).

We then examined children's data for Temporal Preference trials, with valence, age group, and the interaction between valence and age group as predictors of judgment and rating on the Hedonic Value check task as a covariate. The model did not converge. The interaction was removed from the model. There was no effect of rating ($p = .610$) or valence ($p = .292$), but there was a significant effect of age group (Wald $\chi^2(3) = 32.93$, $p < .001$). In follow-up analyses, we first compared the youngest children (4- to 5-year-olds) with older children. At the same levels of rating, 7- to 8-year-olds ($p < .001$), 9- to 10-year-olds ($p < .001$), and 10- to 11-year-olds ($p < .001$) all had higher odds of making a judgment in the expected direction than did 4- to 5-year-olds (7- to 8-year-olds: $b = 1.72$, 95% CI [0.82, 2.61], $SE = 0.46$, Exp(B) = 5.58, 95% CI [2.28, 13.65]); 9- to 10-year-olds: $b = 2.18$, 95% CI [1.14, 3.21], $SE = 0.53$, Exp(B) = 8.81, 95% CI [3.12, 24.87]; 10- to 11-year-olds: $b = 4.12$, 95% CI [2.05, 6.19], $SE = 1.06$, Exp(B) = 61.59, 95% CI [7.78, 487.58]). Further analyses revealed that there were no significant differences between any of the other age groups, except for 7- to 8-year-olds and 10- to 11-year-olds ($p = .026$, $b = -2.40$, 95% CI [−4.52, −0.29], $SE = 1.08$, Exp(B) = 0.09, 95% CI [0.01, 0.75]).

Finally, we examined children's data for Emotion Prediction trials, with valence, age group, and the interaction between valence and age group as predictors of judgment and rating on the Hedonic Value check task as a covariate. The model did not converge. The interaction was removed from the model. There was no effect of rating ($p = .776$) or valence ($p = .984$), but there was a significant effect of age group (Wald $\chi^2(3) = 40.43$, $p < .001$). Follow-up analyses showed that at the same levels of rating, 7- to 8-year-olds ($p < .001$), 9- to 10-year-olds ($p < .001$), and 10- to 11-year-olds ($p < .001$) all had higher odds of making a judgment in the expected direction than did 4- to 5-year-olds

(7- to 8-year-olds: $b = 2.15$, 95% CI [1.26, 3.03], $SE = 0.45$, Exp(B) = 8.55, 95% CI [3.52, 20.78]); 9- to 10-year-olds: $b = 2.54$, 95% CI [1.51, 3.58], $SE = 0.53$, Exp (B) = 12.72, 95% CI [4.51, 35.90]; 10- to 11-year-olds: $b = 3.18$, 95% CI [1.93, 4.42], $SE = 0.63$, Exp(B) = 23.96, 95% CI [6.91, 83.06]. There were no significant differences between any of the other groups.

3.3. Discussion of Experiments 1a and 1b

For all groups of participants apart from the 4- to 5-year-olds, the overall pattern of results on the Temporal Preference task was consistent with Parfit's (1984) claim that people show a past–future preference for hedonic goods. Adults clearly preferred pain to lie in the past and pleasure to lie in the future, and the majority of them thought that others would also be happier when this was the case. However, when predicting others' emotions, they were significantly less likely to demonstrate a temporal bias when considering pleasure than pain. This finding may be at least in part explained by participants assuming a role for memory when predicting emotions but not when making temporal preference judgments. Both pleasant and painful memories are themselves pleasurable or painful, and they can influence present emotional state, but to different degrees: by middle childhood (Rollins, Gibbons, & Cloude, 2018) and into adulthood (Walker, Skowronski, & Thompson, 2003), affect associated with pleasant events fades more slowly than affect associated with unpleasant events. Indeed, although we did not formally analyze the explanations given by participants, some of the adults' emotion predictions regarding past pleasures in particular seemed to reflect an appreciation of the impact of memory on emotions (e.g., "Annie can enjoy the memory and share her experience with others today").

Children as young as 7–8 years of age also demonstrated clear past–future hedonic preferences in the expected directions in the Temporal Preference task, although 7- to 8-year-olds' performance was significantly less consistent than that of 10- to 11-year-olds, who performed very much like the adults. The striking age effects were between the youngest children and the other age groups. Four- to five-year-olds did not show the expected preferences for either type of hedonic experience and indeed showed a tendency to prefer their pleasure to be in the past. In the Emotion Prediction task, they did not predict that others' emotions would be any different in the case of future than of past pain, and in fact they predicted that someone would be happier with their pleasure in the past than in the future. We inspected the explanations of this age group for both tasks, but children struggled to give coherent explanations and those who said anything often either referred just to the enjoyable nature of the pleasurable experience or the mere fact that it occurred yesterday.

Preschoolers are still learning to reason about the causal significance of whether an event is in the past or the future (Grant & Suddendorf, 2010; Zhang & Hudson, 2018) and getting to grips with locating and ordering events in time (Friedman, 1989, 2005; Hoerl & McCormack, 2019). Thus, the pattern of performance observed in this age group may reflect a genuine difference in the significance preschoolers attach to an experience

being in the past versus the future. However, we had some concerns about aspects of the task procedure that younger children found challenging. One issue concerned the use of the temporal adverbs "yesterday" and "tomorrow," which not all preschoolers may understand (Tillman, Marghetis, Barner, & Srinivasan, 2017). Further issues concerned whether children remembered the information about the characters' experiences and understood the form of the test question "Who would you rather be?" In a further experiment, we repeated the task with 4- to 5-year-olds with a modified procedure that addressed these concerns.

4. Experiment 1c

The task structure in Experiment 1c was similar to that used in Experiment 1b, but it omitted the use of the terms "yesterday" and "tomorrow" and included additional pretraining and a number of control questions to check children's memory and understanding.

4.1. Method

Thirty-five 4- and 5-year-old children (M = 64.4 months, SD = 3.89 months, range: 58–70 months, 17 males) were recruited from schools. Data from an additional 15 children were collected, but not used due to not answering questions (2 children), failing memory or comprehension checks (13 children, 3 of whom failed only memory checks, 4 of whom failed only a comprehension check, and 6 of whom failed both), and experimenter error (1 child).

4.1.1. Materials

The rating scale for the Hedonic Value Check task and the pictures of protagonists used at test were identical to those used in Experiment 1b. The pictures of experiences were also identical, save for one change that made it plausible for all of the experiences to take place either early or late in the day: In place of eating a delicious piece of cake, protagonists had eaten or would eat a "delicious donut." Laminated pictures of an additional pleasant event (having delicious ice cream) and an additional unpleasant event (having a sore finger) were used to check children's understanding of the question "Who would you rather be?" Additional pictures of events encountered at regular times by children in the course of a typical weekday were used to scaffold children's understanding of the task (an unmade bed, a backpack containing school equipment, a house, and a dinner plate: Fig. 2). During two training trials, we presented children with additional pictures of people (Fig. 2) and used either a horse or a snake hand puppet to elicit children's responses.

4.1.2. Design and procedure

Design and procedure were identical to those in Experiment 1b, with the following exceptions.

Fig. 2. Depictions of events used during the Pretraining task with 4- to 5-year-old participants, Experiment 1c.

4.1.2.1. Pretraining task: Following the Hedonic Value Check task, children completed an unscored pretraining task. This task was intended to make salient past versus future times and familiarize children with the idea that two characters did the same thing but at different times. Children were introduced to one of two hand puppets (Mr. Horse or Mr. Snake) and told that they would play a game in which some children have done certain things already, and some have not done them yet. Children were told that the puppet sometimes gets confused and cannot remember who has and has not already done something, and they were asked to help the puppet. They were then introduced to two characters (girls saw pictures of female children, and boys saw pictures of male children). Pictures of an unmade bed and a backpack containing school equipment were placed above the picture of the character on the left, who had short hair. Pictures of a house and a dinner plate were placed above the picture of the character on the right, who had long hair (Fig. 2). Children were told that "it's a haircut day for them today." The experimenter explained that this morning, for example, "Nelly got out of bed and got ready for school and then had her hair cut" and that "tonight, Orla is going to go home from school, have her dinner, and then have *her* hair cut." The experimenter asked the puppet to identify the character who "got out of bed this morning, got ready for school and then had her hair cut," and children were asked to help the puppet when he was not sure. Children who responded incorrectly were corrected. The procedure was then repeated for the character who "is going to go home from school and have dinner tonight, and then have her hair cut." In a similarly structured second trial, participants were introduced to two more characters, one wearing glasses (placed to the left under the unmade bed and backpack), and one without glasses (placed to the right under the house and dinner plate) and told that "it's a shopping day for them today"; the character on the left had got out of bed, got ready for school, and then gone with her mother to get some glasses to wear, and the character on the right would go home from school and have dinner tonight, and then go with her mother to get some glasses to wear.

4.1.2.2. Temporal Preference and Emotion Prediction tasks: Participants heard about events that occurred/would occur *this morning* and *tonight*. Several additional pieces of information were also added to the scenarios. First, the painful or pleasurable events were mentioned together with other events that children typically encounter during the morning and evening of a school day. This was in order to make the past–future locations of the events clear, by capitalizing on young children's grasp of the sequence of events in a typical day. Second, participants were told not only that a character is not experiencing a particular event now, but that he/she is engaged in another completely different activity right now (e.g., painting or sitting on the mat). This was to emphasize that the hedonic experiences in question were not currently ongoing. Extensive piloting suggested that young children found it easier to grasp that, for example, a past event was not still ongoing if they were informed that the character was engaged in a different activity.

Thus, participants heard, for example: "This is Annie, and this is Betty. Both of them feel fine now. This morning Annie got out of bed and got ready for school, and then she had a painful injection. After she had the injection she went to school, and right now she is doing numbers at school. And right now Betty is doing numbers at school as well. Tonight Betty is going to go home from school and have dinner, and then she will have a painful injection," with the experimenter pointing to appropriate pictures throughout. This scenario was then repeated: "So Annie had a painful injection earlier this morning. She isn't having one right now though, she had it this morning and right now she's doing numbers at school and she's not in pain. And Betty is going to have a painful injection later this evening. She isn't having one right now though, she is doing numbers at school and she's not in pain, and she'll have the injection this evening."

Children were then asked two types of memory check questions. First, they were asked to identify the person who had had the painful or pleasurable experience "this morning," and the person who would have it "tonight." Next, they were asked whether each character was having the experience "right now." If a child gave an incorrect answer to any of these questions, the experimenter repeated the scenario description, and the question was put to the child again. Regardless of the child's answer to a repeated question, the experiment then continued with the same four Temporal Preference and Emotion Predictions trials used in Experiment 1b.

Once children had completed all four trials, they were asked two follow-up comprehension questions in order to probe their understanding of the "rather be" question used in the Temporal Preference trials. They were first introduced to two new characters and told "This is [e.g.] Jane and this is Kate. Jane has a delicious ice-cream. Kate has no ice-cream at all. Who would you rather be? Jane who has a delicious ice-cream or Kate who has no ice-cream at all?" Next, they were introduced to two more characters, and told "This is [e.g.] Lucy and this is Michelle. Lucy has a sore finger. Michelle doesn't have a sore finger. Who would you rather be? Lucy who has a sore finger or Michelle who doesn't have a sore finger?"

4.1.2.3. Data scoring and analysis: Data scoring and analysis were conducted in an identical manner to Experiments 1a and 1b, with the addition of two procedures. First, if

during the Temporal Preference or Emotion Prediction trials, a child failed to correctly answer after two attempts any memory question, the child's data for the trial in question were excluded from analysis. If as a result only one valid trial remained for a given child, the child's data were excluded from analyses entirely. Second, if in the follow-up comprehension questions a child stated that they would rather be the person with no ice-cream at all or the person with the sore finger, all data for that child were excluded.

4.2. Results of Experiment 1c

Results from the Temporal Preference and Emotion Prediction tasks are reported in Table 2, where they are shown as a proportion of participants who demonstrated temporal location preferences in the expected direction. Table S3 of Appendix S1 reports data for the Hedonic Value check task; these ratings indicate that the experiences had the appropriate hedonic value. As in the previous experiments, we excluded judgments for any experiences for which children did not make the appropriate hedonic value rating.

We examined performance against chance levels using two-tailed binomial tests. Four- to five-year-olds demonstrated the expected temporal preference for pain, preferring their pain to lie in the past. However, 4- to 5-year-olds showed a preference opposite to that of older children and adults, in that they also preferred their pleasure in the past. Children were at chance on both types of Emotion Prediction trials.

We submitted the data to two GEE analyses with binomial distributions and logit-log link functions, using valence as a predictor of judgment and rating on the Hedonic Value check task as a covariate. For Temporal Preference trials, there was no effect of rating ($p = .728$) and a main effect of valence, demonstrating that at the same levels of rating, 4- to 5-year-olds were more likely to make a judgment in the expected direction for painful than for pleasurable events (Wald $\chi^2(1) = 8.67$, $p = .003$, $b = -1.81$, 95% CI [−3.01, 0.61], $SE = 0.62$, Exp(B) = 0.16, 95% CI [0.049, 0.55]). For Emotion Prediction trials, there was no effect of rating ($p = .224$) and a trend toward an effect of valence (Wald $\chi^2(1) = 3.53$, $p = .060$, $b = 1.42$, 95% CI [−0.06, 2.90], $SE = 0.75$, Exp(B) = 0.4.13, 95% CI [0.941, 18.14]). While it did not reach significance, we note that this effect reflects the greater frequency with which 4- to 5-year-olds made judgments in the expected direction for pleasurable than for painful events.

4.3. Discussion of Experiment 1c

When considering painful experiences, 4- to 5-year-olds demonstrated temporal preferences consistent with those of the older children and adults, preferring pain to lie in the past. However, for pleasant experiences, they demonstrated the opposite preference, in that they also preferred pleasure to lie in the past. We are confident that the different pattern of performance displayed by these younger children was not due to a difficulty understanding the task or keeping track of the relevant information. We checked whether children were able to report which character had already had the experience in the past and which would have it in the future, and that the experience was not ongoing right now. There was also a check that children understood the nature of the "rather be"

Table 2
Results of two-tailed binomial tests against chance, Experiment 1c. Percentages represent the proportion of 4- to 5-year-olds who demonstrated temporal location preferences in the expected direction

Trial Type	Valence (N = 35)	Frequency (%)	95% CI	p	Consistent Across Trial Type (%)[a]
Pleasure	Temporal Preference (n = 25)	11 (31)	0.17, 0.49	.041[#]	4 (12.2)
	Emotion Prediction (n = 33)	15 (45)	0.28, 0.64	.728	
Pain	Temporal Preference (n = 26)	19 (73)	0.52, 0.88	.029	1 (4.76)
	Emotion Prediction (n = 28)	10 (36)	0.18, 0.56	.185	

Note: Participant numbers vary across trials because data from participants who did not report the appropriate hedonic value for a specific experience were removed on the relevant trial.
[#]Significantly different to chance in the direction opposite to that expected.
[a]Percentages represent proportion of participants who completed both trial types.

question. The fact that data from a sizable minority of children had to be discarded because they did not pass these questions demonstrates that such checks were necessary, and it casts doubts on whether any conclusions can be drawn from the data from this age group in Experiment 1b in which there were no such checks.

Why did these young children express a preference for pleasurable experiences to lie in the past? Since they chose the past for both pleasurable and painful events, we cannot rule out the possibility that children of this age have a general bias to choose the past; however, we have no theoretical basis on which to expect such a bias. We again asked children to explain their answers, but it was difficult to discern any clear patterns because children struggled to provide substantive explanations of their choices. Some of their explanations suggest that they assume that having had the experience would have made them happy (e.g., with regard to eating the donuts "Because I would be super-duper happy because I already had them"; "Because I want the donuts first because they're delicious"). We note from inspection of the explanations given in Experiment 1b that by the time children are 7 years of age, their explanations for their preferences start to become somewhat more coherent, with numerous children referring to the idea of "looking forward" to a pleasurable activity; this type of explanation also appears in adults' explanations. Very young children would not be expected to use the specific term "looking forward," because this phrase is a metaphorical one that hinges on a time-space mapping, and children of this age are just beginning to acquire conventional time-space mappings and relevant metaphorical skills (Stites & Özçalişkan, 2013; Tillman, Tulagan, Fukuda, & Barner, 2018). Nevertheless, their temporal preference for pleasant experiences suggests that younger children do not yet grasp the idea that anticipating a positive experience is typically pleasurable; instead, they seem to focus on the pleasure that would have resulted from an experience in the past.

Four- to five-year-olds were at chance in the Emotion Prediction trials. Notably, children failed to judge significantly more often than chance that someone feels sadder when a pain is in the future rather than the past, despite themselves having a preference for past over future pain. The type of emotion prediction at issue here is more complex than that

frequently studied in young children. In most previous studies, children typically have to appropriately connect types of experiences or situations to types of emotions (Harris, 2008; Widen & Russell, 2008). Preschoolers clearly understand that certain experiences typically result in specific emotions, but the current task required children to further consider whether the experience in question was in the past or yet to come. We return in the General Discussion to considering the cognitive demands that this places on young children.

5. Experiments 2a and 2b

In Experiment 2, we offered participants the opportunity to trade off a larger amount of past pleasure against a smaller amount of future pleasure and a smaller amount of future pain against a larger amount of past pain. The task began by asking participants to make a similar temporal preference judgment to that in Experiment 1; if participants answered in the expected direction, the amount of past pain or pleasure was then increased incrementally in order to observe whether there was a trade-off point at which people would prefer past pleasure or future pain. Of interest was the magnitude of this trade-off point. We tested both adults (Experiment 2a) and children (Experiment 2b); again, due to the similarity of the procedures, we present the results for both experiments together. Participants again answered questions about their temporal preferences, but in a change to the procedure used in Experiment 1, rather than asking participants to predict emotions, we asked them about other people's temporal preferences. The pattern of results from Experiment 1 suggested that, in general, temporal biases were less in evidence in the Emotion Prediction task than in the Temporal Preference task, and this was true even for the adult sample in Experiment 1a. There are two possible explanations of this difference: One possibility is that it was because the Emotion Prediction task specifically asked participants about relative levels of positive or negative *emotions* rather than *preferences*. For example, as noted above, inspection of the adult explanations of their answers suggested that people believe the determinants of emotion levels regarding pleasurable events are potentially more complex than simple preferences and may be affected by mental states such as memories. Even in the adult group, for pleasurable experiences, participants gave a consistent response to Temporal Preference and Emotion Prediction questions only 62% of the time, suggesting they approached these two questions in different ways. If the nature of the judgment that participants were asked to make affected level of temporal bias, then if we ask instead about other people's preferences rather than their levels of emotion, similar levels of temporal bias may be observed. Such similarity might be predicted if people assume that past–future hedonic preferences are sensible and ubiquitous (Hare, 2013).

The other possibility is that temporal biases were less in evidence in the Emotion Prediction task because that task concerned the perspective of other people, rather than the participant's own perspective. In their study of past–future asymmetries in value judgments, Caruso et al. (2008) reported that such asymmetries were absent when participants

had to consider how much another person should be paid for boring data entry work in the past versus the future, and suggested that when considering another person, the irrelevance of the event to the self leads to a reduced differential between affective engagement with future and past events. Greene et al. (2020) also found that participants' past–future hedonic preferences were less marked when considering another person's perspective than when considering their own. In Experiment 2, by asking participants to make a judgment about another's preference, we were able to examine whether taking a more detached perspective on experiences would reduce past–future hedonic preferences.

5.1. Experiment 2a

5.1.1. Method

5.1.1.1. Participants: Forty-one adults (M = 28 years, SD = 15.09, range: 18–76 years,[1] nine males) participated in the experiment. Participants were recruited through an undergraduate research pool, in which case they received course credit, or as part of a lab-based outreach activity, in which case they received no compensation. Two participants did not report their age.

5.1.1.2. Design, materials, and procedure: Materials were identical to those used in Experiment 1a save for two changes that allowed the experiences to be plausibly repeated within the space of a few weeks. The pleasurable experiences involved a character eating "a free meal at one of his/her favorite restaurants" or "an all-expenses-paid evening out with good friends." Stimuli for Experiment 2a are depicted in Fig. 3.

Adults completed the experiment using their own computers or mobile devices. The experiment was presented using Qualtrics software (Qualtrics, Provo, UT).

Participants completed four trials, two concerning their own preferences (Self trials) and two concerning those of another person (Other trials). For each of these two trial types, they completed one trial about a painful experience and one about a pleasant experience. The specific painful or pleasant experience used for Self versus Other trials was counterbalanced across participants, and the order in which participants completed Self versus Other trials was also counterbalanced.

5.1.1.3. Hedonic Value Check: The Hedonic Value Check was identical to that used in Experiment 1a.

5.1.1.4. Temporal Preference task: All participants completed a minimum of two Self trials (Pain-Self, Pleasure-Self) and two Other trials (Pain-Other and Pleasure-Other). The number of additional judgments was dependent on participants' answers during the first trial of each type.

Self trials were structured identically to the Temporal Preference Trials in Experiment 1a, save for three differences. First, to increase the plausibility of multiple episodes of the experience, past events were said to have taken place "in the last 3 months" and

Fig. 3. Depictions of events used during the Hedonic Value Check with children (above) and adults (below) in Experiments 2a, 2b, 3a, and 3b. Stimuli depict the events described during the subsequent Temporal Preference trials.

future events were to take place "in the next 3 months." Second, within each trial type, participants' decisions to favor certain temporal preferences led to the presentation of additional questions. If participants demonstrated the expected temporal preference for pleasure in the future or for pain in the past on the first question (henceforth, "baseline question"), a second question was presented, preceded by the words "Something is different." In this question, the person who had experienced the relevant event in the past had done so twice (e.g., "Clare ate two free meals in some of her favorite restaurants in the last 3 months"), whereas the person who would experience the event in the future would do so only once (e.g., "Daisy will eat one free meal at one of her favorite restaurants in the next 3 months"). If at this stage participants switched their temporal preference, the point at which they had made this trade-off between amount of pleasure/pain and its temporal location was recorded as being two events. They were then presented with the next Self trial type, which reverted to presenting a choice between one past and one future event.

However, if participants did not switch their temporal preference, a further question increased the number of past events in the trade-off to four (vs. one). This pattern of questioning continued such that if participants did not switch their temporal preference within a trial type, they were offered six events versus one event, then eight versus one and then ten versus one. If those participants who reached a question regarding 10 events retained their initial temporal preference, the final question within the trial described the choice as one between "some" events in the past and one in the future, and asked, for example, "How many expenses-paid evenings out with good friends would Clare have to have had in the last three months before you would rather be Clare?" Participants entered either a number or a text response into a free-text response field. We did not ask participants to explain their choices.

The final difference was that participants were told that the two characters lived in different cities and did not know each other; this was to minimize the possibility that

participants considered the hypothetical impact of an experience undergone by one character on the other character.

In Other trials, unlike Self trials, participants were asked about another person's preferences. Prior to each Other trial, an additional, stylistically distinct line drawing of a person was presented (Zoe for female participants, and Zach for male participants). Participants heard that this person lives in a different city and has some decisions to make, and that they would now answer some questions about this person. All Other trials concluded with the question "Who would Zoe/Zach rather be?", but otherwise they were identical to Self trials.

5.1.1.5. Data scoring and analysis: Coding for the Hedonic Value Check task and for the baseline question of the Temporal Preference task (which presented a single event in both the past and the future) was conducted in an identical manner to Experiment 1a, as was the process of excluding trials. Participants' responses to the remaining questions (henceforth, "trade-off questions") on the Temporal Preference task received a single score equaling the number of past events presented during the trial on which they switched their temporal preference. If participants reached the final question (how many past events would have to take place before the participant would switch their temporal preference) and responded with a number greater than 10 or replied that they would not switch regardless, their response was recorded as "greater than 10 or never." Data from this task were therefore treated as ordinal.

5.2. Experiment 2b

5.2.1. Method

5.2.1.1. Participants: Seventy-one children (30 males) between the ages of 96 and 143 months were recruited from schools and summer programs or tested in the laboratory at the lead author's institution. The sample was split by age: 32 7- to 8-year-olds (M = 102.25 months, SD = 3.99, range: 96–107 months) and 39 10- to 11-year-olds (M = 134.54 months, SD = 6.0, range: 122–143 months). Children were tested in a quiet place at their school or summer program, or in a dedicated room at the laboratory.

5.2.1.2. Design, materials, and procedure: The task was administered by an experimenter and children gave verbal responses or pointed at their answers. The Hedonic Value Check was structurally identical to the check used in Experiment 1b. The design of the Temporal Preference task was identical to that in Experiment 2a, save for modifications to ensure that the task was suitable for children. The pleasurable experiences were the character eating "a delicious scoop of ice cream" and having "a go on a bouncy slide"; the unpleasant experiences were "an hour of waiting that was [will be] really boring" and "a painful injection." Stimuli for Experiment 2b are depicted in Fig. 3. Past events were said to have taken place "in the last week," and future events were to take place "in the next week."

5.2.1.3. Data scoring and analysis: Data scoring and analysis was carried out in an identical manner to Experiment 2a.

5.3. Results of Experiments 2a and 2b

Table S4 (adults) and Table S5 (children) in Appendix S1 report data from the Hedonic Value Check task by event, and they indicate that the experiences had the appropriate hedonic value. Results from the baseline question in the Temporal Preference task are reported in Table 3, and results from the trade-off questions of the Temporal Preference task are shown in Fig. 4.

We first examined participants' responses on the baseline question of the Temporal Preference task against chance levels using two-tailed binomial tests. All groups of participants demonstrated the expected temporal preferences at a rate above chance on all four types of trial (see Table 3). To investigate the effect of valence (pain or pleasure) and perspective (self or other) and, in the case of children, age group, on participants' temporal preference in the baseline trial, we submitted the data to GEE analyses with binomial distributions, logit-log link functions, and independent covariance structures. We separately examined data from children and adults. Several analyses were conducted using combinations of valence, perspective, and their interaction as predictors of temporal preference, with hedonic rating as a covariate. None of the models were significant.

Next, we examined trade-off points for those participants who had answered the baseline question by indicating that they preferred pain in the past or pleasure in the future. For every trial type, and for every age group, the modal, and majority, trade-off point was two past events (see Fig. 4). A much smaller proportion traded off for the other event quantities, although a notable minority indicated that they would trade off temporal preference for less pain or more pleasure only if the number of past events exceeded 10 (range: 11 to never).

We then investigated the effect of valence and perspective on trade-off points. Data were submitted to GEE analyses with multinomial distributions, cumulative logit-log link functions, and independent covariance structures. We first examined adults' data. Several analyses were conducted using combinations of valence, perspective, and their interaction as predictors of trade-off point, with rating as a covariate. None of the models were significant.

Next, we examined children's data. An initial analysis was conducted using valence, perspective, age group, and all two-way interactions between them as predictors of trade-off point, with rating as a covariate. There was a marginal effect of age group ($p = .050$) and a significant effect of rating ($p = .016$). The model yielded no other significant effects (all ps $> .103$). All interactions were then removed and the subsequent model was retained. This analysis demonstrated that children's age predicted their trade-off point (Wald $\chi^2(1) = 3.93$, $p = .047$, $b = -0.78$, 95% CI [−1.56, −0.01], $SE = 0.40$). Collapsed across valence and perspective and at the same levels of rating, 7- to 8-year-olds demonstrated lower odds of selecting a relatively higher trade-off point (i.e., changed their temporal preferences sooner) than 10- to 11-year-olds (Exp(B) = 0.46, 95% CI [0.21, 0.99]).

Table 3
Results of two-tailed binomial tests against chance, Experiment 2. Percentages represent the proportion of participants who demonstrated temporal location preferences in the expected direction

Age Group and Trial Type	Frequency (%)	95% CI	*p*
7–8 (N = 32)			
Pleasure-Self (n = 32)	24 (75)	0.57, 0.89	.007
Pain-Self (n = 30)	24 (80)	0.61, 0.92	.001
Pleasure-Other (n = 30)	23 (77)	0.58, 0.90	.005
Pain-Other (n = 25)	18 (72)	0.50, 0.88	.043
10–11 (N = 41)			
Pleasure-Self (n = 39)	27 (71)	0.54, 0.85	.014
Pain-Self (n = 33)	28 (85)	0.68, 0.95	<.001
Pleasure-Other (n = 37)	28 (76)	0.59, 0.88	.003
Pain-Other (n = 34)	28 (82)	0.65, 0.93	<.001
Adults (N = 41)			
Pleasure-Self (n = 38)	35 (92)	0.79, 0.98	<.001
Pain-Self (n = 37)	36 (97)	0.86, 1	<.001
Pleasure-Other (n = 39)	32 (82)	0.66, 0.92	<.001
Pain-Other (n = 38)	37 (97)	0.86, 1	<.001

Note: Participant numbers vary across trials because data from participants who did not report the appropriate hedonic value for a specific experience were removed on the relevant trial.

This analysis also demonstrated that, regardless of whether an experience was pleasant or painful, the stronger the hedonic rating, the sooner children traded off their initial temporal preference in favor of less pain or more pleasure (Wald $\chi^2(1) = 6.10$, $p = .013$, $b = -0.51$, 95% CI [−0.91, −0.10], $SE = 0.20$, Exp(B) = 0.60, 95% CI [0.40, 0.90]).

5.4. Discussion of Experiments 2a and 2b

When the number of past and future events was fixed at one event, participants' past–future hedonic preferences closely replicated those demonstrated in Experiment 1a and 1b. This was true for both adults and children, and participants showed a very similar pattern of results when predicting another's preferences (i.e., we did not find a significant effect of perspective). However, the temporal bias was far from absolute. At the first opportunity (two past events), the majority of participants switched their preference if the amount of past pleasure or pain exceeded that of future pleasure or pain, and thought that others would do the same. Younger children were likely to trade off their temporal preference for more pleasure or less pain somewhat earlier than were older children. While the hedonic intensity attributed to an experience (given in the Hedonic Value Check task) did not affect the point at which adults made their trade-offs, it influenced the point at which children did so. The greater the hedonic intensity imagined by children for an experience, the sooner the point at which they traded off their temporal preference for less pain or more pleasure.

Participants' tendency to switch their past–future hedonic preferences when the number of past events exceeded the number of future events might be thought to be surprising

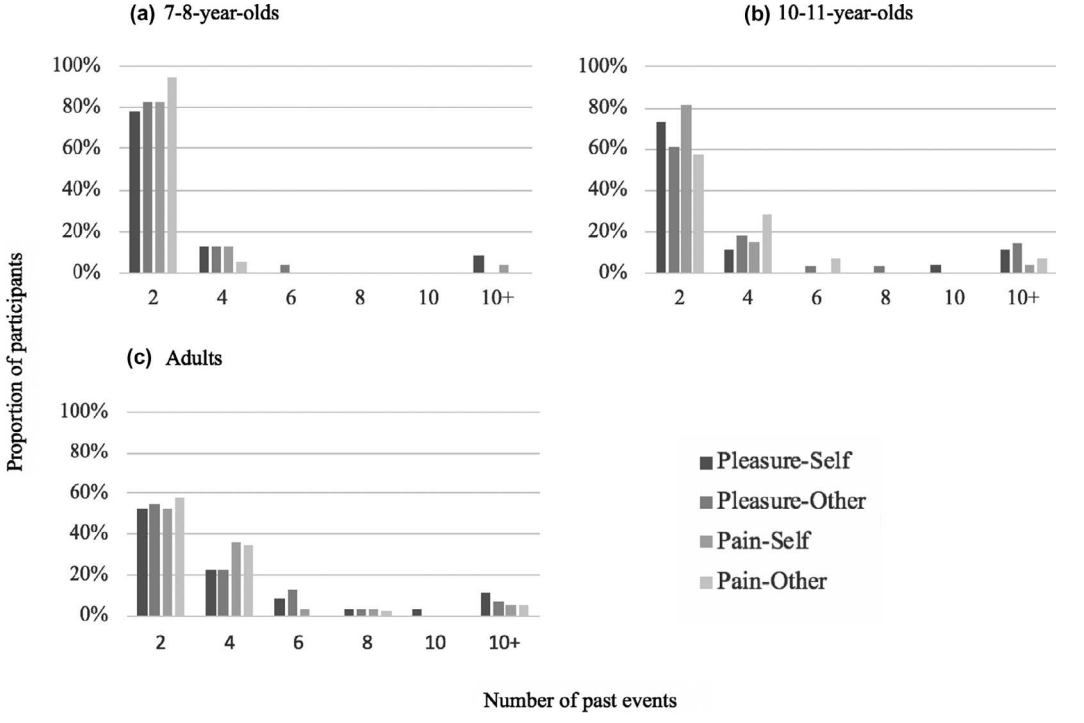

Fig. 4. Proportion of (a) 7–8-year-olds, (b) 10–11-year-olds, and (c) adults trading off temporal preference for less pain or more pleasure at each number of past events, Temporal Preference task, Experiments 2a and 2b.

given previous suggestions about large or even absolute discounting of past experiences (Suhler & Callender, 2012; Sullivan, 2018). Our procedure was such that participants themselves terminated each trial type when they switched temporal preferences, and it is possible that this aspect of the procedure contributed to the early trade-off points. An alternative would have been to make all participants complete the same set of judgments for each trial type. An important part of our motivation in ending a trial type when participants switched preference was to reduce the number of repeated judgments that participants had to make. In particular, we were concerned that children might lose interest in the task if they had to make very large numbers of similar judgments. We note that in the temporal discounting literature, it is common to use procedures where trial numbers are not fixed; rather, many studies use a titration approach whereby the judgments participants have to make vary across participants in order to identify an indifference point more quickly. Arguably our procedure can be seen as a simplified version of such an approach. Existing research on temporal discounting suggests that a titration approach versus a fixed number of trials yields similar results (Rodzon, Berry, & Odum, 2011). Another factor that may have affected trade-off points is in the inclusion of the baseline trial, which offered an equal number of events. The contrast between this trial and the

trade-off trials, which increased the number of past events, may have been a highly salient one. In these circumstances, participants might be particularly swayed in their preferences by the greater number of past events. For this reason, we conducted a further final set of experiments (Experiment 3a with adults and 3b with children) in which we removed the baseline trial.

6. Experiments 3a and 3b

6.1. Experiment 3a

6.1.1. Method

6.1.1.1. Participants: One hundred adults (M = 27.6 years, SD = 6.66, range: 18–46 years, 52 males) participated. All adult participants reported that they were fluent in English. Data collection took place online, using the Prolific subject pool (Peer, Brandimarte, Samat, & Acquisti, 2017). Participants each received compensation of approximately US $2.50.

6.1.1.2. Design, materials, and procedure: The materials and Hedonic Value Check were identical to those used in Experiment 2a.

6.1.1.3. Temporal Preference task: The Temporal Preference task was identical to that used in Experiment 2a, save for two differences. First, participants were not asked any questions that presented a choice between one past and one future event. Rather, the first question within each trial type was a trade-off question presenting a choice between two past events versus one future event. Trade-off questions then proceeded as described for Experiment 2a. Second, each subsequent question was preceded by the words "Here's another decision" rather than by the words "Something is different."

6.1.1.4. Data scoring and analysis: Coding for the Hedonic Value Check and Temporal Preference task was conducted in an identical manner to Experiment 2a, save that no baseline question involving only one past and one future event was asked.

6.2. Experiment 3b

6.2.1. Method

6.2.1.1. Participants: Sixty-one children (39 males) between the ages of 94 and 143 months were recruited and tested in the same manner as in Experiment 2b. The sample was split by age: 28 7- to 8-year-olds (M = 100.43 months, SD = 3.68, range: 94–106 months) and 33 10- to 11-year-olds (M = 136.09 months, SD = 3.5, range: 130–143 months) participated in the experiment.

6.2.1.2. Design, materials, and procedure: The materials and Hedonic Value Check were identical to those used in Experiment 2b. The design of the Temporal Preference task was identical to that used with adults in Experiment 3a, in that no initial baseline question was asked.

6.2.1.3. Data scoring and analysis: Coding for the Hedonic Value Check and Temporal Preference task was conducted in an identical manner to Experiment 3a.

6.3. Results of Experiments 3a and 3b

Results for the Temporal Preference task are shown in Fig. 5 by trial type. Table S6 (adults) and Table S7 (children) of Appendix S1 report data for the ratings task by event and indicate that the experiences had the appropriate hedonic value.

For every trial type and for all age groups, the modal trade-off point was again two past events, regardless of valence or perspective. A much smaller proportion from every age group traded off at six, eight, or 10 events, and a notable minority indicated that they would trade off temporal preference for less pain or more pleasure if the number of past events exceeded 10 (range: 11 to never). Thus, at the first opportunity, all participants were likely to trade off their temporal preferences in order to have more pleasure or less pain overall, and this was the case even though this was the first judgment that participants had to make.

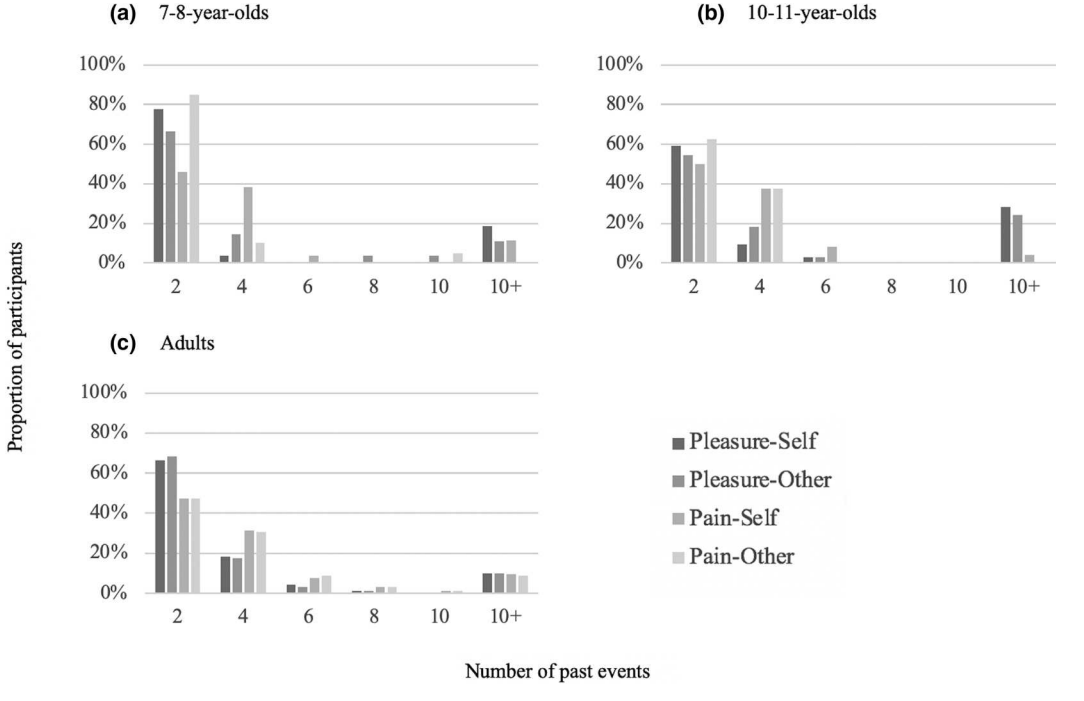

Fig. 5. Proportion of (a) 7–8-year-olds, (b) 10–11-year-olds, and (c) adults trading off temporal preference for less pain or more pleasure at each number of past events, Temporal Preference task, Experiments 3a and 3b.

Next, we again investigated the effect of valence and perspective on participants' willingness to trade off an initial temporal preference in the expected direction for more pleasurable events or fewer painful events overall. Data were submitted to GEE analyses with multinomial distributions, cumulative logit-log link functions, and independent covariance structures. We first examined adults' data. An initial analysis was conducted using valence, perspective, and their interaction as predictors of trade-off point, with rating as a covariate. There was a main effect of valence ($p < .001$) and no other significant effects (all ps $> .495$). The interactions were removed from the model. The main effect of valence remained (Wald $\chi^2(1) = 11.20$, $p < .001$, $b = -.69$, 95% CI [−1.09, −0.285], $SE = 0.21$, Exp(B) = 0.503, 95% CI [0.34, 0.75]), and there were no other significant effects (rating, $p = .499$; perspective, $p = .860$). This model was retained. Thus, when experiences were pleasant rather than painful, there was an increase in the odds of selecting a relatively lower trade-off point.

We then examined children's data. An initial analysis was conducted using valence, perspective, age group, and all two-way interactions as predictors of trade-off point, with rating as a covariate. There was a main effect of rating ($p = .015$), an effect of the interaction between valence and perspective ($p = .008$), and a trend toward a main effect of perspective ($p = .057$). There were no other significant effects (all ps $> .100$). The interactions between perspective and age group and between valence and age group were removed from the model, leaving valence, perspective, age group, and the interaction between valence and perspective as predictors of trade-off point, with rating as a covariate. There was a main effect of rating ($p = .013$) and an effect of the interaction between valence and perspective ($p = .007$), but no main effect of perspective ($p = .081$), valence ($p = .075$), or age group ($p = .223$). This model was retained. This model demonstrated a main effect of rating (Wald $\chi^2(1) = 6.18$, $b = -.56$, 95% CI [−1, −0.12], $SE = 0.22$, Exp(B) = 0.57, 95% CI [0.37, 0.89]), and an interaction between valence and perspective (Wald $\chi^2(1) = 7.34$, $b = -1.44$, 95% CI [−2.48, −0.40], $SE = 0.53$, Exp(B) = 0.24, 95% CI [0.08, 0.67]). Subsequent follow-up analyses suggested that interaction between valence and perspective was driven by the relatively early trade-off point for Pain-Other trials (see lightest bars in the top two panels of Fig. 5); these trials differed significantly from Pain-Self ($p = .005$, $b = 1.16$, 95% CI = [.35, 1.98], $SE = 0.42$, Exp(B) = 3.20, 95% CI [1.42, 7.22]) and Pleasure-Other trials ($p = .003$, $b = 1.20$, 95% CI = [0.41, 1.98], $SE = 0.40$, Exp(B) = 3.31, 95% CI [1.51, 7.27]). Thus, when children considered others' experiences, there was an increase in the odds of selecting a relatively lower trade-off point for painful than for pleasant experiences; and experiences associated with stronger hedonic intensity were associated with faster trade-off of temporal location preferences in favor of a reduction in pain or increase in pleasure.

6.4. Discussion of Experiments 3a and 3b

Experiment 3 confirmed that participants' preferences for the temporal location of hedonic goods were not absolute. In this experiment, the opportunity for participants to trade off their temporal preferences in order to have more pleasure or less pain overall

was present from the first trial. There was no salient contrast with an earlier scenario involving one event in the past and one in the future, as was the case in Experiment 2, but nevertheless adults were likely to trade off their temporal preferences at the first opportunity. Adults were likely to engage in this trade-off somewhat earlier for pleasure than for pain. This significant effect of valence was not seen in the adults' trade-off data in Experiment 2a, but looking across Experiments 1a and 2a (Tables 1 and 3), it can be seen that in the one versus one cases, a slightly lower percentage of adults indicated a temporal preference for pleasure to be in the future than for pain to be in the past. Thus, for adults, there is some (albeit relatively weak) evidence that past–future hedonic preferences are not as strong for pleasure as for pain.

Children also tended to trade off their temporal preferences at the earliest opportunity. However, they did not do this more readily for pleasurable versus painful experiences; rather, they were particularly likely to assume that others would do so readily in the case of painful experiences (the Pain-Other trials). This perspective effect was specific to the Pain trials and only observed in the children. Thus, as in Experiment 2, there was no robust evidence that past–future hedonic preferences were stronger when participants considered their own perspective compared to when they considered a third-person perspective. Finally, as in Experiment 2b, the stronger the hedonic intensity imagined for an experience (i.e., the ratings given in the Hedonic Value Check task), the sooner children traded off their initial preference for its temporal location in favor of less pain or more pleasure. However, unlike in Experiment 2b, we did not observe any age effects. In Experiment 2b, younger children were somewhat faster than older children to trade their temporal preferences for less pain or more pleasure. This effect was no longer in evidence in Experiment 3, suggesting that in Experiment 2b, younger children may have been more strongly influenced than were older children by the shift from an equal (one versus one) to an unequal number of events in the past and future.

7. General discussion

We conducted the first empirical study of the degree to which both adults and children display past–future hedonic preferences. Consistent with the intuitions of Parfit (1984), Sullivan (2018), and others, and consistent with the findings of Greene et al. (2020), our results suggest that adults' preference for pain to lie in the past and for pleasure to lie in the future is ubiquitous. These preferences were also clearly in evidence from the age of 7 and became more reliable between the ages of 7 and 11. From the age of 7, children also expected others to have the same temporal preferences. Even 4- to 5-year-olds showed a preference for pain to lie in the past; however, they were strikingly different from older participants in not preferring pleasure to lie in the future. The other notable, and novel, finding from our studies was that, in all age groups, participants rapidly abandoned past–future hedonic preferences in the face of more past pain or pleasure. This suggests that such preferences are not absolute. Indeed, in children, we also saw evidence that the hedonic intensity of an experience influences the trade-off between amount of

pain or pleasure and its temporal location. Regardless of whether an experience was pleasant or painful, the more extreme children's hedonic rating of the experience, the sooner they traded off their initial preference about its temporal location in favor of less pain or more pleasure.

7.1. The nature of past–future hedonic preferences

Evidence that temporal preferences for hedonic goods arise early in development lends some support to the argument that they may be a manifestation of a more general adaptive tendency to care more about the future than the past (Greene & Sullivan, 2015; Suhler & Callender, 2012). This tendency is assumed to have evolved to support action that can shape events under people's control: that is, those that lie in the future. Even though pains and pleasures often simply happen to one rather than being under one's control, people may have generalized the motivational significance of this asymmetry of control to goods they cannot control (Caruso, 2010; Sullivan, 2018).

Nevertheless, despite the near-total ubiquity of past–future hedonic preferences, participants were (perhaps surprisingly) willing to trade them off when the amount of past pain or pleasure was increased. This result suggests that Parfit's (1984) thought experiment, which was meant to demonstrate the absolute or near-absolute nature of past–future bias, may be a poor guide to everyday preferences. However, we departed from Parfit's thought experiment regarding hedonic temporal preferences in two key ways, which require careful consideration.

First, Parfit deliberately ruled out the influence of memory on preferences by stipulating that the postoperative patient in his example had induced amnesia, whereas our participants could have considered the impact of presently held memories deriving from past experiences. We acknowledge that the extent to which participants consider *only* past and future experiences (or mental states) when making their choices is not yet clear. Indeed, the fact that participants justify their preference for future pleasures by referring to "looking forward" to future experiences suggests that they consider the role of a current mental state (namely, anticipation of pleasure) in making their judgments. However, as we stated in the introduction, it is not clear why this should be seen as a matter of a present mental state potentially confounding past–future hedonic preferences, rather than itself being an expression of such preferences.

One advantage of our simple procedure that avoided a complex cover story is that we were able to use it with very young children. A further advantage is that there are important similarities between the types of choices participants made in Experiments 2 and 3 and the types of choices participants make in other sorts of intertemporal choice tasks, most notably the much studied temporal discounting procedure in which participants decide, for example, whether to take a smaller reward (e.g., $1) now rather than wait for a larger reward at a later time point (e.g., $10 next week). It is possible in any intertemporal choice task, including in the current task, that participants engage in chains of reasoning about the additional causal consequences of, for example, taking a reward at a specific time point. For example, adults in our experiments could have reasoned that if

they had two free meals out in the last 3 months, they might have saved some money on food that they would have available to spend now. Preventing such chains of reasoning would involve introducing a complex cover story whereby these types of consequences are explicitly ruled out, and even then it might be difficult to capture every possible consequence that might occur to participants. In focusing on purely hedonic experiences rather than monetary or other resources, we were attempting to minimize the likelihood that participants would start reasoning about the longer term consequences or implications of possessing a resource at a particular time. Nevertheless, future studies with adults will be needed to address the extent to which participants' judgments are affected by altering aspects of the task cover story, such as whether the scenario does or does not involve amnesia. Subsequent studies could also examine whether the current set of findings extends to other types of hedonic experiences beyond those which we used in our experiments.

A second difference between our task and Parfit's thought experiment is that our participants were not waiting for information while weighing the auspiciousness or otherwise of two possible outcomes. Rather, they were making a choice between two states of affairs. While the choice was a hypothetical one, participants were nevertheless operating with a presumed agency over the past that is absent from their lived experience. The relief we feel when pain is over might be a strong reason to be rationally concerned with its temporal location (Hare, 2007, 2008; Parfit, 1984; Prior, 1959), but only in the absence of control over the past. Given a hypothetical choice that entails a sense of agency over all events in one's past and future, past events may no longer be experienced as "over" and therefore may no longer entail relief. Future research could explore the role of memories and hypothetical personal agency over the past in determining preference judgments.

A further direction for future research might be to assess the strength of participants' preferences. The question "Who would you rather be?" offers a binary choice, enabling us to examine participants' absolute preferences. An indication of the strength of participants' preferences would provide richer data. We took the decision not to present participants with a follow-up scale measure (for instance, "How much would you rather be [person]?") for two reasons. First, while emotion scales have been successfully used to obtain differential ratings from preschoolers for identical events that were preceded by two different sets of outcome expectations (Asaba, Ong, & Gweon, 2019; Doan, Friedman, & Denison, 2020; Lara, Lagattuta, & Kramer, 2019), we reasoned that children might find such a scale difficult in the context of temporal preferences, which had not yet been explored with children of any age. Our caution was also informed by the fact that the answer to the question "Who would you rather be?" is by nature dichotomous. Second, the reliability of such a measure even for adults was unclear. For instance, some participants may primarily consider the undesirability of experiencing any pain at all, and thus give an answer that is low on the scale. Others may answer with reference to the desirability of the past temporal location of the pain, and thus give an answer that is high on the scale. Future research could explicitly examine the reliability of such responses, which may in turn provide another way to gauge the extent, as well as the existence, of

participants' preferences for the temporal location of pain and pleasure. Given that people experiencing depressive symptoms often have expectations for a negative future (Gadassi Polack, Tran, & Joorman, 2020) and demonstrate diminished positive future thinking (Gamble, Moreau, Tippett, & Addis, 2019), future research could also explore the possibility that mood could impact the strength of such preferences.[2]

7.2. Developmental changes

Although our findings suggest that past–future hedonic preferences emerge relatively early in development, aspects of the results also indicate that there are nevertheless developmental changes in this type of temporal bias. As far as developmental differences from age 7 upwards are concerned, we found in both Experiments 2 and 3 that, for children, the more hedonically charged an experience was rated to be, the less weight their temporal bias seemed to carry, whereas this was not the case for adults. Furthermore, although we did not statistically compare adults' and children's preferences because of the differences in the procedures used with these groups, adults less frequently traded off their preferences at the first available opportunity (see Figs. 4 and 5). Moreover, 7- to 8-year-olds were somewhat less likely than older children (or indeed adults) to show past–future hedonic preferences (Experiment 1) and more likely to trade off such preferences earlier (Experiment 2). Taken together, the findings suggest that temporal preferences become more entrenched with development.

The most notable developmental shift, though, occurred between 4–5 and 7–8 years, with the majority of the youngest children preferring past over future pleasure. Potentially, this finding might be seen to be consistent with the developmental findings of Burns et al. (2019), who reported that only at around 6 years of age, do children reliably report more positively valenced emotions when considering future pleasurable events than when considering past pleasurable events. In the absence of any emotional asymmetry in preschoolers' thoughts about future and past pleasures, a desire to "bank" the pleasurable experiences might have driven their responses. A related alternative explanation of young children's preference for pleasure to lie in the past is that children of this age find the very idea of having to wait for a pleasurable experience aversive (i.e., their preferences stem from considering the need to wait for a future pleasure). Such an explanation would be consistent with the well-documented difficulties preschoolers have with delaying gratification (e.g., Mischel, Shoda, & Rodriguez, 1989; Schwarz, Schrager, & Lyons, 1983). One way to examine this possibility might be to look at the relation between delay of gratification abilities in young children and their past–future preference for pleasurable experiences. Certainly, by the time children are 7 years old, they seem to realize that waiting for a pleasurable event is not necessarily aversive, as demonstrated by the fact that some children of this age referred to "looking forward" to future pleasures in their explanations of their choices. This emerging understanding may in turn be facilitated by developmental changes in children's ability to richly imagine future pleasurable events; such future thinking skills are known to improve over middle childhood (Coughlin et al., 2014). Possible component skills include the effective simulation of future experiences,

effective retrieval of relevant events from episodic memory for the purposes of constructing such simulations, and self-concept coherence (Coughlin, Robins, & Ghetti, 2017; Ghetti & Coughlin, 2018). Ghetti and Coughlin (2018) suggest that self-concept, which develops into adolescence, may help to structure both search of and selection from autobiographical memory for information that is relevant to one's own future. It is also plausible that the maturing self-concept could affect the nature of the reasoning that children engage in or the mental representation that they construct when asked, "Who would you rather be?"

Four- to five-year-olds did show the same preferences as older children and adults for painful experiences to lie in the past, by contrast with the developmental pattern for temporal preference regarding pleasurable experiences. This suggests the possibility that the latter preference is more cognitively mediated than the former, a possibility that is also consistent with some (albeit inconsistent) evidence across our studies that even in adults past–future preferences for pleasure are not as strong as those for pain, and with the finding of Greene et al. (2020) that adults show stronger past–future preferences for negatively valenced events than for positively valenced events.

We note that the fact that the youngest children preferred pain to lie in the past rather than the future suggests that we might also expect to see children of this age experiencing the emotion of relief when an unpleasant experience has finished. In philosophy, this type of relief has been depicted as the emotional counterpart of the preference for painful experiences to lie in the past (Hoerl, 2015; Maclaurin & Dyke, 2002; Pearson, 2018). However, to the best of our knowledge, developmental studies have not examined when children first experience relief of this sort (though see McCormack & Feeney, 2015; Weisberg & Beck, 2010, 2012).[3] Although there are obviously ethical issues around measuring this sort of relief in children (insofar as it would involve inducing unpleasant experiences), it would be particularly interesting to examine whether there is a developmental association between experiencing relief and a preference for pain to lie in the past.

7.3. Predicting others' emotions and preferences

The emotion prediction task was particularly challenging for 4- to 5-year-olds (and even for some 7- to 8-year-olds, particularly with regard to unpleasant experiences). Preschoolers showed a distinct pattern of temporal preferences for themselves in Experiment 1c, but did not predict that the degree of happiness or sadness that another person would experience would differ depending on whether an experience was in the past or the future. Using tense in this way to infer the strength of an emotion requires children to consider more than simple causal links between types of experiences and types of emotions (Harris & Olthof, 1982); it requires considering more complex causal connections stretching over time between experiences, thoughts, and feelings. Preschoolers are beginning to understand that emotions can be independent of the current situation because they are causally connected to remembering the past or imagining the future (Lagattuta et al., 2015; Lagattuta, Tashjian, & Kramer, 2018). For example, by the time children are 5, they seem to understand that being reminded of a past unpleasant experience can cause

sadness, even though the experience is no longer happening (Lagattuta & Wellman, 2001; Lagattuta, Wellman, & Flavell, 1997), and moreover that, because of a past negative experience, someone can be worried about the future (Lagattuta, 2007). It may be a further step to grasp that although thinking about a previous negative experience can indeed cause current unhappiness, nevertheless that unhappiness may be tempered by being glad about the very fact that the experience is now located in the past.

We note, though, that, even though they struggled to make predictions about others' emotions, the 4- to 5-year-olds did have temporal preferences for themselves. Although we asked preschoolers specifically to reason about others' emotions rather than preferences, it is worth considering how this finding compares with existing research that suggests that preschoolers find it more difficult to reason about their own future preferences than about those of peers and adults (Bélanger, Atance, Varghese, Nguyen, & Vendetti, 2014). One way to approach this issue is by considering the distinction Bélanger et al. (2014) make between the episodic and semantic components of future mental time travel. These authors suggest that young children's representations of their own future preferences might draw on both types of knowledge, encountering difficulty when attempting to engage an immature episodic system that is strongly engaged with current circumstances, whereas their representations of others' future preferences may rely to a greater extent on the semantic system. The tasks presented by Bélanger et al. (2014) asked children about their own preferences or those of a peer once they are "all grown up" (for instance, between a choice of drinks: Kool Aid or coffee). The relevant semantic knowledge about the difference between adults' and children's beverage preferences is likely to be firmly possessed by young children, and so engaging the episodic system may only muddy the waters. In the case of our own question (who will be more happy or more sad), the relevant knowledge (e.g., that people can be happy about the fact that an experience is over, even though the experience itself may have made them sad) may simply not yet be available semantically (as discussed above), though it may be familiar in children's personal experience. Thus, in the case of temporal preferences for hedonic goods, to the extent that children engage their episodic system, it may serve as a scaffold rather than a hindrance (at least in the case of negative experiences). In other words, if Bélanger et al. (2014) are correct in their suggestion that young children's thinking about others' pasts or futures primarily engages the semantic system, then the 4- to 5-year-olds who completed our task may have lacked the relevant knowledge to reason appropriately about others' past- or future-directed emotions.

These considerations introduce the issue of exactly what types of processes underpinned participants' judgments about their own preferences. One possibility, stemming from existing research on temporal asymmetries in judgments, is that there is an affective basis for such judgments (Caruso et al., 2008; Suhler & Callender, 2012). In Experiment 1, although participants of all ages were asked to make emotional predictions about other people based on the temporal location of experiences, they were not actually asked to predict how they themselves would feel if an experience was in the past versus the future, or how they felt now when thinking about the past or future experience. Thus, although for older children and adults, judgments about others' emotions showed the same

temporal patterns as judgments about their own preferences, we have no direct evidence whether participants' preferences are informed or underpinned by predictions regarding their own emotional states or by current emotions.[4] In their research on past–future asymmetries of value, Caruso et al. (2008) asked participants not only to place a value on a past or future event (e.g., 5 h of boring data entry work) but also to make a judgment about how they felt when considering the past or future events. They found that past–future asymmetries in value judgments seemed to be mediated by asymmetries in emotion (though see Burns et al., 2019). Similarly, future studies could specifically examine the role of affect or affective prediction in temporal preference judgments by asking participants questions about emotions alongside temporal preference questions for the same experiences.

In Experiment 2, we examined participants' predictions of others' temporal preferences rather than emotional states and found children from age 7–8 upwards and adults judged that someone else would have the same pattern of temporal preferences as themselves. The only difference between judgments regarding one's own and others' preference that was in evidence was in Experiment 3, where, compared to their own case, children predicted that another person would be somewhat quicker to trade off a temporal preference for a smaller amount of pain. It is not clear why this might be, although some philosophers have argued that past–future hedonic preferences may be less in evidence when adopting a third-person perspective on events, because this leads to a degree of emotional distancing from experiences (Dougherty, 2015; Greene & Sullivan, 2015). Greene et al. (2020) also reported that temporal preferences were less strong when considering a third-person perspective.

In Experiment 3, in which there was some evidence of a perspective effect in children, participants were always required to weigh unequal amounts of pain and pleasure in the past and future. When thinking about another person, children may have been more likely to focus simply on the numerical difference between, for example, two versus four painful injections, rather than the emotional significance of injections being in the past versus the future. However, adults' predictions regarding others' preferences did not differ in any respect from their own preferences, and when judgments involved equal amounts of past or future pain/pleasure (Experiment 2), all groups of participants showed equally strong temporal preferences for another person as for themselves. Our results showed that even 7- to 8-year-olds seem to assume that past–future hedonic preferences are ubiquitous; given this, it is perhaps not surprising that philosophers have assumed that such preferences are a "brute fact" about human psychology (Hare, 2013). How can we reconcile this with Greene et al.'s (2020) finding that the strength of temporal preferences is affected by perspective? We note that there is an important difference between the question that participants were asked in our procedure, and the form of questioning used in that of Greene et al. (2020). We asked participants to make predictions about another person's preferences, whereas Greene et al. asked participants what they themselves would prefer to be the case for another person. Thus, our task specifically examined whether adults and children assumed that others would have clear temporal preferences, whereas, arguably, Greene et al.'s task focused on what the participant thought might be best for another person.

8. Conclusion

In conclusion, the studies reported here provide new evidence about the ways in which time influences people's decisions and preferences. That past–future hedonic preferences emerge very early in development (at least as far as unpleasant experiences are concerned) provides additional confirmation of a general future bias in human cognition that has been of growing interest to psychologists working across a number of different traditions (Boyer, 2008; Burns et al., 2019; Schacter, Addis, & Buckner, 2007; Suddendorf & Corballis, 2007). However, such a future bias is not absolute: People are concerned about their past as well as their future. Our preferences are not neutral with respect to whether hedonic experiences in our lives have already passed or are yet to come, nor do they appear to be firmly fixed.

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Open Research badge

This article has earned Open Data badge. Data are available at https://osf.io/f74cx/.

Notes

1. The significance of coefficients for analyses in this section does not change when adults aged over two standard deviations above the mean are excluded from the analysis.
2. We are grateful to an anonymous reviewer for this suggestion.
3. The small number of previous developmental studies of relief has focused only on relief on discovering that one has avoided a less optimal outcome in a decision-making task, that is, what Hoerl (2015) refers to as "counterfactual" rather than "temporal" relief.
4. Indeed, it can be seen from the last column in Table 1 that even adults are not always consistent when making judgments about others' emotions and about their

own preferences. However, the task design was such that participants were never making these two types of judgments about the same experiences.

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Supporting Information

Additional supporting information may be found online in the Supporting Information section at the end of the article:

Appendix S1. Participants' ratings of pleasant and unpleasant events during the Hedonic Value Check.