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Past-future preferences for hedonic goods and the utility of experiential memories

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ABSTRACT

Recent studies have suggested that while both adults and children hold past-future hedonic preferences – preferring painful experiences to be in the past and pleasurable experiences to lie in the future – these preferences are abandoned when the quantity of pain or pleasure under consideration is greater in the past than in the future. We examined whether such preferences might be affected by the utility people assign to experiential memories, since the recollection of events can itself be pleasurable or aversive, and we examined the developmental trajectory of the value that people assign to experiential memories of past painful experiences. Using a task in which we manipulated hypothetical memory loss in a series of brief vignettes, we found that for some adults, but not for children, the disutility attached to the recollection of painful past events outweighed the disutility of living through future painful events. Between middle childhood and adulthood, experiential memory appears to assume a more important role in determining the value that people assign to past experiences and in mitigating bias toward the future.

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Temporal; time; hedonic; preferences; memory; utility

1. Introduction

Many theorists find it intuitively plausible that people would prefer a very painful experience in the past over a much less painful one in the future. The philosopher (Parfit, 1984) proposed a thought experiment in order to illustrate this point. The reader is asked to 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 post-operative drug that causes them to

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forget the previous 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 hours, or the patient who will have the operation tomorrow, in which case it will last 1 h. The nurse goes to find out. Parfit claims that people will prefer to hear that they had the 10-h painful operation yesterday rather than that they will have the 1-h painful operation tomorrow, i.e., prefer a far greater pain, but one that is over and done with, over a lesser pain that is yet to come.

1.1 Past-future hedonic preferences

We will refer to preferences over whether a pleasant or unpleasant experience is in the past or future as 'past-future hedonic preferences.' They have also been cast in terms of the idea that people are 'future-biased' (Latham et al., 2021; Sullivan, 2018). There is already a very lively debate about past-future hedonic preferences in philosophy – concerning their significance (particularly for metaphysical debates about time; e.g., Craig, 1999; Pearson, 2018,; Prior, 1959), rationality (e.g., Dougherty, 2011; Scheffler, 2021,; Sullivan, 2018), and origins (Maclaurin & Dyke, 2002). Across these debates, it has often been taken as self-evident that people exhibit past-future hedonic preferences[1]; what is at issue is just why people have them and whether they should, with some arguing that they are hardwired in through evolution because they are adaptive (Suhler & Callender, 2012). Only recently has interdisciplinary research begun to empirically examine explicit preferences regarding the temporal location of hedonic experiences and whether such preferences are impervious to differences in the quantity of past and future pain or pleasure.

1.2 Existing empirical evidence

Greene et al. (2021a) conducted the first empirical study on past-future hedonic preferences. Participants read a vignette about an astronaut on a long mission during which bland meals are dispensed by the spaceship daily; the spaceship is programmed to dispense, on just 1 day of the mission, either a favorite (positive hedonic value) or most disliked meal (negative hedonic value). The astronaut wakes up one morning from a dream concerning this distinctive meal, and initially cannot remember whether they have or have not yet received that meal. Participants made a judgment as to whether they would prefer to find out that the meal had already been dispensed yesterday or was due to be dispensed tomorrow in one of the two conditions: either a first-person condition (imagining themselves as the astronaut), or a third-person condition (imagining another person as the

astronaut). Greene et al. found that the majority of participants had the expected past-future hedonic preferences, although these preferences were more marked for first-person judgments than third-person judgments, and somewhat more marked for negative than positive events (though see Greene et al., 2022a). Making use of much the same vignettes, Greene et al. (2021b) also probed the effects of altering the ratio of past events to future events. The authors found that even when the choice was between 10 past events or one future event, the majority of participants had the expected past-future hedonic preferences for negative events, preferring 10 past negative events to one such future event.

Latham et al. (2021) investigated whether the bias toward the future is cognitively mediated through people's assumption that they cannot causally influence past events. In addition, they investigated whether participants' past-future hedonic preferences were *absolute*, in the sense that hedonic experiences are assigned zero value once they are in the past, as has sometimes been argued (see, e.g., Sullivan, 2018, p. 58). Participants read vignettes about an alien abduction, in which the participant was said to undergo a series of painful electric shocks. The aliens committed to repair any physical harms from the shocks and to give the participant a pill that will neutralize any harmful psychological effects. Participants were presented with an alternative between either one more shock in the past, or one more in the future (equal condition), or between one hundred more in the past, or one more in the future (unequal) (see Latham et al. for details). The majority of participants were less likely to prefer past pain over future pain in the unequal than the equal conditions, suggesting that they were not completely indifferent to past pain, but merely discounted it to some degree. Participants also more strongly exhibited future bias when they merely expressed a preference than when the cover story was constructed such that participants could retrospectively change the past. On the basis of the finding that participants' future bias diminished when the past was said to be causally accessible, Latham et al. suggest that future bias is not (entirely) an inflexible hard-wired adaptation, but rather arises from the fact that people discount past experiences because they believe that past events cannot be influenced. Thus, future bias can be seen as just one instance of a more general disposition to affectively discount practically irrelevant events.

Finally, Lee et al. (2020) used a quite different task to examine past-future hedonic preferences in both adults and children. Participants had to judge who they would prefer to be – a character who had a pleasant (e.g., eating cake) or unpleasant (e.g., a painful injection) experience in the past, or who will have the same experience in the future. Lee et al. found 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; these participants also

predicted that other people will be happier when pleasure is in their future rather than the past, but sadder when pain is in their future rather than the past. Younger children (aged 4–5) had the same temporal preferences as adults for their own painful experiences, but, unlike adults, children in this age group preferred their pleasure to lie in the past and did not predict that others' levels of happiness or sadness vary depending on whether experiences lie in the past or the future. Lee et al. also examined the extent to which past-future hedonic preferences were absolute by systematically varying the quantity of past pain or pleasure and examining whether participants expressed the same preferences regardless of these quantities. Perhaps surprisingly, they found that, 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 thus appear to emerge early developmentally, while also appearing to be flexible. The latter finding is consistent with those of Latham et al. (2021) in suggesting that such preferences are not absolute, contrary to what the Parfit thought experiment has been taken to demonstrate.

1.3 Memory and value

Lee et al. (2020) task differed from Parfit's thought experiment in a crucial respect: it did not involve a cover story about amnesia that would have eliminated any memories of past pain/pleasure. Lee et al. argued that if past-future hedonic preferences are indeed robust, such preferences might be thought to arise even in circumstances in which the relevant past pain/pleasure can still be remembered. There might, however, be reason to suspect that Parfit's amnesia cover story plays a significant role in determining people's reported past-future hedonic preferences. The objects of memory may be past, but recollecting is a mental act in which the subject can be presently engaged and which can itself be more or less pleasurable (Elster & Loewenstein, 1992; Morewedge, 2015): compare fondly remembering a kiss and recalling a botched conference presentation with horror. The idea that the value of any given experience is, at least in part, determined by memory for this experience is not a new one. Notably, Kahneman (1999) stresses the importance of considering the utility of the consumption of experiential memories when evaluating the overall utility provided by any given event. When estimating overall utility, Kahneman says, "[t]he hedonic quality of current sensory experience is the first candidate, of course, but it is not sufficient. The pleasures and pains [associated with] remembering the past must surely be counted" (1999, p. 6). Various empirical findings also provide reason to expect memories to feature prominently in past-future hedonic preferences. There is evidence that people tend to remember

emotionally arousing stimuli in a particularly vivid manner (e.g., Rubin & Kozin, 1984; Schaefer & Philippot, 2005). Since events involving pains and pleasures tend to be emotionally arousing, they may often be vividly remembered, and the vividness of a memory plausibly influences its role in a person's hedonic preferences.

Under the assumption that at least some hedonic value is attributed to episodes of recollection, even philosophers who consider the past-future hedonic preference to be absolute may expect that preferences for past painful events over future painful events will be influenced by considerations regarding the pleasure/displeasure of memories (e.g., Sullivan, 2018, pp. 80–1). Assuming that a more painful event would lead to more unpleasant memories, people might suppose that a painful 10-h operation in the past would result in more future pain – as a result of those memories – than an actual painful one-hour operation in the future. Hence, one interpretation of Lee's et al.'s results could be that their participants were prepared to trade off more pain endured in the past (e.g., five painful injections) for less pain in the future (just one painful injection) because of the role they take memories to play in their welfare over time. This might have masked the strength of an underlying future bias.

However, as things stand the empirical evidence does not allow us to say whether assumptions about the impact of memories on welfare add additional nuance to people's temporal preferences and biases, over and above wanting 'painful episodes' to be located in their past. Thus, probing the relative weight that people appear to give to the temporal location of painful events *and* to memories of pain is the first key motivation behind the current study. Specifically, if people's reports of their preferences for the temporal location of a painful event are affected by what they are told about the subsequent existence, or lack thereof, of memories of that event, this would suggest that episodes of recollection play an important role in determining past-future hedonic preferences.

1.4 Developmental considerations

The second key motivation behind the current study comes from developmental considerations. In Lee et al. (2020) study, from the age of 7 children demonstrated past-future hedonic preferences consistent with those of adults in simple scenarios in which memories for pain and pleasure were intact. However, what is less clear is whether children's assessments of the values of experiences would be modulated by considering a role for memory. Although episodic memory skills emerge in the pre-school years, these skills continue to develop through childhood (Abram et al., 2014; Coughlin et al., 2019). Furthermore, while there is good evidence that young children can grasp the potential impact of a memory on one's current emotional state

(e.g., that being reminded about a past negative event can make someone feel sad, Lagattuta & Wellman, 2001; Lagattuta et al., 1997), making use of memory considerations to modulate judgments of the value of experiences requires additional cognitive skills. Children would need to integrate their assessment of the disutility of unpleasant memories with their assessment of the disutility value of the event itself, and it is not known whether they are able to integrate these sorts of information. They may instead focus solely on the amount of pain, disregarding the influence of memory. Thus, we looked to probe whether the role of memory in temporal preferences changes developmentally.

1.5 The current study

Across a series of experiments we examined the effect of memory, and hypothetical memory loss, on children's and adults' past-future hedonic preference judgments. We presented children and adults with a brief vignette requiring them to judge which state of affairs a temporarily disoriented protagonist would hope to discover: that they will experience 1 painful event in the future, or that they have already experienced 10 painful events in the past. Given some previous evidence that hedonic preferences may be more marked when imagining experiences involving oneself (Greene et al., 2021a), participants had to imagine both themselves (Self trial) and a stranger as the protagonist (Other trial). Some theorists have suggested that considering another's perspective rather than one's own reduces the level of affect associated with the given experience, and that this in turn reduces bias in temporal preference judgments for hedonic goods (Caruso et al., 2008; Greene & Sullivan, 2015; Hare, 2013). In Experiments 1a and 1b, a cover story ruled out a role for memory of pain in informing preferences for the temporal location of painful events. If Parfit, (1984) is correct about preferences for pain to lie in the past being absolute, we would expect adult participants to hope for 10 past painful events rather than for a single future painful event. In the case of children, however, it is possible that they might solely focus on the numerical difference between 1 and 10 events, and thus hope for one future painful event.

Experiments 2a and 2b examined the weight accorded to memories by directly comparing conditions in which the protagonist was said to either have permanent or only temporary amnesia for the period of time encompassing the painful event(s). If the prospect of present and future memories of pain tends to influence judgments, then we might expect these two conditions to produce different results, with only adults whose vignettes feature permanent amnesia preferring a larger number of painful past events to a single instance of future pain (again, children might continue to focus

on the numerical difference between 1 and 10 events). In Experiment 3, we clarified the protagonist's concurrent awareness of whether or not their memory would return.

2. Experiments 1a and 1b

We examined past-future hedonic preferences for a set of painful experiences in adults (Experiment 1a) and children (Experiment 1b). The design and procedure for the experiments were very similar, differing primarily in terms of the number of control questions used with each sample. Given their similarity, the results are reported together. Power analyses using G*Power (Faul et al., 2007) were conducted for binomial tests with alpha and power at the conventional levels of .05 and .8, respectively, presuming strong temporal preferences such that one-quarter of participants or fewer do not share this preference. They yielded a minimum required sample size of $N = 30$.

2.1 Experiment 1a

Method

Participants. Forty-eight adults (4 males) participated. Data from an additional 6 adults were collected, but not used because both of their trials were dropped as a result of failing memory or comprehension checks, rating painful events as hedonically neutral or pleasurable, or both. Adults were recruited through an undergraduate research pool at the university of the lead author and received course credit. Ethical approval for this experiment and for Experiment 1b was received from the research ethics committee of Queen's University Belfast, protocol number EPS 18_217, titled 'Past and Future Thinking: children's and adults' temporal preferences'.

Design, materials and procedure. Adults completed the experiment online. The experiment was presented using Qualtrics software (Qualtrics, Provo, UT). The experiment comprised an initial Hedonic Value Check during which participants evaluated the unpleasantness of two painful events (a painful operation or a painful injection), followed by a past-future task involving two Temporal Preference trials in the form of vignettes. On one trial, the participant was said to be the protagonist (Self trial) and on the other, the fictional person was the protagonist (Other trial). The order of presentation of Self and Other trials was counterbalanced, as was the order in which participants heard about each of two described painful experiences (operation or injection). Examples of trials are presented in Online Resource 1.

Hedonic Value Check. Participants rated the pleasantness or otherwise of the injection and the operation on a 7-point visual-ordered category response measure, labeled from 1 (*Extremely unpleasant*) to 7 (*Extremely pleasant*). The scale used red thumbs-down and green thumbs-up pictures of varying sizes (Figure 1).

Temporal Preference task. Participants read a short text, asking them to imagine that they (Self trial) or another person (Other trial) had experienced a week-long illness called Denboravirus. On Other trials, the protagonist was presented as female ('Annie') for female participants and male ('Andy') for male participants. Participants were told that Denboravirus causes 1 week of memory loss and bad headaches during the illness, but no other symptoms. Once the protagonist recovered from Denboravirus, they would still not be able to remember the week in which they had the illness. Participants were informed that there were two possible courses of treatment that can prevent a person from ever getting Denboravirus again: some people receive a course of 10 painful treatments (10 "really painful" injections of a blue medicine or 10 painful operations, which need to take place without anesthetic) and these are administered in the week when they have the illness; others receive one painful treatment (one injection of a green medicine or one painful operation) the week after they get better. The treatments were said to be equally effective, and the associated pain was said to dissipate soon afterward. Participants were asked to actively imagine that they (Self trials) or the other person (Other trials) needed the injections or the operation.

Participants then read that the protagonist has just got better, has woken up in the hospital, cannot remember the last week at all, but is now fine and not in any pain. Since the protagonist currently has no memory of the event, s/he is presently unaware of whether 10 painful treatments were administered during the week of the illness, or whether one painful treatment will be administered now that the illness has passed. The protagonist asks a nurse, who is not sure of the situation and goes to find out. On Self trials, participants were told "While you are waiting for the nurse to come back, you think about what you hope the nurse will say". On Other trials, they were told "Annie/Andy waits for the nurse to come back. He/she doesn't know what the nurse is going to say."

Next, participants responded to a Temporal Preference question. On Self trials, participants were asked "What do you hope to hear? Do you hope that you had (e.g.,) ten painful injections last week? Or do you hope that you will have one painful injection next week?" On Other trials, these questions referred to the other person: "What do you think would be best for Annie/Andy? Would it be best if s/he had (e.g.,) ten painful injections last week? Or would it be best if s/he will have one painful injection next week?".

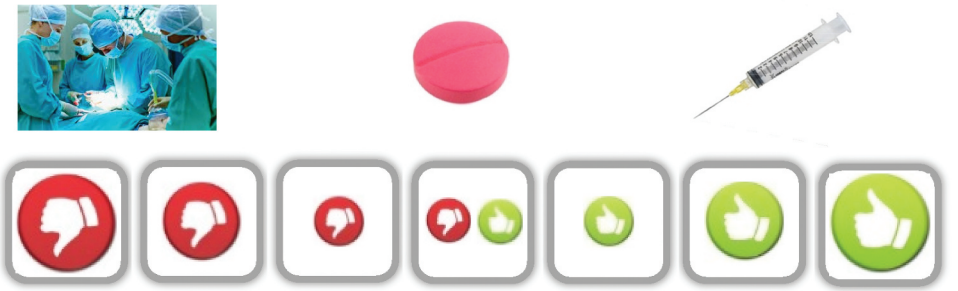

Figure 1. Depictions of events used during the Hedonic Value Check in Experiments 1a and 1b, alongside the visual rating scale used in both experiments.

Participants' response was recorded, and they were also asked to explain their answers by typing into a free text box. A final control question asked whether the protagonist would currently remember the hypothetical 10 past events, had they occurred. Participants were informed at the end of the task that Denboravirus did not exist.

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) through 3 (highest point on the scale). Choosing the midpoint resulted in a score of 0. Dropped trials arising from failure on the control question or from a rating of 0 or higher yielded slightly different *n*s across trials for the analyses below. Choices on the Temporal Preference task were assigned a binary categorical score (1 vs. 10 events).

2.2 Experiment 1b

Method

Participants. One hundred and twenty-six children (60 males) between the ages of 7 and 11 were recruited from schools local to the lead author's institution. The sample was split by age: 53 7-8-year-olds (M = 97.58 months, SD = 3.95, 25 males), 34 9–10-year-olds (M = 121.47 months, SD = 4.43, 17 males), and 39 10–11-year-olds (M = 133.13 months, SD = 3.48, 18 males). Data from one additional 11-year-old were collected, but not used because they rated both painful events as hedonically neutral.

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 children. Rather than children completing the task online, the task was administered by an experimenter and children gave verbal responses or pointed at their answers. The task was presented using Microsoft PowerPoint, configured to appear as if the pages of a book were turning, whilst the experimenter narrated the task.

During the Hedonic Value Check, children used the same rating scale as the one that was used with adults (Figure 1). 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 the two painful experiences (injection and pill).

The Temporal Preference task was identical to the task used with adults, save for three differences (see Online Resource 2). First, in place of the operation(s), children heard about pill(s) that are 'disgusting' and leave

a bad taste in the mouth. Second, the story narrative repeated key information and contained additional illustrations. Finally, there was a series of additional checks on participants' understanding of the narrative (Online Resource 2). These control questions assessed whether children could remember what happens when someone gets sick with Denboravirus; how long Denboravirus lasts; how many injections or pills of each color there are, and when the differently colored injections or pills would be encountered; whether the protagonist can currently remember the last week; whether they know the status of their treatment; whether the protagonist currently knows which treatment they had or will have; and whether, if the protagonist had already experienced the 10 past events, he/she can currently remember them. When children failed a control question, the experimenter re-read the last screen of the narrative and then asked the control question a second time. If children failed the question again, the experimenter continued the narrative. The exception was the final control question: if children failed this question, the experimenter did not ask it a second time. Finally, children responded to Temporal Preference questions identical to those presented to adults in Experiment 1a. Children were asked to explain their answers and the experimenter noted their explanations. At the end, the experimenter informed children that Denboravirus is not a real illness.

Data scoring and analysis. Data scoring and analysis were conducted in an identical manner to Experiment 1a, save that trials were excluded from the analysis if a child failed one or more control questions on the second time of asking (again leading to slightly different *n*s in Table 1). The trial was also excluded from the analysis if a child failed the final control check on the first and only time of asking.

2.3 Results from experiments 1a and 1b

All analyses were performed separately on adult and child data. Data for the Hedonic Value Check task are reported in Online Resource 9, and indicate that the experiences had the appropriate hedonic value.

Results from the Temporal Preference task are reported in Table 1, where they are shown as a proportion of participants who preferred 10 painful past events rather than one painful future event.

We first examined participants' temporal location judgments against chance levels using two-tailed binomial tests, separately for each perspective (Self and Other). Regardless of perspective, 7-8-year-olds hoped for one painful event in the future at a rate above chance, and 9–10-year-olds and 10–11-year-olds responded at chance. Adults chose 10 painful events in the

Table 1. Results of two-tailed binomial tests against chance, Experiments 1a and 1b. Percentages represent the proportion of participants who chose 10 past painful events.

Age group and trial type	*n*	Frequency	%	95% CI	*p*
7–8					
Self	48	13	.27	(.15, .42)	.002#
Other	48	16	.33	(.20, .48)	.029#
9–10					
Self	32	13	.41	(.24, .59)	.377
Other	31	12	.39	(.22, .58)	.281
10–11					
Self	33	15	.45	(.28, .64)	.728
Other	35	16	.46	(.29, .63)	.736
Adults					
Self	45	37	.82	(.68, .92)	<.001*
Other	44	28	.64	(.48, .78)	.096

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

Significantly different to chance in the direction of a preference for 1 future event.

* Significantly different to chance in the direction of preference for 10 past events.

past at a rate above chance when thinking about what they hoped for themselves, and were at chance when thinking about what would be best for someone else.

To investigate the effect of perspective (Self or Other) and, in the case of children, age group, we submitted the data to two Generalized Estimating Equation (GEE) analyses with binomial distributions, logit-log link functions and independent covariance structures. We first examined adults' data. For this and all subsequent experiments employing GEE analyses, we first checked for interactions between predictors of event choice and rating. There were no interactions between perspective and rating. An analysis was then conducted using perspective as a predictor of event choice, with hedonic rating as a covariate. There was a main effect of perspective (Wald χ^2 (1) = 4.371, p = .037, b= 1.18, 95% CI [.07, 2.29], SE = .57), demonstrating that, holding rating constant, adults were more likely to prefer 10 past events on Self trials than on Other trials (Exp(B) = 3.26, 95% CI [1.08, 9.89]).

Next, we examined children's data. There were no interactions between perspective, age group, and rating. An analysis was conducted using perspective, age group, and the two-way interaction between them as predictors of event preference, with rating as a covariate. There were no significant effects (all ps > .100). The interaction was removed, leaving perspective and age group as predictors of event choice, with rating as a covariate. No significant effects were found (all ps > .096). Perspective was removed from the model, leaving age group as the only predictor of event preference, with rating as a covariate. This model was retained. There were no significant effects (all ps > .099).

2.4 Discussion of experiments 1a and 1b

When taking a first-person perspective, adults hoped that 10 painful events had already occurred in the past rather than hoping that only one such event lay in their future, consistent with Parfit (1984) contention that people have a preference for pain to lie in the past that is unaffected by its quantity relative to future pain. When taking a third-person perspective, however, although the majority (64%) of the same adults preferred 10 painful events in the past, this was not at a level significantly different from chance. In Experiment 1b, older children (9–10- and 10–11-year-olds) did not favor either 10 past painful events or one future such event, regardless of perspective; by contrast the youngest children (7-8-year-olds) favored a single painful event in the future, again regardless of perspective.

Adults' preferences, but not young children's, differed from those reported by Lee et al. (2020). In Experiment 3 of the Lee et al. study, both adults and 7-8-year-olds were prepared to trade off their temporal preference for less pain, preferring future pain, when the amount of pain in the past was twice that of pain in the future (2 past events vs. 1 future event). This was the case for both age groups regardless of whether they were thinking about their own preferences or those of other people. Adults in the current study were told about a much larger discrepancy between possible past and future pain (10 vs. 1). Nevertheless, at least when considering their own preferences and contrasting with Lee et al.'s findings, adults hoped for past pain despite its tenfold larger magnitude. An obvious explanation of the discrepancy between the results and those of Lee et al. is that the current study included an amnesia cover story. However, because the studies differed methodologically in some respects, in Experiment 2 we directly examined the role of memory by manipulating it.

3. Experiments 2a and 2b

In Experiment 2a (adults) and 2b (children), an Amnesia condition replicated Experiment 1 with minor amendments, such that the pain of the described events would (as in Experiment 1) never be recalled. In the No Amnesia condition, the illness-induced memory loss was temporary: participants were told that following recovery from Denboravirus, the protagonist would shortly begin to remember the week in which they had the illness. There were two other alterations in the procedure. First, in both conditions, the two painful events were matched more closely between children and adults than in Experiment 1. Second, we also matched the wording of the Temporal Preference question across Self and Other trials. (In Experiment 1, participants had been asked what they hoped for in Self trials, but what

they thought was best for another person in Other trials.) This was done in order to eliminate the possibility that on Other trials participants were attempting a rational choice between two states of affairs, whereas on Self trials they were waiting for information while considering their preferred outcome.

3.1 Experiment 2a

Method

Participants. Eighty-three adults (29 males) participated. Participants were allocated randomly between the Amnesia condition (41 adults) and No Amnesia condition (42 adults). Adults were recruited via the Prolific subject pool (Peer et al., 2017) and received compensation of £0.80 (UK pounds). Ethical approval for this experiment and for Experiment 2b was received from the research ethics committee of Queen's University Belfast, protocol number EPS 19_140, titled 'Past and Future Thinking: children's and adults' temporal preferences.' Data from an additional five adults were collected, but not used because both of their trials were dropped as a result of failing memory or comprehension checks, rating painful events as hedonically neutral or pleasurable, or both.

Design, materials and procedure. Materials for the Amnesia condition were identical to those used in Experiment 1a, save for minor structural changes to the Temporal Preference task described below.

Hedonic value check. The Hedonic Value Check was identical to that used in Experiment 1a.

Temporal preference task. Regardless of condition, participants again completed one Self and one Other trial. Examples of Amnesia and No Amnesia trials are presented in Online Resources 3 and 4 respectively. Trials were structured identically to those in Experiment 1a save for a number of specific changes. We first describe the ways in which the Amnesia and No Amnesia conditions differed, and then describe changes that applied to both conditions.

In the No Amnesia condition, participants were told that following recovery from Denboravirus, the protagonist is temporarily confused ("you feel a bit confused for a little while afterwards") and cannot remember the last week yet, but that "as you're getting better, your memory comes back quickly", so that memories of that week will return "in a short while." In the Amnesia condition, participants were told that once the protagonist recovers from Denboravirus, they cannot remember the week in which they had the illness (as in Experiment 1a).

A number of additional changes applied to both conditions. First, the operation was replaced by a large pill that is very painful to swallow, in order to achieve a closer match with the version of the experiment presented to children in Experiment 2b. Second, the Temporal Preference question, on Other trials, was rephrased from "What would be best for Annie/Andy?" to read instead "What do you hope for Annie/Andy?" to match the wording of the Self trials. Third, both Self and Other trials in the current experiment (2a) prefaced the Temporal Preference question with the words "You/Annie/Andy wait(s) for the nurse to come back. You/he/she don't/doesn't know what the nurse is going to say". Fourth, Denboravirus was no longer said to cause headaches. This was done because in the No Amnesia condition in which the protagonist's memory eventually returns, we wished to avoid the possibility that participants consider memory for the past pain of the headaches rather than just the treatment. Finally, we introduced two control questions to provide additional assurance that adults were able to remember and understand the events in the vignette. In the Amnesia condition, we asked whether people with Denboravirus can remember the last week once they get better. In the No Amnesia condition, this question instead addressed whether people with Denboravirus can remember the last week "straight away" once they are better. We also asked when the differently colored injections or pills would be encountered.

Data scoring and analysis. Data scoring and analysis took place in an identical manner to Experiment 1a, with the addition of the following protocol for the three additional control questions: a trial was dropped if a participant failed to respond correctly, on the first time of asking, to the control question concerning the memory of people with Denboravirus for the last week, or if they failed to respond correctly on the second time of asking to a control question concerning when the injections or pills would be encountered.

3.2 Experiment 2b

Method

Participants. One hundred and eighty-three children (98 males) were recruited from schools and summer programs, or tested in the laboratory at the lead author's institution. The sample was split by age: 88 7–8-year-olds (M = 97.91 months, SD = 5.42), of whom 47 were in the Amnesia and 41 in the No Amnesia condition; and 94 10–11-year-olds (M = 128.76 months, SD = 5.09), of whom 47 were in the Amnesia and 47 in the No Amnesia condition. Data from three additional 7-8-year-olds and one additional 10–11-year-old were collected but not used, because both of their trials were dropped as a result of failing memory or comprehension checks, as well as rating one or more painful events as hedonically neutral or pleasurable.

Design, materials and procedure. The design of the study was identical to that of Experiment 2a. The materials and procedure were modified for the child population. As in Experiment 1b, the task was administered by an experimenter using Microsoft PowerPoint and children gave verbal responses.

The Hedonic Value Check was structured identically to the check used in Experiment 1b, although the 'disgusting' pill was replaced with the 'painful' pill. The Temporal Preference task was identical to the task used with adults in Experiment 2a, other than repetition of key information and additional checks on participants' understanding. These were as described in Experiment 1b, save for the addition of one further question to match that used with adults in Experiment 2a: children were asked whether people with Denboravirus can remember the last week "once they get better" (Amnesia condition) or "straight away as soon as" they get better (No Amnesia condition). Examples of Amnesia and No Amnesia trials are presented in Online Resources 5 and 6 respectively. Children were asked to explain their answers and the experimenter noted their explanations.

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

3.3 Results from Experiments 2a and 2b

All analyses were performed separately on adult and child data. Data for the Hedonic Value Check task are reported in Online Resource 9 and indicate that the experiences had the appropriate hedonic value.

Table 2 shows the results, given as a proportion of participants who chose 10 painful past events.

We first examined participants' temporal location judgments against chance levels using two-tailed binomial tests, separately for each perspective (Self and Other) and condition (Amnesia and No Amnesia). In the No Amnesia condition, 7-8-year-olds hoped for one painful event in the future at a rate above chance for themselves and for others, but were at chance for both themselves and others in the Amnesia condition. Ten-to-eleven-year-olds responded at chance regardless of condition and perspective. In the Amnesia condition, adults hoped for 10 painful events in the past at a rate above chance, regardless of whether they were considering their own situation or that of someone else. However, in the No Amnesia condition, adults responded at chance.

We then submitted the data to two GEE analyses with binomial distributions and logit-log link functions, using perspective (within-subjects: Self or Other), condition (between subjects: Amnesia or No Amnesia), and, in the case of children, age group (between subjects) as predictors. Participants'

Table 2. Results of two-tailed binomial tests against chance, Experiments 2a and 2b. Percentages represent the proportion of participants who chose 10 past painful events.

Age group and trial	Condition	Frequency	%	95% CI	*p*
7–8					
Self	Amnesia (*n*= 37)	14	.38	(.22, .55)	.188
	No Amnesia (*n*= 36)	11	.31	(.16, .48)	.029#
Other	Amnesia (*n*= 42)	18	.43	(.28, .59)	.441
	No Amnesia (*n*= 35)	10	.29	(.15, .46)	.017#
10–11					
Self	Amnesia (*n*= 42)	25	.60	(.43, .74)	.280
	No Amnesia (*n*= 40)	22	.55	(.38, .71)	.636
Other	Amnesia (*n*= 44)	28	.64	(.48, .78)	.096
	No Amnesia (*n*= 40)	17	.43	(.27, .59)	.430
Adults					
Self	Amnesia (*n*= 40)	31	.78	(.62, .89)	.001*
	No Amnesia (*n*= 36)	18	.50	(.33, .67)	1
Other	Amnesia (*n*= 40)	28	.70	(.53, .83)	.017*
	No Amnesia (*n*= 38)	19	.50	(.33, .67)	1

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

#Significantly different to chance in the direction of preference for 1 future event.

*Significantly different to chance in the direction of preference for 10 past events.

ratings on the Hedonic Value check task were again used as a covariate. We first examined adults' data. There was an interaction between perspective and rating (Wald χ^2 (1) = 4.75, p = .029 b= −1.20, 95% CI [−2.28, −.12], SE = .55), as well as a main effect of perspective (Wald χ^2 (1) = 3.65, p = .040, b= −2.56, 95% CI [−5.01, −.12], SE = 1.25). The interaction was not interpretable: given that participants completed trials from both perspectives (Self and Other), and the order in which they were presented was counterbalanced, there cannot have been a difficulty with random assignment. Nor can the value of perspective have caused the rating values, since participants always gave their ratings before hearing the story. The interaction was therefore removed from the model.

A further analysis was conducted using perspective, condition, and the two-way interactions between them as predictors of event preference. There were no significant effects (all ps > .072). The interactions were removed, leaving perspective and condition as predictors of event choice, with hedonic rating as a covariate. There was no effect of perspective (p= .337) but there was an effect of condition (Wald χ^2 (1) = 7.16, p = .007, b= 1.06, 95% CI [0.28, 1.83], SE = .40), demonstrating that holding rating constant, adults were more likely to prefer 10 past events in the Amnesia condition than in the No Amnesia condition (Exp(B) = 2.88, 95% CI [1.33, 6.25]).

Next, we examined children's data. There were no interactions between perspective, age group, and rating. An analysis was conducted using perspective, condition, age group, and the three two-way interactions between them as predictors of event preference, with hedonic rating as a covariate.

There was a main effect of age group (p = .002) and no other significant model effects (all ps > .067). All interactions were then removed, leaving perspective, condition, and age group as predictors of event preference, with rating as a covariate, and this model was retained. There was a main effect of age group, (Wald χ^2 (1) = 9.3, p= .002, b= −.84, 95% CI [−1.38, −.30], SE = .28, Exp(B) = .43, 95% CI [.25, .74]), demonstrating that when holding rating constant, 7-8-year-olds were less likely to hope for 10 past events than 10–11-year-olds, regardless of condition and perspective. There were no other significant effects (perspective, p= .781; condition, p = .061; rating, p = .932).

3.4 Discussion of Experiments 2a and 2b

Experiment 2a provides evidence that when adults compare having undergone a relatively large amount of pain in the past with undergoing a relatively small amount in the future, the prospect of imminent memories of past pain significantly affects their preferences. When adults' memories of the last week were said to have been permanently erased (Amnesia condition), they hoped for 10 painful events in the past, both for themselves and for someone else. However, when their memories of the last week were said to be returning shortly (No Amnesia condition), adults responded at chance. Note that adults hoped for 10 past events for others as well as for themselves, whereas when asked about what would be 'best' for someone else (Experiment 1a) – arguably a question that appealed to rational choice – they displayed no clear preference.

Experiment 2b demonstrates a developmental shift in children's temporal preferences, such that 7-8-year-olds were less likely to hope for the greater amount of past pain than were 10–11-year-olds, regardless of whether memories of the past week would shortly return. Furthermore, one interpretation of the results in Table 2 is that the prospect of memories of pain influenced younger, but not older children's responses. Ten-to-eleven-year-olds responded at chance regardless of whether their memories of the last week were said to be returning. In the No Amnesia condition, 7-8-year-olds hoped for one painful event in the future for themselves and for others. This result was expected, given that children of this age had hoped for one painful future event even when there was no prospect of the memory of 10 painful past events returning (Experiment 1b), and is also consistent with their preferences as reported by Lee et al. (2020). Surprisingly, however, in the Amnesia condition, 7-8-year-olds favored neither 10 past events nor 1 future event, even though both the current experiment

and Experiment 1b featured permanent memory loss. We return to this difference in the findings between Experiment 1 and 2 for this age group in the General Discussion.

Although we did not systematically code participants' explanations of their choices, we did examine them in order to check whether the explanations given raised any concerns about the way the participants understood the narrative. We noticed that some adults in the No Amnesia condition who hoped for 10 past events gave variations on 'because I/he/she can't remember them' as their reason for doing so, even though we stated several times that their memory for the last week would return shortly. It is possible that these participants responded as they did because the story protagonist had no *present* memory of the last week, and they reasoned that the mere prospect of the return of memories of past pain would not sway the hopes of a person who does not currently possess such memories. Another possibility is that participants were unclear about the protagonist's state of knowledge at this crucial juncture. In the No Amnesia condition, we told participants that the protagonist's memory will come back soon. That is, participants were given narrated information that this is what will ultimately happen in the story. However, we did not explicitly inform them that at the critical juncture within the story, the *protagonist* is in possession of this information. If this was not clear to all participants, then some may have thought that the protagonist would hope for 10 past events only due to lack of an awareness that their memory will shortly return. Were this the case, then eliminating the misunderstanding might result in adults hoping for 1 future event in the No Amnesia condition, rather than displaying no preference. In Experiment 3, we explored this possibility with adults by making small changes to further clarify the scenario.

4. Experiment 3

4.1 Method

Participants

Eighty-seven adults (37 males) participated in the experiment. Participants were allocated randomly between the Amnesia condition (43 adults) and No Amnesia condition (44 adults). Adults were again recruited via the Prolific subject pool and received compensation of £0.80 (UK pounds). Ethical approval for this experiment was received from the research ethics committee of Queen's University Belfast, protocol number EPS 19_140, titled 'Past and Future Thinking: children's and adults' temporal preferences'

Data from an additional 4 adults were collected but not used, due to failing memory or comprehension checks on both trials.

Design, materials and procedure

Design, materials, and procedure were identical to those used in Experiment 2a, save for three changes. First, in the No Amnesia condition, the nurse described the protagonist as "getting better" rather than "better"; second, in this condition, the nurse explicitly informed the protagonist that their memory will return shortly ("You're getting better, so you'll remember yourself soon which one it is. But I'll go and find out"). Third, in both conditions, we replaced the request for a free-text explanation of the participant's temporal preference with a forced-choice question.

Hedonic value check. The Hedonic Value Check was identical to that used in Experiment 2a.

Temporal preference task. Participants again completed one Self trial and one Other trial. Examples of Amnesia and No Amnesia trials are presented in Online Resources 7 and 8 respectively.

Reason question. The forced-choice Reason question for temporal preferences followed immediately after participants indicated their response to the Temporal Preference task. We re-stated participants' answer to the Temporal Preference question, (e.g., "You said that you hope you had 10 painful injections of the blue medicine last week"), presented five candidate explanations, which differed as a factor of condition, trial type, and participant response to the Temporal Preference task, and asked "Which is the closest to what you were thinking when you said that?" Candidate explanations and descriptive statistics are summarized in Tables 4 (1 future event) and 5 (10 past events), which indicate the proportion of participants who chose each explanation.

Control questions assessing participants' memory for and understanding of the events in the vignette were identical to the questions asked in Experiment 2a.

Data scoring and analysis. Data scoring and analysis took place in an identical manner to Experiment 2a.

4.2 Results and discussion from experiment 3

Data for the Hedonic Value Check task are reported in Online Resource 9 and indicate that the experiences had the appropriate hedonic value.

Results from the Temporal Preference task are reported in Table 3 as a proportion of participants who chose 10 painful past events.

Table 3. Results of two-tailed binomial tests against chance, Experiment 3. Percentages represent the proportion of participants who chose 10 past painful events.

Trial type	Condition	Frequency	%	95% CI	*p*
Self	Amnesia (*n*= 41)	30	.73	(.57, .86)	.004a
	No Amnesia (*n*= 41)	22	.54	(.37, .69)	.755
Other	Amnesia (*n*= 38)	29	.77	(.60, .89)	.001a
	No Amnesia (*n*= 41)	22	.54	(.37, .69)	.755

Note. Participant numbers vary across trials because data from participants who did not report the appropriate hedonic value for a specific experience was removed on the relevant trial.
aSignificantly different to chance in the direction of preference for 10 past events.

Table 4. Responses to Reason question for a preference for 1 future event collapsed across Self and Other trials, Experiment 3.

Condition	Reason	Frequency	%
Amnesia			
n= 11 (Self)	Because 1 event is less painful than 10 events	2	10
n= 9 (Other)	Because 1 event is not as many as 10 events	7	35
	Wouldn't now remember 10 events	0	0
	Would never remember 10 events	5	25
	Something else	6	30
No Amnesia			
n= 19 (Self)	Fewer bad memories in future	1	2.63
n= 19 (Other)	1 event is not as many as 10 events	3	7.89
	1 event not as bad as memory of 10	27	71.05
	Memory of 1 not as bad as memory of 10	6	15.79
	Something else	1	2.63

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

We first examined participants' temporal location judgments against chance levels using two-tailed binomial tests, separately for each perspective (Self and Other) and condition (Amnesia and No Amnesia). As in Experiment 2a, in the Amnesia condition adults hoped for 10 painful events in the past at a rate above chance, regardless of whether they were considering their own situation or that of someone else. Again, as in Experiment 2a, in the No Amnesia condition they responded at chance.

We then submitted the data to a GEE analysis with a binomial distribution and logit-log link function, using perspective (within-participants: Self or Other) and condition (between participants: Amnesia and No Amnesia) as predictors. Participants' ratings on the Hedonic Value check task were again used as a covariate. There were no interactions between perspective and rating. An analysis was conducted using perspective, condition, and the two-way interactions between them as predictors of event preference. There was an effect of condition (Wald χ^2 (1) = 4.55, p = .04, b= 1.02, 95% CI [.05, 1.99], SE = .50), demonstrating that holding rating constant, adults were more likely to prefer 10 past events in the Amnesia condition than in the No

Table 5. Responses to reason question for a preference for 10 past events collapsed across Self and Other trials, Experiment 3.

Condition	Reason	Frequency (trials)	%
Amnesia			
n = 30 (Self)	Cannot remember 10 events yet	5	8.47
n = 29 (Other)	Will never remember 10 events	17	28.81
	10 events have already happened	21	35.59
	Won't have to have 1 event next week	16	27.12
	Something else	0	0
No Amnesia			
n = 22 (Self)	Cannot remember 10 events yet	3	6.82
n = 22 (Other)	Will never remember 10 events	0	0
	10 events have already happened	34	77.27
	Won't have to have 1 event next week	7	15.90
	Something else	0	0

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

Amnesia condition (Exp(B) = 2.77, 95% CI [1.05, 7.33]). There were no other significant effects (all ps > .685). These results replicate those of Experiment 2a.

Finally, we examined the forced choice responses (Tables 4 and 5). Crucially, in the No Amnesia condition, no participants who hoped for 10 past events reported being under the misapprehension that those events would never be remembered (i.e., no participants who made this choice in the No Amnesia condition chose the statement "Will never remember 10 events"). These responses are addressed further in the General Discussion.

Experiment 3, which clarified the status of the protagonist's knowledge, replicated the results of Experiment 2a. When adults' memories of the last week were said to have been permanently erased, they hoped for 10 painful events in the past at a rate above chance, regardless of perspective. However, when adults' memories of the last week were said to be returning shortly, they responded at chance, and participants' explanations indicated that this was not due to a misapprehension of the memory status of the protagonist.

5. General discussion

5.1 Summary of the findings

We empirically investigated the relative weight that people give to the temporal location of painful events, and to memories of pain, by examining adults' and children's past-future hedonic preferences for painful events, under varying conditions of hypothetical memory loss for the events in question. Across three experiments, we found that when adults considered the prospect of past or future experiences, devoid of any trace in memory, the majority of them hoped for 10 painful events in their past over only one such event in their future, consistent with Parfit (1984) intuitions about the

absoluteness of past-future hedonic preferences. Their hopes for someone else were the same (Experiment 2a), though when asked about what would be 'best' for someone else (Experiment 1a), they did not favor either possibility at rates different from chance. When adults expected that the relevant memories would return, they showed no clear preference, and this was consistent across both Experiments 2 and 3.

Children's preferences were distinct from those of adults: neither younger children (7-8-year-olds) nor older children (9–10- and 10–11-year-olds) preferred 10 painful past events for themselves or others in any experiment at levels above chance, regardless of whether or not those events would ever be followed by associated memories. That is, groups of children of any age never showed the adult-like pattern of responses: a significant preference for 10 painful past events if followed by amnesia. The overall pattern of judgments across Experiments 1 and 2 for the youngest group (7-8-year-olds) was less clear-cut than that of older children and adults. In the youngest age group, the majority response was always to prefer one future painful event. However, the circumstances under which children of this age group had preferences for a single future event that differed significantly from chance varied across Experiments 1 and 2. In Experiment 1, 7-8-year-olds hoped for a single painful future event both for themselves and someone else at a rate significantly above chance, even though they were told that the protagonist would not remember the 10 painful past events. This finding suggested that this group was primarily focused on contrasting the numbers of painful experiences. By contrast, in Experiment 2b this age group were at chance in an Amnesia condition, but in the No Amnesia condition again hoped for a single future event at a rate above chance. A further developmental finding was that, although the oldest group (10–11-year-olds) never showed the adult-like pattern of responses, in Experiment 2 10–11-year-olds were nevertheless more likely than were 7-8-year-olds to hope for 10 painful events in the past over one in the future.

5.2 Implications of the findings with adults

In Experiments 2a and 3, the contrast in adults' performance, across two otherwise identically structured conditions, strongly suggests that considerations about the memories caused by painful events contributed to the propensity of some adults in the No Amnesia condition to report a preference for undergoing a lesser amount of pain in the future over having already undergone a larger amount of pain in the past. In Experiment 3, we asked adults to select reasons for their preferences, and this helped shed some light on the basis of their preferences (Tables 4 and 5). The majority of adults in the No Amnesia condition who reported a preference for one painful episode in the future gave as their reason for

doing so that having to undergo one painful event was better than having to remember 10 painful events. Thus, whilst these findings are compatible with the idea that people have the past-future hedonic preferences typically ascribed to them in the philosophical literature, they suggest that people attribute significant weight to the memories they want to live with, rather than merely the events that they wish to live through.

This is significant because the utility attached to particular episodes of recollection, and the precise role that consideration of such episodes plays in people's past-future hedonic preferences, has not been carefully investigated, despite the fact that some theorists have stressed the importance of considering the utility of the consumption of memories when evaluating the overall utility provided by any given event (Kahneman, 1999; Morewedge, 2015). The current approach provides a way to try to quantify the utility of the consumption of memories. Our findings suggest that, at least for some adults, the main concern is not for the consumption of one's experiences of given events as they are lived through. Rather, the consumption of experiential memory may play a primary role in their considerations when expressing preferences regarding hedonic goods.

We note, though, that in this study we have only established this for painful events. Further research is necessary to examine the role of memory in the case of pleasant experiences. Across several studies, Greene et al. have found evidence that event valence influences past-future hedonic preferences. Given an equal number of events in the past and future, people demonstrated the expected past-future hedonic preferences regardless of whether the event in question was negative or positive, but these preferences were more pronounced for negative than for positive events (Greene et al., 2021a). Given a 10:1 ratio between the number of past and future events, respectively, while the majority of participants showed the expected preferences for negative events despite the ratio (i.e., preferring 10 past negative events to one future negative event), this was not the case for positive events: participants preferred 10 past positive events to one future positive event (Greene et al., 2021b). (Although it should be noted that the expected preferences returned for positive events when a lower 2:1 ratio of past to future events was applied – see Greene et al., 2022.) One possible explanation might be sought in evidence that while negative events are often remembered with a greater sense of vividness than positive events (e.g., Dewhurst & Parry, 2000; Ochsner, 2000), the affect generated by pleasant events tends to fade more slowly than affect generated by unpleasant events (Walker et al., 2003). People may be aware of this, at least tacitly, and, as a result, tend to give greater weight to positive than to negative events in memory. That is, all being equal, people may take the utility of memories of positive events to outweigh the disutility of memories of negative events. This could

disguise what might otherwise be a similar bias toward the future across positive and negative events. If this is the case, in future research, we would expect to see an equally strong future bias for positive as well as negative events where participants are told that memory for the events will never return.

The performance of adults in the No Amnesia condition differed from that of the adults tested by Lee et al., 2020). Lee et al.'s participants reliably and readily reported preferring a single painful event in the future to a larger number of painful events in the past, despite not including an amnesia cover story. Lee et al. interpreted this result as inconsistent with the absoluteness assumption (described in 1.1) regarding past-future hedonic preferences. By contrast, adult participants in the No Amnesia condition of the present study displayed no clear preference across two experiments and indeed were almost evenly split between the two choices. What explains the discrepancy between the adults' choices in the No Amnesia condition in the current study and those of Lee et al. The reasons given by the adults in Experiment 3 who preferred 10 past painful events (Table 5) indicate that they were primarily focused on the fact that the 10 painful events had already happened, consistent with the idea that this sub-group were indeed discounting the past pain absolutely (or at least very heavily), unlike the adults in Lee et al.'s study.

There are a number of differences between the two studies, making it difficult to pinpoint a single reason for the contrast in findings between the two. One important difference may lie in the nature of the choice participants had to make: in the current study, participants were asked about what they hoped to hear, whereas in the Lee et al. study participants were asked who they would prefer to be (someone whose pain was in the past or in the future). As we will discuss, the form of questioning may affect how the participant conceives of the choice itself.

In philosophical discussions (see, e.g., Heathwood, 2008) there appears to be an assumption that in judgments regarding hedonic value people may sometimes adopt an impersonal stance, on which they treat pain as bad regardless of temporal location, and sometimes adopt a personal stance, which introduces the temporal bias toward the future. 2021) describes these two different ways of thinking about our lives in time as 'the whole-life perspective' and 'the future-facing perspective,' arguing that, abstracting from their temporal position, a person can consider which of two alternatives would make their life as a whole go better; yet, from their temporally situated perspective – in which it is salient that some of their life lies in the past and some of it in the future – they may instead be primed to consider which of two alternatives would make *the rest* of their life go better.

In Lee et al. (2020), participants are asked which of the two people they would rather be. As this is framed as a choice between two situations in which two people find themselves, it is possible that participants adopt an impersonal stance, considering which of the two alternatives would make one's life as a whole go better. This may explain the tendency of participants in that study to trade off more pain endured in the past for less pain in the future, as from such an impersonal stance less pain overall is judged to be preferable. In the present study, by contrast, participants are either asked to suppose that they are the protagonist of the narrative (Self), or to consider the situation that a protagonist finds him/herself in (Other), and in either case, they are informed that they are waiting for news about which of two alternative scenarios obtain, and are asked which of the two alternatives they would prefer. In this case, it is plausible that participants are more likely to adopt a personal, future-facing perspective, where they are primed to consider which of two alternatives would make *the rest* of the protagonist's life go better, hence preferring more pain endured in the past to less pain to be endured in the future. In each study, participants may, of course, have considered the alternatives from both an impersonal *and* a personal stance. Nevertheless, one potential explanation of the difference between the Lee et al. findings and the current findings is that participants in that previous study were more likely to consider matters from an impersonal, whole-life stance relative to those in the present study.

We note, though, that our adult sample was almost evenly split in terms of their choices in the No Amnesia condition, meaning that there are individual differences between adults that are also in need of explanation. Indeed, such differences were also present, although less marked, in the Amnesia condition. Although the majority of adults in this condition chose 10 painful events in the past, 20–30% of them did not, indicating that a minority did not discount past experiences absolutely, even when those experiences could not be remembered, which does not appear to be consistent with suggestions that past-future hedonic preferences are universal (as Parfit, 1984; Sullivan, 2018 appear to suggest). The small numbers involved make it difficult to reach any conclusions about the basis for such judgments, even when inspecting the reasons provided for such answers in Experiment 3. Nevertheless, these findings suggest that there are differences, as yet unknown, between adults either in how they make their decisions, or in the value assigned to past experiences. Future studies could examine these differences.

5.3 Developmental findings

The most striking developmental finding was the contrast between adults and children in terms of the effect of memory: children of all age groups never chose 10 painful past events at a rate above chance, even in the absence of memory for

those events. We are confident that this is not because children did not grasp the important facts in the story, given that children had to answer control questions correctly. Thus, the results suggest that even in late childhood, children do not necessarily consider the utility of memories in the same way as adults, which is a novel finding. We note, however, that in Experiment 2 there were significant developmental changes, with the older children (10–11-year-olds) providing responses in the Amnesia condition that more closely resembled adult responses than those of the younger children (7-8-year-olds).

These findings suggest that factoring in the utility of memory in adult-like ways may depend upon relatively sophisticated cognitive abilities that develop across childhood. We are not aware of any existing research that has examined this specific issue developmentally, although there is a large literature on children's understanding of and knowledge about memory (Flavell & Wellman, 1977; Schneider & Löffler, 2016), which has been primarily focused on children's ability to use and control memory effectively. It is known, though, that young children can understand that being reminded about a negative past experience that is not currently ongoing can lead to negative emotions (Lagattuta & Wellman, 2001; Lagattuta et al., 1997). Moreover, Lee et al. (2020) showed that older children can infer that someone who had one painful experience in the past is likely to be happier than someone who is due to have one in the future – indicating that they can in principle use the temporal location of events to make inferences about emotional states. However, the current task involves a more complex inference: participants must consider the presence or absence of memories of painful events, make an assessment about the utility of such memories relative to a different quantity of future pain, and then use that assessment to consider what someone in that situation might hope to hear. Figuring out which aspect or aspects of this chain of reasoning is particularly difficult for children would require research that breaks down and examines each of these components, potentially using simpler scenarios than the one employed here.

We finish by considering the performance of the 7-8-year-olds, who resembled children of that age in Lee et al. (2020) study in choosing less pain in the future significantly *more* often than chance, albeit inconsistently. In Experiment 1, this pattern was observed in an Amnesia condition, and in Experiment 2 it was observed in the No Amnesia condition. Alongside the fact that 10–11-year-olds were significantly less likely to express this preference than the 7-8-year-olds in Experiment 2, the findings of the current study suggest that these younger children tended to focus primarily on the numerical contrast between the amounts of past and future painful events, but that this tendency reduced with age. Nevertheless, the inconsistency of the performance of 7-8-year-olds across Experiments 1 and 2 needs to be considered. In Experiment 2, we had anticipated that this age group would again show a significant preference for the smaller amount of future pain in the Amnesia

condition. Although the majority of 7-8-year-olds did indeed have this preference in Experiment 2, it was not at statistically significant levels. The story procedure in Experiment 2 differed in a number of respects from that in Experiment 1, again meaning that further research is needed to establish exactly which aspects of the methodology contributed to the difference in findings between the studies. Nevertheless, the finding that younger children were more likely than older children to simply focus on the overall quantities of pain can be observed in both experiments.

Conclusions

We investigated the influence of memory for pain on past-future hedonic preferences, manipulating hypothetical memory loss in a series of vignettes structured similarly to Parfit (1984) thought experiment. In adulthood, but not yet by middle childhood, the anticipation of recollections of pain affected preferences for the temporal location of the painful event. It appears that, for at least some adults, memories are a key consideration in their preferences regarding the temporal locations of hedonic goods. Indeed, for some adults, the disutility attached to particular future episodes of recollection for painful past events can outweigh the disutility of living through future painful events. Thus, considerations concerning the consumption of experiential memory appear to play an important role in people's bias toward the future. However, children do not resemble adults in this regard. This empirical investigation of the role of memory in preferences for the temporal location of painful experiences moves us toward a more comprehensive grasp of the relationship between temporality and cognition, and its change across development.

Note

1. This assumption pertains to 'pure' pains and pleasures; for other goods, the matter is under debate. See, for instance, Dougherty (2015); Sullivan (2018). To speak about hedonic goods as 'pure' is here to signify that we are concerned with the pain or pleasure that is an intrinsic quality of the experience, devoid of any concerns regarding the instrumental value that people may sometimes assign to such experiences (e.g., taking pleasure in how one has overcome past suffering).

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