

# Making Decisions about the Future

## *Regret and the Cognitive Function of Episodic Memory*

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Episodic memory is the capacity to consciously recollect particular events from one's own past (Hoerl, 2007; Tulving, 1985). Empirical work in psychology suggests that it is a fairly sophisticated memory capacity that may develop later than other memory and learning abilities (McCormack & Hoerl, 1999) and that can be selectively impaired in amnesia (Squire & Zola, 1998). It is also often held to be unique to humans (Hoerl, 2008; Suddendorf & Corballis, 2007; Tulving, 2002)—echoing the long-standing philosophical trope that animals' lives are in some sense confined to the present (Aristotle, 1930; Bennett, 1964; Bergson, 1991; Nietzsche, 1983; Schopenhauer, 1999)—although there is considerable debate about this in comparative psychology. Existing discussions of episodic memory in philosophy are typically concerned with the idea that episodic recollection involves being in a distinct kind of epistemic state (Martin, 2001; Soteriou, 2008) and a state with a distinct kind of phenomenology (Hoerl, 2001; Hopkins, forthcoming). In both disciplines, the question as to what episodic memory is *for*—what distinctive evolutionary function it might serve—has, until relatively recently, rarely been asked (Baddeley, 1988), but is now becoming a very lively area of debate (Boyer, 2008; Klein, 2013; Suddendorf & Corballis, 2007). In fact, this question has arguably emerged as one of the most significant challenges for memory research. While learning about the general characteristics of the world (and retaining such information for future use) is clearly beneficial, of what benefit is it to the individual to be able to remember particular past events as such, given that those particular events will never come again?

This chapter will consider an approach to this issue that has not yet been explored, by examining how the set of cognitive abilities employed in episodic memory might be necessary for the emotion of regret. Regret, at least as we will understand this notion in the context of the present chapter, is by definition an emotion directed toward the past: one regrets a choice one has made, typically believing

that if one had chosen differently a better outcome would have obtained. However, although when we experience regret it is directed toward the past, psychologists have argued that this emotion has an important effect on our future lives (Roese, 2005; Zeelenberg & Pieters, 2007). Having experienced regret over a choice, we may choose differently when faced with a similar choice again. Moreover, when making choices, we may anticipate and seek to avoid future regret.<sup>1</sup> What we will explore in this chapter is the role of episodic memory in regret, and hence future-oriented decision-making itself.

As we see it, a key advantage of exploring this issue is that it may make vivid how episodic memory, which itself is intrinsically backward-looking, may nevertheless play a vital role in shaping our decisions about the future. In the first section, we set up the puzzle of accounting for a distinctive function for episodic memory in future-oriented decision-making. Recent accounts of the function of episodic memory have sought to identify a role for it in such decision-making, but, as we show in the next section, it is not clear how the accounts that have been put forward so far include the backward-looking element that is an essential aspect of episodic memory. In the second section, we will consider psychological research that has demonstrated the different ways in which regret may inform decision-making, distinguishing between the effects of experiencing versus anticipating regret. Finally, we will then consider how experiencing and anticipating regret may be connected to mental time travel, and whether episodic memory can be seen to be essential in supporting the way of thinking about time that is involved in regret. Our argument will be that episodic memory, because of its backward-looking element, underpins the ability to experience regret, and that this an important way in which episodic memory impacts on and supports adaptive future-oriented decision making.

## 1. FINDING A DISTINCTIVE ROLE FOR EPISODIC MEMORY IN FUTURE-ORIENTED DECISION-MAKING: THE BASIC PUZZLE

Having originally been conceived of in relative isolation from other cognitive abilities, episodic memory has in recent years been re-conceptualized as one aspect of the more general capacity for engaging in what is sometimes referred to as “mental time travel” (Schacter & Addis, 2009; Suddendorf & Corballis, 1997, 2007). This has been partly in response to the growing recognition that there is also a distinctive, episodic way of thinking about future events (Atance & O’Neill, 2001), and in response to evidence from imaging studies and studies of cases of amnesia that such episodic future thinking relies on the same brain network as episodic memory (Schacter, Addis, & Buckner, 2007). However, part of the motivation behind it has also been the thought that the function of episodic memory must ultimately turn on its connection to the ability to engage in episodic future thinking, and the role that the latter plays in enabling certain forms of planning or decision-making (Klein, 2013). The basic line of thought here is that, although it stems from the past, episodic memory is primarily useful not because it is about the past, but because it allows us to prepare adaptively for what is to come (Klein, forthcoming).

One problem, though, with this general line of argument is that it threatens to do away with any distinctive function for specifically episodic memory (by

contrast to other types of memory) in our mental lives. Indeed, a consideration of this line of argument can serve to demonstrate what the problem of accounting for the function of episodic memory comes to. To illustrate this, we will focus on one particularly persuasive and influential claim that has been made about the role of episodic memory, and episodic thinking more generally, in future-oriented decision-making: that of Boyer (2008). Recent accounts of episodic future thinking often emphasize that it is a type of mental simulation; the typical claim in the literature is that this simulation involves the flexible recombination of material from episodic memories of past experiences (Eacott & Easton, 2012; Suddendorf & Redshaw, 2013). Boyer's (2008) claim is that episodic memory is critical for future-oriented decision-making, insofar as it supports the mental simulation of future events that allows us to give due weight to the future rather than current benefits of certain choices.

The paradigmatic decision-making scenario envisaged in this context is one that involves delayed gratification. Boyer argues that episodic memory allows simulation of the future, and in virtue of this property it has a special link to the emotions: he states that the episodic system results in the generation of "emotions that bypass current goals as well as time discounting and, therefore, provide us with immediate counter-rewards against opportunistic motivation" (Boyer, 2008, 222). That is, insofar as the episodic system yields mental simulation of possible future events, it preferentially supports choices that may currently seem unattractive or have no immediate benefits but that are in the long term advantageous. This argument is on the face of it persuasive, because it focuses not just on the type of information about the world that the episodic system could deliver, but on the distinctive way in which this information is delivered, namely as input into a type of simulation.

Boyer focuses particularly on the idea that such simulation delivers a preview of a future emotional reward (see also Benoit et al., 2011). However, in virtue of the fact that it involves mentally "pre-experiencing" the future, it is plausible that episodic future thinking may also impact on other factors that are already known to affect temporal discounting, but which have not typically been explicitly linked to episodic thinking as such. Two examples of such factors are subjective temporal distance (Kim & Zauberman, 2009, 2013; Kim, Zauberman, & Bettman, 2012) and level of connectedness to one's future self (Bartels & Rips, 2010; Hershfield, 2011). Kim and Zauberman (2009) argue that the extent to which one discounts a future event is closely linked to how far away in the future it feels; a natural extension of this suggestion is that simulation of the future underpinned by the episodic memory system might reduce subjective temporal distance to the future and thus reduce temporal discounting. Similarly, Bartels and Rips (2010) argue that individuals feel to varying degrees psychologically connected to their future selves (e.g., oneself in the distant future may be represented as only partially overlapping with one's current self), and that this can help explain the typical temporal discounting function. Again, a plausible hypothesis is that episodic simulation may alter psychological connectedness to one's future self and may thus support future-oriented decision-making.

Not only are there good reasons to hypothesize that mentally simulating the future will lead to it being more valued, empirical studies have begun to emerge demonstrating that encouraging people to simulate the future impacts on the

extent to which it is discounted (Benoit, Gilbert, & Burgess, 2011; Lin & Epstein, 2014; Peters & Buchel, 2010, 2011). The crucial question in the current context, though, is whether this can be used to support the idea that it is specifically *episodic* memory that does some crucial work in decision-making that involves simulation in this way. Mental simulation, of the type envisaged, clearly relies on past experience; even when we simulate a novel type of event, we can only do so to the extent that the elements out of which our simulation is composed correspond to experiences with which we are familiar (Lewis, 1990). In that sense, information that is in memory as a result of our own past experiences must play an important role in supporting simulation of the future. Yet, this does not mean that simulation requires that we can actually recall the particular past occasions on which we had those experiences (Hoerl, 2014). We may engage in such simulation, drawing on information from memory, without actually casting our minds back to our past at all. Indeed, from an adaptive point of view, engaging in recollection in the context of this type of decision-making can put us at a disadvantage (see also Schacter, Benoit, De Brigard, & Szpunar, 2015, for this point), given that drawing on memories of particular past events in predicting the future introduces systematic biases—when casting our mind back to the past, instead of remembering how things typically go, we in fact tend to remember occasions that were atypical (Morewedge, Gilbert, & Wilson, 2005).

What these considerations illustrate is that there is an obvious function that memory can play in decision-making in cases where the choice is between outcomes of a type one has already encountered. In such cases, memory can provide the necessary materials for simulating the future. But for memory to serve that function, the relevant memory does not need to include the capacity to recollect particular past events *per se*.<sup>2</sup> The basic problem here is that once the primary function of episodic memory is thought to be one of serving future-oriented decision-making, it becomes difficult to see why this type of memory, with its backward-looking element, should be seen to play a distinctive role in serving this function that cannot also be served by types of memory that do not include this element.

At the risk of laboring the point, the structure of the problem in accounting for a distinctive role for episodic memory could be put as follows. One approach to establishing a distinctive role for episodic memory in our mental lives would be to try to identify a type of information about past events that could only be yielded by episodic memory. For example, one might argue that episodic memory brings with it information about the spatiotemporal context in which remembered events occurred (see McCormack, 2001, for discussion). However, the immediate difficulty that arises is that any such information one might try to home in on that might become useful again in the future (including information about the context in which an event occurred) could in principle be supplied by other types of memory (Klein, 2013, forthcoming). Presumably for this reason, researchers trying to account for the function of episodic memory have instead typically turned to focus on the way in which episodic memory delivers information about the past, highlighting its distinctive phenomenology that involves “re-experiencing” events (Suddendorf & Corballis, 1997, 2007). They suggest that episodic future thinking has a parallel type of phenomenology: we simulate the future and as a result “pre-experience” it. The idea is then that episodic memory may play some special role in supporting such simulations (for example, the title

of Schacter et al.'s, 2007, paper is “Remembering the Past to Imagine the Future”). This line of thought can also be seen to underpin Boyer's description of why episodic memory helps with future-oriented decision-making. But the problem with this suggestion is that it is not clear why the information used in such simulations need derive specifically from recollecting particular past events. Why should episodic memory, with its backward-looking element, be what is required for simulation of the future?

There are two immediately obvious responses to this puzzle, both of which have been put forward by Stanley Klein. One response here would be to bite the bullet and hold that there is indeed nothing distinctive about the function of episodic memory in this regard. Klein (2013, forthcoming) recognizes the puzzle when he argues that episodic memory is not necessary for future mental time travel, suggesting on empirical and theoretical grounds that purely semantic memory might be not only necessary but also sufficient even for the type of mental simulation that is typically thought to accompany future mental time travel. The other, not incompatible, response would be to deny that we should place any special weight on the backward-looking element of episodic memory. So, for example, Klein (2014; Klein, Robertson, & Delton, 2010, 2011) argues that even episodic memory should be viewed primarily as future-oriented, with its backward-looking element merely an evolutionary byproduct of a system that evolved to help us anticipate the future (though see Klein, forthcoming, for a somewhat different evolutionary explanation of the backward-looking element of episodic memory).

We agree with Klein's (2013, forthcoming) assessment that some sorts of future-oriented thinking and decision-making need not necessarily involve episodic memory, and that there is empirical evidence to support this assessment. For example, we have been considering Boyer's (2008) hypothesis that the episodic system may play a special role in the paradigmatic case of decision-making that involves temporal discounting. But, in experimental settings, amnesic patients who lack episodic memory for the past are not more inclined to discount the future than healthy controls (Kwan, Craver, Green, Myerson, & Rosenbaum, 2013). This suggests that if Boyer (2008) is correct that temporal discounting is affected by the ability to imagine the future, it is a type of imagination that does not rely on being able to recollect the past.<sup>3</sup>

However, we believe that, even if it is true that the adaptive function of episodic memory ultimately lies with the role it plays in future-oriented decision-making, there may be ways of fleshing out this thought that also recognize the importance of its backward-looking element. The challenge is to consider whether there are aspects of future-oriented decision-making that do seem to require a type of mental simulation that is itself intrinsically bound up with a capacity to recollect one's past (i.e., that have what we termed a backward-looking element). In the next section, we will argue that experiencing and anticipating the emotion of regret play a crucial role in future-oriented decision-making. One of the defining features of regret is its backward-looking nature: by necessity, one can only regret what is in the past (although, as will be discussed, one may anticipate future regrets). Nevertheless, there are good reasons to believe that regret shapes our future behavior. A consideration of regret provides an alternative way of thinking about how episodic memory might play an essential role in future-oriented decision-making, not despite its backward-looking element but because of it.

## 2. REGRET AND DECISION-MAKING

The idea that regret plays an important role in decision-making has gained much currency over the last two decades (for reviews, see Koch, 2014; Roese, 2005; Zeelenberg & Pieters, 2007). Regret is typically defined within the psychological literature as the negative emotion that one feels when one realizes or believes that an outcome could have been better if one had chosen differently. In psychology, the term *regret* is typically reserved for cases in which one had responsibility for the choice and hence the outcome (Weisberg & Beck, 2012; Zeelenberg, Van Dijk, & Manstead, 1998, 2000; though see Ordóñez & Connolly, 2000). It has been shown to be an extremely common emotion; for example, one study (Shimanoff, 1984; see also Saffrey, Summerville, & Roese, 2008) indicated that it was the most frequent negative emotion mentioned in everyday conversation—and one that has far-reaching effects on our behavior (Roese, 2005; Zeelenberg & Pieters, 2007).

One way to argue for a close relation between regret and future-oriented decision-making might be to point to its close relation with agency and personal responsibility: indeed, Zeelenberg and Pieters (2007) argue that regret is the only negative emotion that has a special relation with one's own choices, such that it is only experienced if one believes one has made a poor or suboptimal choice. However, for present purposes we want to focus on the temporal character of regret. Zeelenberg and Pieters (2007, 8) capture this character in their claim that “[r]egret bridges the past and the future in the present.” What they mean by this is that although regret is experienced in the present, it is always past-directed; at the same time, although regret is directed toward our past, it has the capacity to exert a strong influence on our future.

Regret researchers typically distinguish between two broad ways in which regret may affect future decisions: through experienced regret or anticipated regret. In the former case, experiencing regret about a choice might have a subsequent effect on what one decides to do when faced with that decision again. In the case of anticipated regret, the basic idea is that, when faced with a choice, one anticipates the regret that might result as a consequence of one's different choice options, and this guides the choice that one makes. In both cases, regret is assumed to affect behavior primarily as a result of regret aversion (Zeelenberg & Beattie, 1997; Zeelenberg, Beattie, van der Pligt, & deVries, 1996), that is, because people attempt to avoid feeling regret and take steps to regulate the emotion when they do experience it (Zeelenberg & Pieters, 2007).

Turning first to the case of experienced regret, studies suggest that experiencing regret may impact on subsequent decision-making because, following a poor decision that one regrets, one may make a better choice the next time one is faced with the same type of decision (O'Connor, McCormack, & Feeney, 2014; Ratner & Herbst, 2005; Zeelenberg & Pieters, 2004). In this way, regret may have an impact on choices that are encountered repeatedly (e.g., whether to hit the snooze button when the alarm clock goes off, or whether to eat the large slice of chocolate cake). O'Connor et al. (2014) demonstrated the effect of experienced regret in a developmental study by showing that children who experienced regret about a simple choice (which of two boxes to pick in order to win a prize) were more likely to switch choices when faced with the same decision again than children who did not experience this emotion. In this way, regret can be seen as a functional or



useful emotion that helps us to learn and adjust our behavior adaptively (Roese & Summerville, 2005). In O'Connor et al.'s (2014) terms, experiencing regret facilitates "adaptive switching."

However, there may be other circumstances in which the experience of regret has an impact, albeit more indirectly, on future decision-making, even if one is never faced with the same choice again. Beike, Markman, and Karadogan (2009) argue that the paradigmatic case of experienced regret is one of missed or lost opportunity. They showed that people report the most intense regrets about choices that cannot be revisited, because as a result of making the initial choice, certain opportunities were lost and were lost irreversibly. Loss of opportunity in this sense could occur for both minor (e.g., deciding whether to buy a souvenir T-shirt in Disneyland) as well as major life choices (e.g., deciding whether to propose marriage), but may be particularly clear in the case of certain major life choices. To give an example, if one decides not to have children, for women at least there will come a point in their lives in which that choice cannot be reversed. In such circumstances, it is not possible for one's regret to affect behavior through adaptive switching, because the option to switch is no longer available. Nevertheless, the fact that one experiences regret in the face of lost opportunities may have an impact on one's future choices. Beike et al. (2009, 395) argue that "regretting lost opportunities reminds people not to lose out on other current opportunities. Hence, regret motivates people to seize the day." If this is correct, experiencing regret about missed opportunities could have wide-ranging effects on subsequent choices, because when faced with another opportunity-providing choice, given one's previous experience, one anticipates feeling regret about not taking up this option, and this informs one's choice.

There are many other circumstances in which anticipated regret is likely to affect decision-making. Experimental studies on economic decision-making have demonstrated that the anticipation of regret is one factor that shapes choice patterns, with people avoiding choices that are likely to lead to regret (e.g., Camille et al., 2004; Coricelli et al., 2005; Coricelli, Dolan, & Sirigu, 2007; Mellers, Schwartz, & Ritov, 1999). The general idea is that people try to minimize future regret by assessing the level of regret that might result from each choice and considering how likely it is that choices might result in such regret. There are influential formal models of economic decision-making that are based on this type of principle (Bell, 1982; Loomes & Sugden, 1982). Studies of economic decision-making in brain-damaged patients who have lost the ability to experience or anticipate regret indicate that a lack of regret is associated with poorer choice (Camille et al., 2004; Coricelli et al., 2007). The powerful nature of anticipated regret has also been demonstrated in numerous studies in applied psychology, where levels of anticipated regret have been shown to be good predictors of subsequent health-related behavior and experimental manipulations to induce anticipated regret have been demonstrated to impact on choice (e.g., with regard to deciding whether to use contraception [Richard, van der Plicht, & DeVries, 1996], get a vaccination [Chapman & Coups, 2006], or take up smoking [Conner, Sandberg, McMillan, & Higgins, 2006]; see Koch, 2014, for review).

Viewed this way, regret can be seen to be a functional or useful emotion that helps guide better decision-making (Roese, 2005; Zeelenberg & Pieters, 2007). Indeed, when questioned, people seem to value regret more than any other negative emotion because they believe it helps them to avoid repeating their mistakes and helps them to know how to act in the future (Saffrey et al., 2008). Although

research indicates that regret has a positive function, avoiding future regret turns out to be very important for one's well-being, at least in the longer term. Research has also shown that high levels of lingering regret are associated with poorer mental and physical health (Torges, Stewart, & Miner-Rubino, 2005; Wrosch, Bauer, Miller, & Lupien, 2007; Wrosch, Bauer, & Scheier, 2005). For example, Wrosch et al. (2005) found that among elderly adults, intensity of regret predicted higher levels of depressive symptoms, poorer physical health, and lower levels of reported life satisfaction. These authors argue that when reflecting on how one's life has unfolded, having long-standing regrets about the path one has chosen can be detrimental in measurable ways to one's health (Wrosch et al., 2007).

### 3. REGRET AND EPISODIC THINKING

The overall aim of this chapter is to explore whether we might come to a better understanding of how the possession of episodic memory can be seen to play a distinctive role in future-oriented decision-making by considering the role that regret has in decision-making. In section 2, we reviewed research that has demonstrated how regret, although an intrinsically backward-directed emotion, can nevertheless play an important role in future-oriented decision-making. Having established the importance of regret in this regard, we now need to consider how this emotion may depend upon episodic memory abilities. The thought that regretting something (or at least paradigmatic cases of doing so) involves episodic recollection may already be intuitive enough. But we think it is worth exploring in more detail just how exactly regret and episodic memory might be seen to be connected, as it may allow us to uncover how decision-making, too, might be seen to trade crucially on episodic thinking. We will do this in two stages. First, we will characterize the way of thinking about time that seems to be involved in both experienced and anticipated regret. Second, given this characterization, we will then consider how episodic memory plays a distinctive role in regret and, as a consequence, future-oriented decision-making.

#### 3.1. Ways of Thinking about Time and Regret

##### 3.1.1. EXPERIENCING REGRET

Regret is by definition a counterfactual emotion: it depends upon counterfactual thought insofar as it involves looking back at a past decision that has led to a certain outcome and thinking about how one would have felt had one made a different choice. We can identify two important aspects of the way of thinking about time that is recruited in this sort of counterfactual thought. First, it seems to require an ability to consider two different temporal perspectives on the same point in time, where the relevant point in time is the point at which the choice was made. One of these is looking backward from one's current location in time to the choice point. That choice is now in the past, and its consequences have become apparent. However, this is not all one is doing when one is experiencing regret: one is also thinking counterfactually about how things could have turned out differently. Such counterfactual thought seems to require being able, at least in principle, to think



back to a point in time when one was making a choice, but having made the choice was still in the future. From that alternative, temporal perspective, there were different options available to the decision-maker and it was not yet settled which one she would take. Experiencing regret seems to hinge on being aware of the availability of these different options, which are now in the past but which were once possible ways the future could have unfolded, and a consideration of how they would have yielded alternative outcomes.

The second, related, aspect of this way of thinking about time that we want to emphasize is that it requires a capability to engage in what elsewhere we have described as “event-independent thinking about time” (McCormack, 2014, 2015; McCormack & Hoerl, 2008). What we are trying to capture by this term is the ability to think about particular times independently of the events that have occurred or that could occur at such times. A spatial analogy is helpful in clarifying this notion. When we think of a place, we can think about it independently of the objects that occupy it. For example, we can think of “that place over there where my desk is” as remaining “that place” even if it was occupied by a different object or no object at all. That is, we can think about space in an object-independent way. Similarly, at least as mature thinkers, we can think about points in the past or the future as being distinct from any specific events that may have happened or will happen at those points in time. That is, we can think *about particular times* per se, rather than just being able to think about events.

The sort of counterfactual thought about the past that one engages in when experiencing regret recruits event-independent thought about time. When one thinks back to the time before one’s choice was settled, in considering possible alternative courses of action one could have taken, one is able to think about the choice point as a location in time at which different events could have happened. Counterfactual thought of this sort is intimately connected to grasping that there are multiple possible ways in which events can or could have unfolded (Beck, Robinson, Carroll, & Apperly, 2006). What we are arguing here is that such a grasp should also be seen as part of what it is to be able to think about time itself (for this argument in more detail, see McCormack, 2015).

Our purpose in unpacking the temporal abilities involved in experiencing regret is to demonstrate that there is a very robust sense in which regret might be said to involve mental time travel into the past. First, one needs to be able to, at least in principle, adopt a past temporal perspective at which having made one’s choice was still in the future, and the choice itself was as yet undecided. Second, it is genuinely a particular past time that the subject revisits in her thinking, in so far as the subject thinks of that time as one in which she made a particular choice, but does not think of the time just *in terms of* the choice she made them, but as one at which she could have made a different choice.

### 3.1.2. ANTICIPATING REGRET

In the previous section we mentioned the idea that decision-making can also turn on the anticipation of regret. That is to say, in some choices agents aim to minimize anticipated regret—they imagine looking back at their choice from a point of view later in time and thinking counterfactually about how they would have felt had they made a different choice. What they are concerned with is how they will look back on a decision that they have yet to take once the decision has been made and

they have to live with its consequences. Note that this type of thinking, too, can be seen to involve mental time travel in a very robust sense, albeit now into the future. Indeed, it is arguable that, because of the more complex temporal structure of the simulation it involves, anticipating regret more clearly involves mental time travel than the type of mental simulation described in section 1. In that section, we considered existing claims (e.g., those of Boyer, 2008) about how mental simulation may impact on decision-making about the future. The type of mental simulation that is invoked in that context is typically characterized as mental time travel from one's present point in time to a future one at which the outcome of one's choice will obtain (e.g., imagining a future reward, which may reduce temporal discounting). In fact, it is far from obvious how much of an understanding or reasoning specifically about *time* that type of simulation actually requires on the part of the subject. Indeed, as we have suggested, there is a sense in which the purpose of such simulation is precisely to diminish the relevance of time, by allowing the subject to "pre-experience" the future outcome already, reducing subjective temporal distance to it, and forging a tighter connection between one's present self and one's future one.

Time itself, by contrast, plays a far more central role in the reasoning involved in anticipating regret, particularly with regard to the need to occupy a future perspective in time from which one is looking back at what will then be a potentially irrevocable decision, but is now an as yet undecided choice, and comparing the outcome of that decision with the counterfactual outcome that would have obtained had one's choice been different. It is again genuinely a different time the subject occupies in imagination in this type of reasoning, in virtue of the fact that this time is thought of in an event-independent way. That is to say, the imaginary future point of view occupied by the subject is conceived of as a time at which only one of the possible choice outcomes will obtain, but it is not thought of in terms of which such outcome will obtain, but as a time at which different outcomes may obtain, depending on the choice.

Thus, mental time travel abilities, both into the past and into the future, can be seen to play a crucial role in experiencing and anticipating regret. While anticipating regret involves future-directed mental time travel, though, and experiencing regret itself involves past-directed mental time travel, there is a backward-looking element that is an essential embedded ingredient in the future-directed thinking involved in anticipating regret. Because of this, we could say that anticipation of regret involves not just prospection (Buckner & Carroll, 2007) but prospective retrospection.

### 3.2. Episodic Memory and Regret

We have argued that there is a rich sense in which experiencing and anticipating regret involve mental time travel. However, what remains to be elaborated in more detail is how the ability to experience and anticipate regret depends essentially on memory that is specifically episodic, rather than some other type of memory or knowledge about the past gained in another way. As we mentioned earlier, it may seem intuitive that regret involves recollecting the past. Indeed, we think that it is highly likely that in many cases in which people experience regret, not only are they engaged in past-directed thought of the sort outlined earlier, but that episodically

remembering the past is a central ingredient of such thought. That is, although the past-directed thought must have a counterfactual aspect, episodically remembering a past choice forms the backdrop for the associated counterfactual cognition. When we described the temporal structure of thought that seems to be involved in experiencing regret, we emphasized that it seemed to involve considering dual temporal perspectives: thinking of one's choice as being in the past but also having an awareness that there was a time at which this was not yet the case and alternative choices could have been made. What is intuitively compelling about the idea that regret typically involves episodic recollection is that in regretting a choice one seems to be not simply retrieving information about a past choice, but mentally revisiting a previously occupied point in time and dwelling on the possibilities that existed when one actually occupied that temporal perspective. And it is this sort of revisiting of the past that usually held to be the preserve of episodic memory. Indeed, as we will describe in the following, recent neuroscientific research strongly suggests that episodic memory is typically involved in the sort of counterfactual thought about the past that features in regret.

Note, though, that we want to make a different (and in fact stronger) claim about the link between episodic memory and regret than simply that this type of memory normally is a central ingredient of regret. For a start, insofar as we are seeking a role for episodic memory to play, via its connection with regret, in future-directed decision-making, we are also interested in ways in which episodic memory might be seen to be involved in underpinning the capacity to anticipate regret,<sup>4</sup> which we have argued plays an important role in such decision-making. Yet anticipating regret concerning a future decision cannot literally involve episodic recollection of that decision in the way that experiencing regret about a past decision can, and it is also not always a matter of recollecting past decisions of the same type, as we try to anticipate regret even when making entirely novel decisions. Moreover, even in the case of experienced regret, it is straightforward to think of instances in which one could regret a decision despite being unable to episodically remember making the decision itself. For example, you could switch on your computer in the morning to find out to your horror that in last night's drunken stupor, you sent an inadvisable email to your boss. You could still engage in past-directed mental time travel in such an instance, and deeply regret the incident, but under such circumstances your past-directed mental time travel would be based on reconstruction rather than recollection of the past. Rather than arguing that all experiences of regret must involve episodically remembering the past, we want to instead claim that episodic memory underpins the very ability to engage in the ways of thinking about the past and the future required for regret (both experienced and anticipated). As a result, regret based on reconstruction of, rather than episodic memory of, the past must be parasitic or dependent on being able to experience regret as a consequence of episodic memory.

A related line of thought can be found in Bertrand Russell, who seems to be describing what nowadays would be called episodic memory when he says that “[i]t is obvious that we often remember what we have seen or heard or had otherwise present to our senses, and that in such cases we are still immediately aware of what we remember, in spite of the fact that it appears as past and not as present” (Russell, 1912, 26). Russell then goes on to argue that “[t]his immediate knowledge by memory is the source of all our knowledge concerning the past: without it, there

could be no knowledge of the past by inference, since we should never know that there was anything past to be inferred” (1912, 26). In short, his idea is that recognizing that there is a past in the first place, portions of which we can reconstruct from information obtained in the present, presupposes having knowledge of at least some portions of that past that is not thus reconstructed, through (what would now be called) episodic memory. Thus, insofar as regret, too, can sometimes be based on reconstructing the past from present information rather than actually episodically recollecting the past, this, too, is only possible against a backdrop of episodic memory.

One way of understanding Russell’s argument here is in terms of an idea that Annette Baier (1976, 220) expresses by saying that “it is not an unimportant conceptual truth that memory is of times, while knowledge is of facts, and that times cannot be discontinuous, as known facts can be disjoint.” As the context makes clear, the type of memory she has in mind here is, more specifically, episodic memory, which she explicitly contrasts with “the sort of human memory which is just information storage, just a capacity to regurgitate input” (1976, 219). The point she can be seen to be making is that an important dimension of the contrast between the two types of memory (which psychologists would call the contrast between episodic memory and semantic memory) is that, whereas the latter presupposes a separate understanding of whatever information is retained, and cannot explain such an understanding, the former can itself contribute to, or be a manifestation of, understanding—specifically an understanding of time itself as a domain in which the remembered events fall (see also Debus, 2013). It is this type of understanding, which we have also called event-independent thought about time, which also makes it possible for us to reconstructively populate the past with events we cannot actually remember and to think counterfactually about how, even though we did one thing at a certain point in the past, we could have done something else at the time.

Thus, the general claim about the connection between episodic memory and regret that we want to put forward is that, even though regret may sometimes occur in the absence of episodic memory for the particular past action that is its object, episodic memory has a key role to play in grounding the kind of understanding of time involved in regret (and also in anticipating regret). One way of understanding this claim is as a developmental one—that episodic memory is required for the acquisition of the relevant understanding of time. But a stronger, constitutive, reading of it is also possible—that is, that episodic memory abilities are also required to retain such an understanding. Whether it should only be understood in the former sense, or whether it can also be defended on the latter reading, is not our current concern (for a debate on this issue, see Hoerl, 1999, and Craver, 2012). Rather, we can ask whether, apart from the kinds of philosophical considerations mentioned earlier, there is also empirical support for the idea of a connection between episodic memory and regret of the general type we have suggested.<sup>5</sup> As it turns out, there are several recent findings in psychology that at least point in such a direction.

In line with the suggestion that episodic memory and regret are closely linked, recent neuroimaging studies have indicated that episodic memory/future thinking, and thinking counterfactually about a past event seem to depend, at least in part, on the same core network (often referred to as the Default Mode Network; see Schacter et al., 2012, for a review). This line of research has focused on what has recently been termed *episodic counterfactual thinking* (De Brigard, Addis, Ford,

Schacter, & Giovanello, 2013; De Brigard & Giovanello, 2012; De Brigard, Spreng, Mitchell, & Schacter, 2015), that is, counterfactual thinking that involves imagining how a specific episode in one's personal past could have been different, which is the sort of counterfactual thinking that is central to the experience of regret. Recent fMRI studies indicate that there is significant overlap between the brain regions involved when participants are asked to episodically remember an event from their past and when they are asked to engage in the sort of upward episodic counterfactual thinking associated with regret (De Brigard et al., 2013; Van Hoeck et al., 2013; Van Hoeck, Ma, Van Overwalle, & Vandekerckhove, 2010; Van Hoeck, Watson, & Barbey, 2015). This overlap is particularly notable when the counterfactual thinking involves imagining realistic alternatives to what actually happened to oneself (De Brigard et al., 2013) and is largely absent when the counterfactual thinking is impersonal (De Brigard et al., 2015). De Brigard et al. (2015) conclude from these studies that specifically episodic memory is typically heavily involved when thinking counterfactually about events in one's own past. Indeed, De Brigard (2014, 177) has argued that "the very cognitive system by means of which we operate with mental contents about personal events that did happen also allows us to process mental contents about events [that] we think could have plausibly happened in our lives."

Thus, recent neuroscientific evidence strongly supports the idea that there is a close link between episodic memory, counterfactual thinking, and regret, although of course evidence of this type is restricted to establishing correlations and leaves the precise nature of the relevant links between different cognitive abilities undetermined. Interestingly, though, there is also some, albeit limited, empirical evidence suggestive of the more specific claim that episodic memory is necessary for the capacity to experience regret. This emerges from the only attempt we are aware of to examine regret in amnesia. Craver, Kwan, et al. (2014) interviewed K. C., whom they described as "the definitive case of episodic amnesia," about regret. What they showed was that K. C. had a good understanding of what regret was, in that he could give a generalized description of the nature of regret and the sort of things that might cause regret. Strikingly, though, K. C. was completely unable to describe any regrets that he had, and he was even unable to think of any regrets that anyone else (such as his mother) might have (see also Craver, Cova, et al., 2014). This is despite K. C. still possessing information about his past that remained intact in his semantic memory. Assuming that his responses to direct questioning provide reliable enough evidence, the case of K. C. thus suggests that, in the absence of episodic memory, individuals lack the mode of mental simulation that allows them to experience regret or even to imagine another's regrets.<sup>6</sup>

So far, we have primarily considered how experiencing regret may require episodic memory. However, as we pointed out in section 2, regret has an important impact on future-oriented behavior, not just as a result of experiencing it, but as a result of anticipating it. Is it plausible to argue that episodic memory also plays a role in the anticipation of regret? The answer to this question depends on what is meant by "plays a role." If what is meant is "plays a role developmentally," then making such a case is straightforward: if episodic memory is required for experiencing regret, then insofar as anticipating regret depends developmentally on being able to experience it (and the evidence suggests that it does; McCormack & Feeney, 2015), then episodic memory abilities are a developmental necessity for anticipated

regret. Note, however, that in addition to arguing that episodic memory might be developmentally necessary for experiencing regret, at the start of this subsection we also suggested that it is intuitively very plausible that when actually experiencing regret, one typically is engaging in recollection and thus recruiting episodic memory. As we have already pointed out, it is less straightforward to see how episodic memory may play a similar role in the anticipation of regret.

Again, one answer that one might give here is that retrieval of information from episodic memory is not the critical ability that is involved in anticipation of regret (although there may indeed be many occasions on which such memory retrieval informs the future simulation). Rather, it is the mode of thinking about time that is instantiated in episodic memory that is critical in the anticipatory case. As we have described it, the anticipation of regret has not only a forward- but also a backward-looking element: one is imagining oneself looking back on a decision that will be in the past, but is currently in the future. And insofar as this backward-looking element of the simulation can be viewed as typically supplied by the episodic memory system, episodic memory processes can be seen to contribute to the anticipation of regret.

Finally, before leaving the issue of the connection between episodic memory and regret, it is worth considering further the different ways in which episodic memory might make its contribution depending on the nature of the regret. We pointed out in section 2 that regrets about missed opportunities may be particularly salient cases of regret (Beike et al., 2009). These are regrets that one cannot easily come to terms with because the previously presented opportunity no longer exists. What may be distinctive about such regrets is that on considering the missed opportunity, one often *regrets anew* one's choice, a process that re-involves episodic memory, at least in central cases. By contrast, experiencing regret regarding a repeatable choice can straightforwardly impact on decision-making without regretting anew. In the case of repeatable choices, it is plausible that, when faced with the same choice again, the most that memory need deliver is that one once came to regret this choice—information that could perhaps straightforwardly be supplied by semantic memory. It may even be the case that having experienced regret about a choice can affect one's subsequent decision-making without one having to remember that one once regretted that choice. That is, experiencing regret may have led one to think of that type of choice as a poor one, and to avoid it subsequently, even if one no longer has any memory of the experience of regret itself (and, arguably, even if one cannot remember ever even facing such a choice before).

However, this cannot be the means by which regret about lost opportunities can have an impact on future decisions. As described in section 2, the impact of these sorts of regrets must be more indirect. By definition, one cannot be faced with exactly the same type of choice again. In the case of these lingering regrets, it may be that one re-engages in the same sort of mental time travel that resulted in regret in the first place, which we have already argued typically involves episodic recollection. Then the question is how regretting a lost opportunity anew, which recruits episodic memory, may impact on decision-making. It was suggested in section 2 that, when faced with another opportunity-providing choice, one may anticipate regretting another sort of missed opportunity, and this may shape the choice that one makes. By this means, episodic memory can have a further, albeit more indirect, input into anticipated regret.



#### 4. BACK TO THE QUESTION OF FUNCTION

We started this chapter by raising the question of the evolutionary function of episodic memory: Of what adaptive benefit is it to us to be able to remember particular past events as such, given that those particular events will never come again? The way in which we have approached this question is by looking at ways in which episodic memory might have a distinctive role in decision-making. In particular, we have looked at the role of regret in decision-making, and the sophisticated capacities for mental time travel recruited in experiencing regret and anticipating regret. And we have discussed reasons for thinking that the ability to recollect past events in episodic memory underpins these capacities for mental time travel. We want to conclude this chapter by considering how exactly the arguments we have put forward bear on the question of the evolutionary function of episodic memory itself.

It might perhaps be thought that showing how episodic memory underpins certain abilities recruited in particular forms of decision-making is sufficient to demonstrate how it can have an adaptive role. Yet, we have not quite closed the circle, as, in order to complete the answer about the evolutionary function of episodic memory, we also have to show that there are no other, considerably simpler, forms of decision-making processes that could essentially play the same role—in which case it is not clear why these specific ones have evolved—and also that the relevant forms of decision-making are in fact adaptive. These are the issues we want to address in what follows.

One type of decision-making that we have discussed turns on experienced regret. In section 2, we presented evidence that experienced regret has an influence on decision-making by facilitating adaptive switching. In a situation in which a subject has come to regret a particular type of choice they made in the past, this will lead them to avoid making the same choice again when encountering a choice situation of the same type in the future. There is a problem, though, with relying on this sort of case in framing claims about the evolutionary function of regret, and by extension of those of the episodic memory abilities that plausibly underpin the capacity to experience regret.

The problem here is somewhat similar to the problems we raised, in section 1, for attempts to frame claims about the evolutionary function of episodic memory more directly in terms of ways in which it might be involved in decision-making in situations in which the decision-maker has come across a choice situation of the relevant type before. In such choice situations, what is important is that past experience equips the subject with the means to know how to act next time she encounters a situation of the relevant type again. Of course, if the subject comes to regret having made the poor choice in the past, this can be one way for her to possess such knowledge. However, given the rather sophisticated cognitive capacities that we have argued are required to experience regret, and also given the emotional cost that feeling regret carries with it, even in situations in which it aids decision-making, it could be thought that this is a rather cost-intensive way of solving the problem of finding a way to learn from past experience how to make better decisions in the future. Insofar as the function of regret in these sorts of cases is simply to make salient what the right choice is to make next time, it is not obvious that the backward-looking aspect of regret plays an essential role in them, and it is possible to think of other, less cost-intensive ways of solving that problem.<sup>7</sup> It is therefore

difficult to argue that the function for which regret has evolved is primarily to aid decision-making in this type of situation.

This suggests that a better context within which to frame claims about the evolutionary function of regret is in fact that of decision situations in which the subject faces choices of a type she has never made before. As we have argued, regret plays a role in such decision situations, too, because deliberation in such situations turns on minimizing anticipated regret. Yet here, too, it might in fact be thought that there is a particular kind of challenge that arises for the line of thought we have sketched, if it is to provide us a potential insight into functions for which particular cognitive capacities have evolved.<sup>8</sup>

Our suggestion has been that decision-making in the context of major life choices, in particular in cases in which the subject is faced with a choice of a type she has never faced before, often involves reasoning about anticipated regret. That is to say, the subject's deliberations turn on whether, in looking back on her choice, she will come to feel regret when comparing it with the other choice(s) she could have made. Yet, it might be argued that it is hard to see why using such a decision-making procedure should be considered to be adaptive in the context of choice situations of a kind the subject has not encountered before—in particular, ones that involve potential choice options of a kind that the subject has never encountered before. This is because, in such a situation, the subject does not have enough to go on to figure out *which choice she will in fact come to regret* when comparing it with others, precisely because she has not been in the relevant situation before. Thus, if she comes to decide *that* she will regret certain choices more than others, there is an important sense in which that decision is not based on proper evidence, because she is not yet in possession of the relevant evidence that would allow her to make that decision (we will say more about this shortly). As such, there is no reason to think that using the decision procedure will reliably lead her to do what is in fact best for her—and it is therefore difficult to see how it could be adaptive. Indeed, it may be thought that using this decision procedure comes at a considerable cost, especially if the subject ends up pondering endlessly about whether or not she will come to regret her decision. Also, as we mentioned before, regret itself comes at a cost to one's welfare, especially in situations in which the decision that subject feels regret about cannot possibly be reversed; thus, the realization that one might unwittingly make a choice that one will come to regret this way is also likely to impact negatively on one's welfare to some extent.

One central ingredient in the line of thought just sketched has recently been discussed under the heading of *transformative choice*, where the claim has been made that choices of the kind just described, in which the subject faces the question as to whether she should make a decision of a type she has never made before, cannot be made rationally (Paul, 2014, 2015; Ullmann-Margalit, 2006). In particular, the argument has been that, whatever the decision-making processes involved in making such choices, there is an important sense in which these processes are unable to yield a normatively correct answer as to which is actually the better choice for the subject to make, because one or more of the choices open to the subject is potentially *transformative*.

L. A. Paul (2014) distinguishes in particular between two different ways in which choices can be transformative: epistemically transformative choices and personally transformative choices. In short, decisions can be epistemically transformative or personally transformative—and many major life decisions such as the decision to

have a child are arguably typically both—because *experience* can be epistemically transformative and personally transformative.

Experience can be epistemically transformative, because it can provide the subject with a type of knowledge that she could not possess before undergoing the experience—namely, what it is like for her to undergo the experience itself. The only way to acquire this form of knowledge is by actually undergoing the relevant form of experience onself (Jackson, 1982). An epistemically transformative choice, thus, is a choice where what is at stake is whether or not one should undergo an experience of a type one is not yet familiar with.

Experience can also be personally transformative; an individual can change as a person in response to experience, insofar as experience can change what her interests and values are. As a result, choices, too, can be personally transformative insofar as they are choices between options that may change the subject in this way. And the existence of personally transformative experiences also affects decision-making in a broader way. Even if personal transformation is not the object of one's choice—that is, one's decision is not between whether or not one should undergo a (potentially) personally transformative experience—the existence of personally transformative experiences can make it the case that one faces choices about outcomes that one may come to view differently at the time because one's interests and values have changed (Pettigrew, 2015).<sup>9</sup>

A key theme of Paul's discussion of the nature of epistemically and personally transformative choices is that they imply that we are sometimes faced with choices in which at least one alternative, and sometimes each of them, constitutes, in an important respect, a step into the unknown. In both epistemically and personally transformative choice, we lack a crucial piece of information concerning the value we will attach to at least one of the outcomes we have to choose between: in epistemically transformative choice, we have not had the relevant experience before, and may be unable for that reason to determine how much we would value (or disvalue) having it; in personally transformative choice, we may not lack any relevant knowledge about the outcome itself, but we do not yet know how much our choice will affect the extent to which we will value it.

The key distinguishing features of transformative choices, then, are that the subject faces a genuine choice, but also knows that she lacks a crucial piece of knowledge about at least some of the outcomes she has to choose between, insofar as they involve situations of a type she has no experience of as yet, or insofar as her future self might attach different values to them than her present self does. In particular, as Paul argues, there is a distinctively first-personal aspect to the subject's epistemic lack: she lacks a specific type of epistemic basis for judging what value she herself will attach to the relevant outcomes, because she has no prior experience of being in the types of situations they involve or cannot anticipate to what extent her own values may change as a consequence of her decision.<sup>10</sup> As a result, she argues, a standard decision-theoretic model based on maximizing expected value cannot accommodate choices involving transformative experience—it provides no rational means for the subject to make her choice.

The existence of transformative choices, then, may be thought to raise the following problem for our overall argument. If it is right that certain options the subject must choose between in transformative choice situations are steps into the unknown, whose future value to her the subject has no rational way of assessing, it might seem

that *whatever* decision-making processes the subject uses in such choice situations will be unable to reliably (or even probabilistically) lead to an outcome that is in fact better for her, when compared with the other possible outcomes. And this general argument might be thought to apply also to the decision-making process we have sketched, which turns on reasoning about anticipated regret, as much as to any other process the subject might use in transformative choice situations. Thus, no reason for thinking that this type of decision-making process is adaptive has yet been given.<sup>11</sup>

In fact, though, we believe that the issues we have discussed are somewhat orthogonal to those at stake in Paul's argument that, from a certain kind of normative perspective, transformative choices cannot be made rationally. It is important in this context to clarify that our claim is not that the decision-making processes that we have described, which turn on anticipating future regret, can somehow make up for the particular epistemic lack suffered by the subject facing transformative choices that Paul is concerned with. Within the context of the present chapter, one way of describing Paul's (2014) argument is in terms of the idea that the kind of decision-making based on simulation that we described in section 1 of this chapter is unavailable in the case of transformative choices, because the subject faces a choice of the relevant type for the first time. The difficulty, as she sees it, is that we are unable to judge what the subjective value of certain future outcomes may be to us, if they involve unfamiliar, transformative experiences. In section 3, we described a different, rather more sophisticated form of simulation centered on anticipating regret. In doing so, however, we did not mean to suggest that this form of simulation can somehow solve the problem Paul says cannot be solved using the simpler type of simulation when we are dealing with a case of transformative choice. In an important sense, that problem remains. What we are suggesting, in some sense, is that the more sophisticated form of simulation may be seen to help the subject come to a decision despite it.

But this still leaves the question as to how the ability to anticipate regret might be adaptive in the case of transformative choices, despite not being able to remove the epistemic lack that subjects face in those choices, that is, the fact that she cannot as yet know what value she will assign to at least some of the outcomes she has to choose between. We want to end with three brief and admittedly speculative comments on this issue.

First, while the ability to anticipate regret cannot make up for the epistemic lack involved in facing transformative choices, it plausibly plays a key role in one's being able to appreciate and take account of their potentially transformative character in the first place. Transformative choices carry the risk that one may end up with an outcome one is not happy with but which one cannot make undone, and regret about past such outcomes or about lost opportunities can alert one to the possibility of one's choice having such consequences again in the future. Appreciating the irrevocability of certain choices (Hoerl, 1999; Ullmann-Margalit, 2006), and of the effect they may have on oneself, can clearly be beneficial, for instance in the context of the thought that one is not ready to make the decision to have a child, because one's life situation is not yet settled enough to cope with some of the more stressful or negative experiences associated with having a child.

Second, awareness that a choice is potentially transformative, and that one may live to regret it, may also lead one to seek more third-person information about the extent to which others who have made the relevant choice have come to value their

decision. While third-person information may not conclusively allow the subject herself to settle how she herself may feel upon making the relevant type of choice, it may at least increase her confidence as to whether or not that choice will be the right one for her to take as well (Dougherty, Horowitz, & Sliwa, 2015; Pettigrew, 2015). Note further that the decision-making process that we have described, which turns on anticipating regret, might also explain in this context how the subject's decision can be first-personal while being based on such third-person information. (Paul [2014] describes this as the question as to how decisions in the context of transformative choice can be *authentic*.) A concern with future regret, that is, might help explain how a subject can choose a certain future course of action *for herself*, even though doing so constitutes a step into the unknown for her, whose actual effect on her she is unable to predict, and all she has to go on in judging that it will be the right course of action is the testimony others have given her of their own cases.

Finally, a focus on how decision-making in the context of transformative choice is bound up with the ability to anticipate regret might also provide for a way of recognizing a benefit in transformative choice itself. Animals and young children presumably undergo experiences that are epistemically transformative for them, or that transform them as individuals. Yet, it is less plausible to think that this is something they make choices about as such (rather than it occurring as a mere consequence of their other choices). As adults, however, we do sometimes consciously seek out new experiences or personal transformation, even while knowing that doing so constitutes a step into the unknown. Moreover, there seems to be a particular kind of value that we attach to the very idea of having new experiences or doing something for the first time, rather than simply doing things we are already familiar with. As we mentioned earlier, for instance, the kinds of choices people seem to regret most take the form of lost opportunities. And while it is of course right that consciously seeking out new experiences and challenges may not always produce the best result for us (indeed, as we said two paragraphs ago, it carries with it specific risks), the fact that we can and value doing so is arguably part of what explains the vast gulf between the kinds of learning abilities that we find in animals and the distinctive way in which humans are able to take active control of their lives and their own acquisition of knowledge.

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## NOTES

1. We will say more about this understanding of regret as an emotion directed at choices. Also, we will focus specifically on regret, as regret can be seen to play a particularly prominent role in decision-making. However, for other purposes it

might be useful to think of regret as just one example of a broader set of similarly structured emotions with both a backward-looking and a counterfactual ingredient, of which relief is also a member.

2. On similar grounds, Zentall, Clement, Bhatt, and Allen (2001) argue that tasks that require extensive prior training are unsuitable for demonstrating the existence of episodic memory in animals.
3. The alternative possibility is that the correct description of such patients is that they cannot properly imagine the future, and Boyer is wrong in claiming that mental time travel can moderate temporal discounting. Craver, Kwan, Steindam, and Rosenbaum (2014) argue for this interpretation.
4. We will say more about the relevance of this for our overall argument in section 4.
5. What we know about development is clearly consistent with at least the developmental reading of the claim mentioned earlier: children do not seem to be able to experience regret until around 5–6 years (O'Connor, McCormack, & Feeney, 2012; O'Connor et al., 2014; Weisberg & Beck, 2012), and cannot anticipate regret until around 8 years (McCormack & Feeney, 2015). Thus, these abilities emerge at a time when episodic memory abilities are already intact and robust. However, given the sophisticated temporal and counterfactual reasoning abilities involved in regret, it is unsurprising that it is a relatively late developing emotion, which makes it hard to argue for any more specific link with episodic memory on the basis of the developmental evidence.
6. Craver, Cova, et al. (2014) demonstrate that K. C. is susceptible to a particular type of effect in economic decision-making (the Allais paradox) that has been previously explained in terms of anticipated regret (Loomes & Sugden, 1982). One interpretation of this finding is that K. C. can in fact anticipate regret, even though he does not seem to experience it. Such an explanation is broadly compatible with the recent suggestion that the anticipation of regret may involve different brain regions from the experience of regret, and that the former can be intact even in the absence of the latter (Levens et al., 2014). However, Craver, Cova, et al. (2014) instead suggest that regret-based explanations of the paradox must be incorrect.
7. It is of course still true that regret, with its counterfactual element, provides for a *less* cost-intensive way of learning from past experience than even simpler ones, because it makes salient not only that one's choice was a poor one, but which alternative choices might have been better. In the absence of such counterfactual thought, learning may be slower, as it might be necessary to actually try out each of the alternatives one by one. This is one reason that counterfactual thought is often assumed to be particularly beneficial in correcting suboptimal behavior (see Epstude & Roese, 2008, for more detailed discussion of the adaptive benefits of counterfactual thinking).
8. See also Schacter et al. (2015, 20), who, immediately after stating that “[b]oth ‘prefeeling a possible future scenario and reminiscing about foregone past choices could [...] provide motivational incentives that foster more farsighted decisions’ (in contrast to decisions driven by more immediate interests), go on to point out that “this mechanism need not always enhance the probability of making choices that are [in fact] beneficial in the long run.”
9. This latter issue is less prominent in Paul's own discussion of transformative experience, and we will also largely set aside in what follows. There are in fact two different issues that decision-makers face in this situation: first, they may not be able tell to what extent their interests and values will change; but even to the extent



that they are able to do so, they face the question of which set of values they should choose to evaluate the desirability of the outcome.

10. Most of the existing critical responses to Paul's argument, in one way or another, target this element of her argument, and the implication that transformative choices pose problems separate from those involved in decision-making under other forms of uncertainty. The suggestion, in short, is that while testimony from others or observational knowledge of other's behavior who are in the kind of situation envisaged may not provide *conclusive* evidence about what things will be like in one's own case (because of what Paul refers to as the reference class problem), they can provide some evidence—and in this the choice situation is no different in kind from other choice situations in which we have only limited information about the likely outcomes of our actions. We will leave this issue to one side.
11. Note that the argument described in this paragraph is not one Paul herself makes. We are just describing one way in which one might think her argument bears on our position.

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