Empirical support for the adaptive and maladaptive functions of autobiographical memory

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Abstract

Autobiographical memories are hypothesised to serve at least three functions: they direct people's behaviour, inform their identity, and facilitate social bonding. But most of the research on these three functions has focused on how memories serve them in ways that are adaptive—in fact, we know little about how memories might serve functions in ways that are maladaptive. We also know little about the factors that drive memories to serve functions in adaptive or maladaptive ways. Across four sets of experiments, we[1] investigated both the extent to which memories serve maladaptive functions and the factors that drive memories to serve functions in adaptive or maladaptive ways. We found that people's positive memories are primarily adaptive, whereas their negative memories serve a mix of adaptive and maladaptive functions. In addition, we found that the more a memory is associated with a sense of reliving, the more adaptive it tends to be. Finally, we found evidence that it is not necessary for people to have personally experienced an event, nor for them to believe an event really happened, in order for the memory of that event to serve functions. Considered together, these data highlight the need for researchers to take more nuanced view of the functions of autobiographical memory and demonstrate the importance of measures that separate adaptive and maladaptive functions.

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[1] Here, my use of the word "we" reflects that, although the research in this thesis is my own, I conducted it in a lab where I supervised a team comprised of undergraduate and Honours students. I also received advice and direction from my supervisors. For those reasons, I often use the words "our" and "we" in this thesis. Elsewhere in this thesis, I use the word "we" in a different sense; for example, to refer to what is or is not known in the wider scientific community.

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Outline of the thesis

The first chapter of this thesis provides an overview of the literature on the functions served by autobiographical memories, and outlines the rationale for the manuscripts presented in this thesis. Chapters 2 through 5 present the results of our research in the form of four manuscripts published in or submitted to peer-reviewed academic journals. Chapter 2 presents our first manuscript, published in *Memory*. Chapter 3 presents our second manuscript, published in the *Journal of Applied Research in Memory and Cognition*. Chapter 4 presents our third manuscript, submitted February 6, 2021, and under review at *Memory & Cognition.* Chapter 5 presents our fourth and final manuscript, submitted February 10, 2021, and under review at the *Journal of Applied Research in Memory and Cognition*. Finally, Chapter 6 integrates the findings from these four manuscripts and discusses their contributions to the literature.

Chapter 1: Introduction

Memory plays a vital role in people's lives. Without the ability to remember information, people would be wandering around with no idea who they are, what they are supposed to be doing, or where they left their keys (Sherry & Schacter, 1987). But there is more to memory than just a collection of facts about the world. People also remember specific events that happened to them, often accompanied by a vivid sense of reliving (Tulving, 1972). These vivid, specific memories are known in the literature as *autobiographical memories*.

Autobiographical memory

Autobiographical memories have long been of interest to philosophers and psychologists. In fact, the study of these memories can be traced all the way back to Aristotle's *De Memoria* (Ross, 2014). Aristotle noted that people can bring to mind the "sensations" of previous experiences—a clear reference to what we would now call autobiographical memories. Many other philosophers, such as Locke and Hume, also discussed people's memories for personal experiences, and made a distinction between these autobiographical memories and general knowledge (see Herrmann, 1982 for a review).

More recently, discussions of autobiographical memory can be found in the works of early psychologists in the late 19th century. Galton, for instance, described in detail the various characteristics of his own recollections, including the sensory images that accompanied them (Galton, 1883). For example, in commenting on the mental image of his breakfast table, he noted that it was "fairly clear, but not quite so bright as the reality." William James, too, discussed autobiographical memory at length in *The Principles Of Psychology*, suggesting at one point that

"Memory requires more than mere dating of a fact in the past. It must be dated in my past. In other words, I must think that I directly experienced its occurrence" (James, 1890, p. 650). Here, James is outlining one of the key features of autobiographical memories: that people believe the events really happened to them.

Not long after, Colgrove examined a subset of autobiographical memories that would come to be known as "flashbulb" memories (Colegrove, 1899). He asked subjects to describe their memory of Lincoln's assassination, and found that people's accounts tended to be highly vivid and detailed. Like Galton and James, Colgrove pointed out that these memories were often accompanied by both visual images and belief.

Even Freud was interested in autobiographical memory, proposing that painful memories are repressed or pushed into the unconscious where they continue to exert an influence on people's mood and behavior (Freud, 1915). Although the evidence does not support Freud's theories of repression, the central role of these ideas in his psychoanalytic theories highlights the importance of autobiographical memory to the thinkers of the time (Loftus, 1991).

But with the rise of behaviorism in the early 20th century, the study of people's mental experiences—including autobiographical memories—largely fell by the wayside (Brennan, 2014). It was not until the cognitive revolution of the 1950s and 60s brought the study of mental experience back to the forefront of psychological science that research addressing autobiographical memories began to reappear. For instance, in one seminal paper, Tulving (1972) distinguished between factual *semantic* memories and *episodic* memories of specific events that are accompanied by a sense of reliving. In that paper, Tulving argued that we need to

understand (and therefore study) both episodic and semantic memories if we want to fully understand how memory works.

Two years later, Crovitz and Schiffman (1974) published one of the earliest empirical studies of autobiographical memories. In this study, which drew on Galton's work, people were asked to describe autobiographical memories that came to mind in response to various cue words. There was a "recency effect" such that memories of recent events tended to come to mind more frequently than memories of distant events. This landmark study inspired a body of work that has employed similar methods (Franklin & Holding, 1977; Rubin, 1982). For instance, one study used the word-cue method to show that this recency effect can be found across people of various different age groups. A subsequent word-cue study suggested that recency alone cannot fully explain the distribution of people's memories—the results demonstrated that people tend to remember more memories from their late teens and twenties than a recency effect would predict. This phenomenon has come to be known as the reminiscence bump, and is still being investigated today (Rubin & Schulkind, 1997; Tekcan et al., 2017; Wolf & Zimprich, 2020). In the late 1970s and early 1980s, calls to investigate memory as it occurs in "everyday life" helped the study of autobiographical memory gain increasing momentum (Bruce, 1985; Neisser, 1978). And from the considerable work that has been done in the decades that followed, we now know much about the characteristics of people's autobiographical memories.

Characteristics of autobiographical memories

As Aristotle noted more than 2000 years ago, one of the key characteristics of autobiographical memories is that they are often accompanied by a sense of reliving—the sights, sounds, emotions, and other sensations from the event come to mind, and the event is "replayed" in the

mind's eye almost as though one is "mentally time traveling" back to it (Suddendorf & Corballis, 1997; Tulving, 1972, 1983). This mental time travel sometimes takes a first-person perspective, as though people are re-watching what happened through their own eyes. Other times, people relive the event from a third-person perspective, as though they were an observer watching from a nearby vantage point (Nigro & Neisser, 1983; Robinson & Swanson, 1993; Talarico & Rubin, 2003). Regardless of the perspective, engaging in this mental time travel requires people to bring to mind the various elements that make up the memory, reconstruct both the spatial layout of the scene and the temporal order in which events played out, and place themselves in it (Rubin et al., 2019). This process of reconstruction is possible because the various elements of an event are associated together during encoding, with the hippocampus playing a key role (Nadel & Moscovitch, 1997; Rubin & Umanath, 2015).

Another key characteristic of autobiographical memories is that people believe the events really happened to them (Brewer, 1986; Pillemer, 1998). In fact, people tend to be confident in the accuracy of their autobiographical memories, and are unwilling to take effortful steps to verify their veracity (Nash et al., 2017; Wade et al., 2014). This confidence is not always justified, though. The reconstructive nature of autobiographical memories means they are malleable—inaccurate information can sometimes be incorporated into them (Loftus & Palmer, 1974). To understand why, we need to consider how people distinguish between reality and fiction.

According to the Source Monitoring Framework, information in memory does not tend to be "tagged" with where that information came from (Johnson et al., 1993). For this reason, when people bring to mind mental images of an event, they make judgments in the moment about

where these images came from—a process known as source monitoring. For instance, people sometimes need to decide whether an event really happened or was rather something they dreamed about or imagined (Johnson et al., 1988). Other times, people need to decide which external source a piece of information came from ("did I read that the earth is flat in the *New York Times* or in *The Onion*?") or when they encountered that information ("did I read about that last night, or a year ago?").

In many cases, people make these source judgments in a relatively rapid, effortless way (Mitchell & Johnson, 2000). To do so, they tend to rely on the phenomenological characteristics of the memory itself. For instance, there is evidence that people use a heuristic that if a "memory" is vivid, it is likely to be real (Johnson et al., 1993). Indeed, real memories tend to be more vivid and detailed than "memories" of imagined or dreamed events (Johnson et al., 1993). But this rapid, heuristic approach to source monitoring can sometimes lead to errors. If, for example, the "memory" of an imagined event is highly vivid and detailed—perhaps because it was imagined repeatedly—people can mistake it for something that really happened (Garry et al., 1996). But in situations in which people are highly motivated to accurately recall the past, such as when witnesses to a crime testify about what they saw, people can attempt to take a more systematic approach to source monitoring to avoid these heuristic errors. This systematic approach relies less on the phenomenological characteristics of the memory and more on reasoning, logic, and supporting memories (Johnson et al., 1988). For example, someone might decide his vivid "memory" of seeing Santa fly through the snow one Christmas is not real because he knows Santa does not exist or because a supporting memory of his family having an outdoor barbecue that Christmas suggests it could not have been snowing. Of course, if an

imagined event is highly plausible, there is still no guarantee this systematic approach will lead people to correctly judge the "memory" as being an imagined event (Hyman & Loftus, 1998).

Because people sometimes make these source monitoring errors, inaccurate details can be incorporated into their memories (Bartlett, 1932; Loftus & Palmer, 1974). Even memories of momentous events such as the 9/11 attacks can be wildly inaccurate, despite people being very confident in the accuracy of these memories (Neisser & Harsch, 1992; Talarico & Rubin, 2003). And in extreme cases, people can come to believe in entire events that never happened (Wade et al., 2002). For example, experimenters have led subjects to develop false memories for a wide range of events, from spilling punch on the bride's mother at a wedding to being attacked by a dog as a child (Hyman et al., 1995; Porter et al., 1999). In the real world, too, there are many examples of these false memories, including false memories of events that would have been traumatic (Loftus, 1993). For instance, during sessions with a church counselor, a woman named Beth Rutherford came to believe her father had raped and impregnated her on at least two occasions, and that he had forced her to abort the fetuses with coat hangers (Loftus, 1997). But subsequent medical examinations showed that these memories were false—Rutherford was still a virgin and had never been pregnant. During the counseling sessions, the counselor had suggested to Rutherford that it was likely she had been abused as a child and that any images and dreams she might experience relating to sexual abuse must be real memories—suggestive techniques that ultimately led Rutherford to make tragic source monitoring errors. Together, this evidence highlights the fragile nature of autobiographical memories and shows that people's belief in their memories is not always justified.

We also know that autobiographical memories are ever present in people's thoughts and conversations. For instance, diary studies that ask people to note each time an autobiographical memory comes to mind suggest that people think about these memories dozens of times each day (Rasmussen et al., 2015; Rasmussen & Berntsen, 2011). In many of these instances, the recall is voluntary—that is, people intentionally search for a memory and bring it to mind, perhaps because they think it might help them achieve their current goals (Conway, 2005). For example, a man looking for his keys might bring to mind the memory of arriving home the night before in the hope he might remember where he left them. But autobiographical memories also frequently come to mind in an involuntary way, brought to mind without intention by cues in the environment (Berntsen, 1998). For instance, smells act as powerful memory cues that can evoke memories from early life (Willander & Larsson, 2006).

Of course, people do more than just think about their autobiographical memories—they also talk about them with others (Miller, 1994). In fact, in one study, as many as 75% of conversations included discussions of at least one autobiographical memory (Beike et al., 2016). Moreover, on any given day, people talk to others about more than half of the memorable events they experienced that day (Pasupathi et al., 2009). Surely, if people think and talk about their autobiographical memories so often, these memories must play an important role in people's lives.

Indeed, the evidence fits with this idea. Impairments in people's ability to recall specific autobiographical memories are associated with a host of problems. For example, patients with brain damage that has impaired their ability to recall specific memories tend to have considerable difficulty planning for the future and functioning on a day-to-day basis (Schacter et al., 2007;

Talland, 1965; Tulving, 1985). Furthermore, there is evidence that even mild impairments in people's ability to recall specific episodes can contribute to the development of depression (Williams et al., 1996). Taken together, the evidence suggests that autobiographical memories play an important role in people's lives.

Functions of autobiographical memories

Why, though, are autobiographical memories so important? In other words, what functions do they serve? This important question was posed by Baddeley (1988) in his classic paper, "But what the hell is it for?". In that paper, Baddeley suggested that a full understanding human memory must consider the functions that memory evolved to serve. After all, humans—and their memory systems—are a product of evolution (Darwin, 1859; Neisser, 1978). Through the process of natural selection, "adaptive" traits that improve an individual's chances of surviving to reproduce tend to become more common over time. Why? Because individuals who possess the adaptive trait will reproduce more than individuals who do not. Therefore, as long as the trait is passed down genetically from parent to child, the proportion of individuals in the population possessing the adaptive trait will increase over time. It is logical to conclude, then, that for our memory systems to have evolved as they have, they probably provided some adaptive benefits (Dawkins, 1976; Klein et al., 2010). For these reasons, Baddeley proposed that scientists should take a "functional approach" to the study of memory—that is, they should investigate the functions that people's memories serve, rather than focusing solely on how accurate memories are under different circumstances. Such an approach would help generate new questions that scientists might not otherwise think to ask, and ultimately further our understanding of how memory affects people's behavior in everyday life. (Bruce, 1989; Neisser,

1978). In the decades that have followed Baddeley's directive, a growing body of work has applied these ideas to the study of autobiographical memories, investigating the functional significance of being able to vividly remember specific episodes from the past.

Overview of the Three Function Model.

Although it is impossible to say with any certainty what evolutionary functions autobiographical memories serve, the most widely accepted model posits that autobiographical memories serve three main kinds of functions: they direct people's behaviour (the *directive* function), help people form and maintain a sense of self (the *self* function), and promote social bonding and communication (the *social* function; Pillemer, 1992; Bluck, 2003). Of course, this model is not universally accepted. There is evidence that autobiographical memories might serve other important functions, too, such as helping people regulate their emotions (Pasupathi, 2001). In addition, the relative importance of the three functions is disputed; some evidence suggests the directive function is the primary function of memory (Schacter et al., 2017), while other evidence suggests social functions are the most important (Mahr & Csibra, 2018; Neisser, 1978).

Alternative models of functions have also been proposed. For example, one model suggests that instead of measuring the extent to which a memory serves each of the three categories of functions, we should instead measure where the functions of that memory sit along two independent dimensions (Webster, 2003). The first dimension of this model pits self-related usage against social usage—a memory at the "self" end of this dimension would be important for people's sense of self, whereas a memory at the "social" end would be important for social connections. The second dimension pits "growth-focused" memories against "loss focused memories—memories at the "growth focused" end would be used to achieve one's goals and

improve one's circumstances, while memories at the "loss focused" end would be used to cope with losses and failures. For the purposes of this thesis, I will adopt the three-function model because it has the broadest empirical support and a strong theoretical foundation (Bluck & Alea, 2011; Waters, 2014). In this thesis, I aim to advance our understanding of directive, self, and social functions in two main ways: first, by investigating the extent to which these functions can have maladaptive outcomes; and second, by examining the factors that drive autobiographical memories to serve functions in adaptive or maladaptive ways.

Directive Functions

To suggest that autobiographical memories serve a directive function is to suggest they guide people's thinking and behaviour. It is hardly surprising that the ability to remember information is crucial for people's capacity to make decisions and respond to their environment (Damasio, 1995). But there are at least three reasons why the ability to remember specific autobiographical memories might have advantages over and above simply remembering general facts about the world.

First, specific autobiographical memories allow people to draw on information that is unique to a particular occurrence of an event (Pillemer, 1998). Take, for example, people who are trying to remember where they parked their car on a given morning. Of course, these people could simply rely on their general knowledge about where they typically park. But if, on this particular day, their usual carpark was full and they were forced to park in a different location to normal, that general knowledge would be of little use. In such a scenario, being able to recall the specific memory of parking the car that morning could save these people a great deal of time and effort. For this reason, it has been suggested that autobiographical memories are particularly

useful for remembering events that deviate from scripts or schemas that people hold (Schank, 1990).

Second, the sensory, temporal, and spatial details that accompany autobiographical memories are, in and of themselves, useful pieces of information that people can draw on to guide their actions (Pillemer, 1992; Schacter & Madore, 2016; Williams et al., 2007). For instance, for someone who witnessed a crime to provide a full account of how the crime played out or a description of the perpetrator's appearance, it is important for that witness to be able to mentally time travel back to the event and picture the scene (Allwood, 2010; Schwartz, 2005). Moreover, these episodic details can serve as memory cues that help people bring to mind relevant memories when they are needed. Even in isolation, visual images and smells are powerful memory cues that can evoke even decades-old memories (Paivio, 1990; Willander & Larsson, 2006). Furthermore, in autobiographical memories, the various episodic elements that are encoded are bound together in memory. As a result, when a similar situation arises in the future, people can quickly bring to mind memories matching that specific combination of cues, often without requiring a deliberate memory search (Berntsen, 1998). This fast access to relevant memories makes it possible to draw on past experiences to determine the best response to the current situation. (Conway et al., 1992; Conway & Pleydell-Pearce, 2000; Schank, 1990; Tulving, 1985).

Finally, episodic details provide people a way of distinguishing between memories for real experiences and mental images of events that did not really happen (Rubin et al., 2019; Tulving, 1985; Johnson et al., 1993). Because people sometimes bring to mind thoughts and images of events that did not occur—such as imagined future events or the contents of a dream—

they need to "reality monitor" by making a judgment about whether those events really happened. Errors in reality monitoring can have severe consequences, as demonstrated by the tragic case of Beth Rutherford coming to believe she was raped by her father (Loftus, 1997). As I have discussed, one way people make these reality monitoring judgments is to consider the phenomenology of the memory. Memories of real events tend to be more detailed and vivid than "memories" of imagined or dreamed events, so people use these characteristics to distinguish between what is real and what is not (Johnson et al., 1988, 1993). But even "memories" of events that never happened can be vivid, which can lead to reality monitoring errors. Nonetheless, without the episodic information that accompanies autobiographical memories, it would probably be even more difficult for people to distinguish between reality and fiction (Brewer, 1988; Tulving, 1985).

For all these reasons, we might expect autobiographical memories to contribute to people's ability to make decisions and solve problems, especially when those memories are accompanied by episodic recollection. Consistent with this idea, people often report drawing on specific memories when faced with problems or decisions (Bluck et al., 2005; Pillemer, 1998; Rasmussen & Berntsen, 2009). College students, for example, often report bringing to mind a specific learning experience to help them answer exam questions (Conway et al., 1997). Similarly, when solving hypothetical social problems, people who reported they brought to mind specific memories tended to have more success at solving the problems than people who did not (Goddard, Dritschel, & Burton, 1996). Even in sporting contexts, athletes report using specific memories of past failures to provide motivation (Pillemer, 1998). There is also some limited experimental evidence to suggest autobiographical memories guide people's behavior—one experiment found that recalling a positive memory about a college leads people to be more likely

to recommend that college and to donate to the college instead of an alternative charity (Kuwabara & Pillemer, 2010). Together, these studies provide evidence that autobiographical memories can serve directive functions in a variety of ways.

But autobiographical memories do more than just help people deal with immediate challenges—they also help people plan for the future. It is hardly surprising that future planning an important ability (Klein et al., 2010; Troub, 1982). Long-term endeavors, such as pursuing a degree or building a house, depend on people's ability to consider what the outcomes of those endeavors might be in the future. Even day-to-day activities, such as packing a lunch before leaving for work, demonstrate the value of planning for the future. To engage in future planning, people often mentally travel forward in time to imagine possible futures (Tulving, 1985). Doing so allows people to consider how different scenarios might play out, and ultimately helps them decide on the best course of action (Sanson et al., 2018; Schacter, 2012; Suddendorf & Corballis, 1997, 2007).

There is considerable evidence that this process of imagining possible futures relies, at least in part, on autobiographical memory. The general idea is that people draw on and recombine elements from their past experiences in order to imagine the future (Schacter et al., 2007; Suddendorf & Corballis, 1997). For example, to decide on whether a holiday would be worth the cost, people might imagine what that holiday would be like. They might first imagine themselves on a sunny beach by bringing to mind the image of a beach from a past holiday, then place their friends or family in the scene by drawing on memories of how those people look and act. Of course, this recombination process does not necessarily happen in such an intentional, stepwise way. Nonetheless, the evidence is consistent with the idea that people draw on elements

from their memories when constructing future scenarios. For instance, studies of brain damaged patients demonstrate that people who have impairments in their ability to bring to mind episodic memories also tend to have difficulty imagining and planning for the future (Klein et al., 2002). In addition, neuroimaging studies have found that remembering past and imagining the future produce similar patterns of brain activation, which fits with the idea that the two abilities involve similar processes (Addis et al., 2007). Finally, future thoughts tend to have similar phenomenological characteristics to autobiographical memories—both can be vivid, emotional, and accompanied by a sense of being transported in time. Taken together, these data fit with the idea that autobiographical memories provide building blocks that allow people to simulate and plan for the future.

Self Functions

The second proposed function of autobiographical memory is to develop and maintain people's sense of self. This sense of self—made up of people's priorities, desires, values, and beliefs about themselves—can have a profound influence over people's decision making and behaviour (Conway & Pleydell-Pearce, 2000). Take, for example, the future planning we have already discussed. For people to engage in useful simulations of the future, they first need to decide what to simulate. Ultimately, they will also need to decide what actions to take in order to realize (or avoid) those simulated futures. Both of these decisions will, of course, depend on people's desires and goals—in other words, their sense of self (Conway, 2005). After all, someone who aspires to be a world champion swimmer will surely simulate different futures to someone who is aiming to complete a PhD. Likewise, the two will probably make different

decisions about how to spend their time. In this way, people's sense of self can affect their thinking and behavior.

People's sense of self has long been theorized to depend on their autobiographical memories. In the late 1800s, for example, William James suggested that people's "personal memories" are a crucial part of what makes them who they are—an idea that has been echoed ever since (Baddeley, 1988; Conway & Pleydell-Pearce, 2000; James, 1890). But how might autobiographical memories contribute to people's sense of self? The answer to this question is complex, because recent views of the self suggest that it is not one unitary construct, but a series of interrelated constructs (Klein, 2010; Neisser, 1988; Prebble et al., 2013). In particular, autobiographical memories are theorised to be important for two key aspects of the self: people's self-concept and their sense of self-continuity.

First, let us consider the self-concept, which consists of people's beliefs about their own traits and personality characteristics. For example, one person might believe she is hard-working and organized, while another might believe she is lazy and disorganised. Intuitively, it makes sense that these beliefs about the self would be informed by autobiographical memories. For example, the memory of working long hours to finish a project on time might lead someone to believe that she is hard-working. Indeed, people report that one of the reasons they bring to mind autobiographical memories is to maintain or alter their beliefs about themselves (Bluck et al., 2005; Rasmussen & Berntsen, 2009). Moreover, people's goals and worries about the future are often associated with important, vivid memories known as "self-defining memories" (Singer et al., 2013). Further evidence for the importance of autobiographical memories in the self-concept comes from developmental studies, which suggest that children's ability to reminisce plays an

important role in the development of their self-concept (Fivush & Reese, 1992). Similarly, older adults with Alzheimer's disease—a condition that impairs people's ability to recall autobiographical memories—tend to be less able than healthy older adults to come up with descriptions of their own personality (Addis & Tippett, 2004). It is important to note, however, that people's self-concept might not rely *entirely* on autobiographical memories. In fact, brain-damaged patients with profound impairments in their ability to recall autobiographical memories are sometimes able to both retain and update their self-concept (Klein, 2010). But considered as a whole, the evidence suggests that autobiographical memory contributes to people's self-concept.

Next, let us consider self-continuity. Self-continuity is the sense of being fundamentally the same person over time, such that people tend feel a connection to their past self and also to their imagined future selves (Sani, 2008; Troll & Skaff, 1997). That people have self-continuity does not mean they view themselves as unchanging over time—on the contrary, people tend to think they are constantly improving (Wilson & Ross, 2001). Still, this sense of connection to past and future selves is an important part of what leads people to feel a sense of responsibility for their past actions (Prebble et al., 2013; Sani, 2008). Connection to past and future selves might also contribute to people's motivation to act in ways that provide long-term benefits. After all, if people did not feel a connection to their future self, why would they ever forgo immediate gratification in pursuit of long-term goals? This important sense of self-continuity is thought to be associated with autobiographical memory in at least two ways. First, autobiographical memory allows people to mentally time travel back to their past experiences. It has been suggested that the sense of being transported back to an event and watching it play out leads people to feel like their present self is connected to that event (Tulving, 1985; Wheeler et al.,

1997). Second, autobiographical memories provide the building blocks that people use to create a narrative of their life story, which in turn serves as an explicit link between the present self and past experiences (Addis & Tippett, 2008; McAdams, 2001). Consistent with these ideas, people report that they bring to mind autobiographical memories when they are thinking about how they have changed over time (Bluck et al., 2005).

Taken as a whole, the literature suggests that autobiographical memories contribute to people's sense of self. But this relationship also goes in the other direction—that is, people's sense of self affects what people remember about their past (Ross & Wilson, 2003). For instance, people's current goals can cue specific memories that are relevant to or congruent with those goals (Conway & Pleydell-Pearce, 2000). Moreover, people's sense of self can affect the way in which people remember and interpret specific memories. We have long known that memories, even vivid episodic ones, are not simply objective records of the past (Bartlett, 1932). Instead, memories are shaped by people's beliefs, schemas, and biases (Barclay & Wellman, 1986; Bartlett, 1932; Loftus & Palmer, 1974). As just one example, people's memories tend to become distorted over time in ways that are thought to help people maintain a positive sense of self (D'Argembeau & Van der Linden, 2008; Greenwald, 1980; Ross & Wilson, 2003). This evidence further demonstrates the tight connection between people's sense of self and their autobiographical memories.

Social Functions

Up to this point, I have discussed how autobiographical memories can guide people's own decisions and behaviour. But people's chances of survival and success don't just depend on their own decisions. After all, humans are social creatures, and cooperation with others affords huge

survival benefits Aronson (1999). For example, working together in social groups likely provided early humans with safety in numbers, allowed them to work together to take down large prey, and meant that knowledge could be transferred from one generation to the next. Cooperation has also allowed for successful division of labor and specialization, which have been vital to the success of modern society (Boyd & Richerson, 2009). Even today, people go to great lengths to seek out attachment with others, and being ostracized from others can cause intense distress and anxiety (Baumeister & Leary, 1995; Williams, 2007).

To form and maintain these important social bonds, people need others to like and trust them. Autobiographical memories contribute to this goal by strengthening social bonds between people. For example, studies that examine conversations between dyads have found that when one person shares an autobiographical memory with another, both people tend to feel closer to one another other. (Beike et al., 2016; Laurenceau et al., 1998; Pasupathi, 2003). Moreover, when people are asked about the situations in which they have shared autobiographical memories with others, they frequently report doing so to form and or strengthen relationships with others (Bluck & Alea, 2011; Hyman & Faries, 1992; Rasmussen & Berntsen, 2009). One reason autobiographical memories might contribute to the formation of relationships is that these memories convey information about who we are as a person. Therefore, by strategically sharing particular memories with others, people can highlight shared interests and values, or simply present a positive image of themselves (Hyman & Faries, 1992; Marsh & Tversky, 2004). In the case of already formed relationships, talking about memories of shared experiences can elicit feelings of closeness or intimacy towards the conversation partner (Alea & Bluck, 2003). Unsurprisingly, people talk about their positive memories more than negative memories (McLean & Lilgendahl, 2008). Yet people do also talk about negative memories, which might be

beneficial in some situations—for instance, there is evidence that sharing negative memories can elicit empathy from others (Bluck et al., 2013; Rimé et al., 1992). There is even evidence that just thinking about a memory involving another person can lead the rememberer to feel closer to that person (Alea & Bluck, 2007). In all these ways, autobiographical memories might help strengthen relationships.

Another important aspect of social relationships is effective communication (McCann & Higgins, 1992). Here, too, autobiographical memories can be beneficial by helping people convey information to others in an engaging, persuasive way. There is evidence that sharing autobiographical memories tends to capture listeners' attention and interest more than sharing general facts, perhaps because the rich episodic details in these memories make it easier for listeners to picture and connect with the story being told (Pillemer, 1998; Schank, 1990). These episodic details can also make the information being shared seem more credible than it otherwise would, potentially convincing others to trust and act on it (Bell & Loftus, 1989; Bruce, 1989; Mahr & Csibra, 2018). Perhaps for all these reasons, people often share autobiographical memories in an attempt to justify or explain their behavior (Mahr & Csibra, 2018; Pasupathi et al., 2002). Together, the evidence fits with the idea that autobiographical memories can facilitate communication, which would benefit both those sharing the memories and those listening to them (Pillemer, 1992).

Overview of the thesis

Manuscripts 1 and 2

Taken together, the literature suggests that autobiographical memories direct people's behaviour, give people a sense of self, and help people form and maintain social bonds (e.g. Bluck et al., 2005; Rasmussen & Berntsen, 2009). But there is one major problem with this work: it has largely assumed these functions produce adaptive outcomes. Indeed, for autobiographical memory to have evolved in the way it has, it makes sense that these memories would be adaptive in the long run. But it is not necessarily the case that when some function evolves, it produces adaptive outcomes across the board (Darwin, 1859). For example, certain polymorphisms make some groups from Africa resistant to malaria—an adaptive function, to be sure (Haldane, 1990). Yet these same polymorphisms dispose this group to sickle cell anemia—a potentially fatal condition. Likewise, consider the dodo bird. With no natural predators, it was adaptive for the dodo to become flightless to build up fat reserves that could help it survive the food-scarce dry season (Fuller, 2002). But when Dutch sailors arrived, that same trait meant the dodo was unable to escape the sailors, ultimately leading to the extinction of the species. Clearly, then, traits that evolved to serve an adaptive function can ultimately be maladaptive in some situations.

This fact has long been recognized in the autobiographical memory literature. For example, Bruce (1985, p. 85) suggested traits that evolved to serve an adaptive function "may even presently be maladaptive, perhaps reflecting a constraint in the organism's design." More recently, models of the social function have acknowledged that the extent to which sharing a memory is adaptive depends on a variety of factors, including the relationship between the sharer

and the receiver, and the characteristics of the memory being shared (Alea & Bluck, 2003). For example, if a Republican were to share with a Democrat the memory of a time they attended a Trump rally, the sharing of that memory might harm the relationship, rather than help it. Likewise, it is easy to think of situations in which memories might serve self or directive functions in ways that are maladaptive. Consider someone who experienced a catastrophic failure as he pursued his career goals. If he decides, based on this memory, to give up on his career or ruminate excessively about the failure, this memory would be serving directive functions in ways that could be considered maladaptive (Harris et al., 2014; Nolen-Hoeksema, 2000). Furthermore, if this person developed a negative sense of self as a result of incorporating this memory into his sense of self, we might consider the memory as serving a maladaptive self function. Indeed, there is evidence that incorporating traumatic events into one's sense of self is associated with posttraumatic stress disorder (Berntsen & Rubin, 2006). It seems reasonable, then, to expect that autobiographical memories might sometimes serve functions in ways that are maladaptive.

If we want to understand the role people's autobiographical memories play in their lives, it is important that we understand these maladaptive functions. In fact, a landmark paper published more than a decade ago argued that "a later development in any program of research on function would be the identification of adaptive and maladaptive ways in which memory is employed in everyday life" (Bluck et al., 2005, p. 92). More recently, the field was urged to take a broader view of autobiographical memory functions, including the idea that functions can be thought of as "reasons for remembering" that could be adaptive or maladaptive (del Palacio-Gonzalez et al., 2018; Harris et al., 2014). Surprisingly, though, little empirical work has investigated the extent to which memories serve functions in maladaptive ways.

Instead, the literature tends to rely on measures that focus primarily on the ways people's memories are adaptive, or that conflate adaptive and maladaptive outcomes. Take, for example, the Thinking About Life Events questionnaire (TALE)—the most commonly used measure of functions in the literature (Bluck & Alea, 2011). The TALE asks people how often they think back over or talk about their life for various reasons, including "when I want to develop a closer relationship with someone." and "when I need to make a life choice and I am uncertain which path to take." Endorsement of these items is taken as evidence that people's memories are adaptive. Yet these items do not necessarily suggest adaptive outcomes. After all, people might *want* to develop closer relationships with others, but could end up sharing a memory in a way that hurts their relationships. Likewise, when people bring to mind a memory to help them choose which path to take, there is no guarantee the memory will lead them to make the best decision. As another example, consider a study that measured the self function of specific memories by asking people to rate the degree to which "this memory tells me something about my identity" (Rasmussen & Berntsen, 2009). This item cannot, of course, tell us whether people's memories are shaping their identity in ways that are adaptive or maladaptive. This problem is not confined to these two measures, but cuts across the literature as a whole (see, for example, Kulkofsky & Koh, 2009; McLean & Lilgendahl, 2008; Pillemer et al., 2015). To what extent, then, do memories serve maladaptive functions? That is the question that the first two manuscripts of this thesis addresses.

In our first manuscript, published in *Memory*, we adapted function items from the literature to capture both adaptive and maladaptive functions. Then, we measured the extent to which people's positive and negative memories serve these adaptive and maladaptive functions. In addition, to address the possibility that adaptive functions are the reason why people value

their autobiographical memories, we examined the relationship between these functions and how much people wanted to hold onto the memories.

In our second manuscript, published in the *Journal of Applied Research in Memory and Cognition*, we focused specifically on the social function. Research on this function has told us much about when and why people share their memories (Alea & Bluck, 2003; Hyman & Faries, 1992). But models of the social function make clear that the extent to which sharing a memory is adaptive depends on how those listening to the memory respond (Alea & Bluck, 2003). It is therefore important that we understand the factors that affect how people appraise and respond to the memories shared with them by others. In this manuscript, we investigated how people's own appraisals of how an event has affected them might influence other people's appraisals of those experiences, and in turn, the extent to which that memory might serve social functions in ways that are adaptive or maladaptive.

Manuscript 3

Taken together, the results from the first two manuscripts support the hypothesis that memories can serve both adaptive and maladaptive functions. But under what conditions are memories most likely to be adaptive or maladaptive? To answer this question, we need to understand the factors that drive memories to serve adaptive and maladaptive functions. Theoretical accounts suggest that the episodic characteristics that accompany autobiographical memories help these memories serve adaptive functions by providing useful information and acting as memory cues (Tulving, 1985). There is also some empirical evidence to support these ideas (Sheldon et al., 2011). But less is known about how other characteristics of autobiographical memories relate to the functions those memories serve. For instance, one

defining feature of autobiographical memories is that people believe the events really happened to them (Pillemer, 1998). To what extent is this belief in a memory important for that memory to serve functions? The third manuscript of this thesis addresses this question.

The relationship between belief and the functions of memories is important to investigate to help us understand the factors that drive memories to serve functions. An understanding of this relationship will also help us understand what might happen when people stop believing in an autobiographical memory. Sometimes, people realize one of their memories is false, and retract their belief in the memory—as Beth Rutherford did after the medical examinations proved her memories of being raped by her father could not be real. In Rutherford's case, the retraction came about because there was evidence that contradicted the memory. In other cases, people might retract their belief in a memory because it conflicts with logic or reason, or because a family member told them the event never happened (Scoboria et al., 2015). When people retract their belief in a false memory, though, the memory itself does not simply disappear. On the contrary, people often retain a vivid "memory" for the event, even though they know the memory is false (Mazzoni et al., 2010). These "retracted memories" are common—one in five people report they have at least one such memory (Mazzoni et al., 2010). But the extent to which these retracted memories serve functions—helpful and harmful—remains unclear. To the extent that belief is important for memories to serve functions, we should expect that retracted memories tend to serve functions less than memories people still believe. But if memory functions are primarily driven by other factors, such as a vivid sense of reliving, retracted memories should continue to serve functions, much like memories that people do believe. In our third manuscript, under review at *Memory & Cognition*, we address these competing hypotheses

by asking people to rate the functions of their retracted memories, and comparing these functions to the functions of memories they still believe.

Manuscript 4

Another defining feature of autobiographical memories is that they are of specific, personally experienced, events. But how important is it that an event was personally experienced for the memory of that event to serve directive, self, and social functions? After all, people can also hold specific memories of events that they did not experience themselves. For example, people sometimes have "vicarious memories" for events they learned about from other people (Larsen & Plunkett, 1987). Basketball player Bill Russell, for instance, reported that his grandfather had once recounted to him the memory of standing up to members of the Klu Klux Klan. According to Russell, this vicarious memory stayed with him his whole life (Pillemer et al., 2015). People also tend to have specific memories of important events from their country's history—known as collective memories (Hirst et al., 2018; Wertsch & Roediger, 2008). For instance, when asked for the events that shaped their country's identity, almost 70% of Americans mention the American Civil War. To what extent might these vicarious and collective memories serve functions even though people did not personally experience the events?

In the case of vicarious memories, there are some data to answer this question: people tend to report that their vicarious memories serve directive, self, and social functions—although slightly less often than their own autobiographical memories (Pillemer et al., 2015). Bill Russell, for instance, suggested that his grandfather's memory taught him an important lesson about not being intimidated by others. But the extent to which collective memories serve functions remains unclear. There have been suggestions in the literature that collective memories might serve

functions for the collective as a whole that are similar to the functions of autobiographical memories—for example, by forging the identity of the group or guiding its decisions (Hirst & Manier, 2008). But there is little empirical evidence to support these suggestions. Therefore, in our fourth manuscript, under review at *Journal for Applied Research in Memory and Cognition* we asked people to report the functions served by their collective memories, and compared these functions to the functions of autobiographical memories. The findings further our understanding of the extent to which memories of events that were not personally experienced can serve functions.

Chapter 2: Negative memories serve functions in both adaptive and maladaptive ways

Manuscript published in *Memory*:

Burnell, R., Rasmussen, A. S., & Garry, M. (2020). Negative memories serve functions in both adaptive and maladaptive ways, *Memory*, *28*, 494-505, https://doi.org/10.1080/09658211.2020.1737133

Abstract

Autobiographical memories are said to serve at least three functions: they direct people's behaviour, inform their identity, and facilitate social bonding and communication. But much of the research on these three functions has not distinguished between memories that serve functions in adaptive ways from those that serve functions in maladaptive ways. Across two experiments, we asked subjects to provide either positive or negative memories. Then, to operationalize adaptive and maladaptive functions, we asked subjects to rate the extent to which those memories serve directive, self, and social functions in ways that "help" and in ways that "hurt." To investigate whether people believe the adaptive benefits of their memories outweigh any maladaptive effects, we also asked subjects how willing they would be to erase the memories if given the opportunity. We found that negative memories served functions in both helpful and hurtful ways, whereas positive memories were primarily helpful. Furthermore, the more helpful a memory was, the more reluctant subjects were to erase it. Conversely, the more hurtful a memory was, the more willing subjects were to erase it. These results suggest it is important to distinguish between adaptive and maladaptive functions when investigating the functions of autobiographical memory.

Keywords: autobiographical memory; function; maladaptive; negative memory; posttraumatic growth

Athlete-turned-actor Dwayne “The Rock” Johnson often tells the story of his “Seven bucks moment.” All his life, Johnson dreamed of playing professional football. After an injury kept him out of the US National Football League, Johnson joined the practice squad of the Canadian Football League’s Stampeders (Johnson, 2016). But not long afterwards, the Stampeders cut him from the team. In that moment, Johnson saw a lifetime of dreams vanish: “I left home when I was 18 and promised my family I’d make something of myself. Now 5yrs later at 23, I’m moving right back in with my parents, a failed football player with just 7 bucks in my pocket. Dream over” (Johnson, 2018). Johnson fell into depression, sitting at home on his couch with no idea what to do with his life. It was The Rock’s “rock bottom.” Given how painful this experience was, we might expect The Rock would jump at the chance to rid himself of this negative memory.

As it turns out, though, he would not. On the contrary, he is so fond of the memory that he even named his production company “7 Bucks Productions.” But why? One possibility is that memories—even negative ones—serve adaptive functions. Evidence from the autobiographical memory literature shows that people’s memories serve at least three broad functions—they direct people’s thinking and behaviour, help people maintain a sense of self and identity, and are shared with others in social contexts to help form and strengthen relationships (Bluck & Alea, 2002; Cohen, 1998; Hyman & Faries, 1992; Pillemer, 1992).

It has also been proposed that autobiographical memories can serve other functions, such as regulating emotions (e.g. Kulkofsky, Wang & Hou, 2010; Pasupathi, 2003) and providing a sense of social identity (e.g. Berntsen, 2009; Rasmussen & Berntsen, 2009; Wright & Gaskell, 1992). In the reminiscence literature, more specific functions such as teaching others and maintaining intimacy have also been subject for systematic research—these functions have been

viewed as sub-categories of the three broad functions (e.g. Bluck & Alea, 2002; Cappeliez, O'Rourke, & Chaudbury, 2005; Webster, 2003).

It is not just people's positive memories that can serve these various functions. In fact, people tend to rate their negative memories as more directive than their positive memories, and researchers have suggested that even the most traumatic events can serve adaptive functions (Pillemer, 2003; Rasmussen & Berntsen, 2009). Furthermore, it has been shown that negative memories sometimes have redemptive qualities (McAdams, Reynolds, Lewis, Patten, & Bowman, 2001) and can serve as turning points in the life story (Pillemer, 2001; 2003; see also Habermas & Bluck, 2000 for similar views). The Rock, for example, used his "seven bucks" memory to motivate him to do more with his life (Johnson, 2016).

But negative memories can also be maladaptive in a variety of ways. After all, we know that thinking back to negative experiences can produce strong negative emotions (D'Argembeau, Comblain, & Van der Linden, 2003). In extreme cases, negative memories are even related to psychopathology—for example, rumination is associated with depression (Nolen-Hoeksema, 2000), and there is evidence that the characteristics of people's memories for a trauma contribute to the development of PTSD (Rubin, Dennis, & Beckham, 2011). Furthermore, research on reminiscence functions has identified specific uses of memory that are sometimes maladaptive, such as bitterness revival and boredom reduction (Harris, Rasmussen, & Berntsen, 2014; Webster, 2003).

But memories could also be maladaptive in ways that map onto the directive, self, and social functions of memory. Although it might generally be adaptive for memories to serve these three functions (e.g. Bluck, Alea, Habermas, & Rubin, 2005), it is possible that some instances in which memories serve these functions could be maladaptive. Take, for example, an alternate

reality where The Rock's "rock bottom" memory led him to give up on his dreams and stay on his couch. In that case, The Rock's memory is serving a directive function by guiding his behaviour, but is doing so in a way that is maladaptive. Likewise, if the memory led him to think that he is incapable of succeeding, we might then consider the memory as serving a self function in a way that is maladaptive. Finally, if the Rock had complained to others about his experiences in a way that made people annoyed or frustrated with him, we might think of the memory as serving a social function in a way that is maladaptive (see Pillemer, 2003 for similar examples). For the sake of brevity, we will henceforth refer to memories that serve functions in ways that are adaptive as serving *adaptive functions* and memories that serve functions in ways that are maladaptive as serving *maladaptive functions.*

Surprisingly, we know little about the extent to which people's memories serve directive, self, and social functions in ways that are maladaptive. One reason for this gap is that the literature investigating the directive, self, and social functions of autobiographical memory tends to rely on measures that focus primarily on the ways people's memories are adaptive, or that do not separate adaptive and maladaptive outcomes. Take, for example, a study that measured the self function by asking people to rate the degree to which "this memory tells me something about my identity" (Rasmussen & Berntsen, 2009). This item cannot, of course, tell us whether people's memories are shaping their identity in ways that are adaptive or maladaptive. Likewise, more extensive survey measures that use more than one item to address the three broad functions largely do not differentiate between adaptive and maladaptive usage (e.g. Bluck & Alea, 2011; Webster, 2003). This insensitivity to the maladaptive contributions of people's memories is a problem that cuts across the literature as a whole (see, for example, Kulkofsky et al., 2010; McLean & Lilgendahl, 2008; Pillemer, Steiner, Kuwabara, Thomsen, & Svob, 2015).

It makes sense that in trying to understand why we have autobiographical memories, research has focused on adaptive usage. After all, trying to understand the adaptive advantage a behaviour or process confers on us is an important part of psychological science (see, for example, Bruce, 1985; Suddendorf & Corballis, 2008). But without a full understanding of the ways in which autobiographical memories are maladaptive, it is hard to know the extent to which autobiographical memories are, on the whole, adaptive. Indeed, a landmark paper published more than a decade ago addressed function in terms of everyday usage, but encouraged scientists to distinguish between adaptive and maladaptive ways of using memory in future research: "A later development in any program of research on function would be the identification of adaptive and maladaptive ways in which memory is employed in everyday life" (Bluck et al., 2005, p. 92). The present experiments aim to address this gap by examining the adaptive and maladaptive ways people's memories serve directive, self, and social functions in everyday life.

More recently, the field was urged to take a broader view of the functions of autobiographical memory, including the idea that functions can be thought of as "reasons for remembering" that could be adaptive or maladaptive (Del Palacio-Gonzalez, Watson, & Berntsen, 2018; Harris et al., 2014). But we still know little about the relative adaptive and maladaptive contributions of people's memories. To what extent do people's memories serve directive, self, and social functions in adaptive and maladaptive ways? To answer this question, we conducted two pre-registered experiments in which we asked people to provide either positive or negative memories. In each experiment, we asked subjects to report the extent to which the memories "help" them and "hurt" them in ways that map on to the directive, self, and social functions of autobiographical memory.

Of course, even if a memory is maladaptive, it could still be that the adaptive benefits of that memory outweigh its maladaptive effects. We might expect, then, that people want to hold on to adaptive negative memories—as The Rock does with his "seven bucks" memory—but want to get rid of maladaptive negative memories. We tested this possibility by asking subjects how willing they would be to "erase" the memories they provided (in Experiments 1 and 2) and how willing they would be to "save" the memories forever (in Experiment 2).

Experiment 1

Method

Experiments 1 and 2 were both pre-registered—analyses that were not pre-registered are noted as exploratory. The pre-registrations, supplemental materials, and data for the two experiments are available at osf.io/y6vg2/

Subjects

We recruited workers from the United States and Canada on Amazon's Mechanical Turk platform (https://www.mturk.com/) through TurkPrime (Litman, Robinson, & Abberbock, 2017). Subjects participated in exchange for $0.20 Amazon credit. We aimed to collect data until we had 400 useable data points, after exclusions. Because of the way Mechanical Turk interacts with Qualtrics, 418 subjects completed the survey, 4 of whom did not provide autobiographical memories, and a further 4 who did not pass the attention check[1]. The final dataset included 410 subjects (M_{age} = 41.25, SD = 13.42) of whom 150 identified as men, 257 as women, and 3 as gender diverse. All but five of our subjects reported that English was their primary language. Those five subjects reported their primary language as Italian, Urdu, Chinese (two subjects), and

Spanish.

Design

We manipulated the type of memory subjects brought to mind (most positive, most negative) between subjects.

Procedure

This experiment was approved by the University of Waikato's School of Psychology Research Ethics Committee under delegated authority of the University's Human Research Ethics Committee. We conducted this experiment in accordance with the World Medical Association Declaration of Helsinki.

The procedure took place in a single session, comprising five parts. First, we told subjects we were interested in people's memories for specific events that took place within 24 hours at a specific time and place that they personally experienced. Then, we asked some subjects to describe their most negative memory and other subjects to describe their most positive memory (see the Supplemental Materials in Appendix A for the full instructions). We asked subjects for negative memories because we reasoned that negative memories are those most likely to be maladaptive (Nolen-Hoeksema, 2000; Rubin et al., 2011). We asked for positive memories to provide comparison memories that should be similar in emotional intensity, but have different valence.

Second, subjects rated the extent to which their nominated memory serves functions in ways that help them, and in ways that hurt them. To gather these data, we modified function items that have been used in the literature (Rasmussen & Berntsen, 2009; 2013). These items

comprise one item for each of the directive, self, and social functions. We also included a fourth item measuring the social identity function, which addresses social bonding and a sense of belonging with others but without the memory having to be shared (see Berntsen, 2009; Wright & Gaskell, 1992). We modified these items because the original items do not separate whether a memory is serving functions in ways that are adaptive or in ways that are maladaptive, which was our main research interest. For example, we split the item "this memory tells me something about my identity" into two items ("this memory tells me something about my identity in ways that help me" and "this memory tells me something about my identity in ways that hurt me"). We repeated this modification for each item, so that the original four-item scale became an eight-item scale, with four items measuring the adaptive functions, and four items measuring the maladaptive functions (see Table 1 for the full list of these function items and their anchors). Finally, we created a sum variable for helpful functions by taking the mean of the four items measuring helpful functions and a sum variable for hurtful functions by taking the mean of the four items measuring hurtful functions.

Third, subjects completed a series of other ratings about their nominated memory. More specifically, as a manipulation check, we asked subjects to rate the valence of their memory on two items (see Table 1; Rubin, Schrauf, & Greenberg, 2003). Next, subjects completed an attention check and then rated how significant the memories were for their life story and how old they were when the event took place.

Fourth, we told subjects to imagine they had the opportunity to completely erase their nominated memory, meaning that the memory would be gone—they would not be able to bring to mind any aspect or aspects of what happened. We asked subjects to rate how likely they would

be to erase the memory, and then to make a dichotomous yes/no decision about whether they would erase it (see the Supplemental Materials in Appendix A for the full instructions).

Finally, subjects answered basic demographic questions about their age, gender, and primary language.

Table 1. Full list of items for Experiments 1 and 2.

Function
This memory guides my thinking and behavior in ways that help me
This memory guides my thinking and behavior in ways that hurt me
This memory tells me something about my identity in ways that help me
This memory tells me something about my identity in ways that hurt me
I share this memory with other people in ways that help me
I share this memory with other people in ways that hurt me
This memory gives me a sense of belonging with other people
This memory gives me a sense of disconnection from other people
Valence
The feelings I experience as I recall the event are extremely positive
The feelings I experience as I recall the event are extremely negative
Willingness to erase/save
If you could actually erase[save] this memory, how likely would you be to do that? (1 = not at all likely, 7 = extremely likely)
If you could actually erase[save] this memory, would you? (Yes/No)
Age of event
How old were you when this event took place? Please give your age at the time estimated in years; type in the number, e.g., 7
Centrality
This memory is significant for my life because it imparts an important message for me or represents an anchor, critical juncture, or a turning point (1 = not at all, 7 = completely)

Note. Function and Valence items all rated from 1 (not at all) to 7 (to a very high degree). Items adapted from Rasmussen and Berntsen (2009), and Rubin, Schrauf, and Greenberg (2003).

Results & Discussion

Our primary research question was: to what extent do people's memories serve functions in ways that are adaptive and maladaptive? Before turning to this question, we first examined subjects' descriptions and checked that our manipulations were successful.

Descriptives & manipulation checks

Subjects' most negative memories took place at a mean age of 27.66 (*SD* = 13.97; Range = 3-65). In the mean, these memories took place 13.40 years ago (*SD* = 13.51). The descriptions were also fairly short (M_{words} = 49.50, *SD* = 41.83, Range = 2-365)[2]. Subjects rated their memories as highly negative ($M_{negativity}$ = 6.21, *SD* = 1.31; $M_{positivity}$ = 1.42, *SD* = 0.94), and significant to their life story (*M* = 5.35, *SD* = 1.64). Examples of negative memories subjects described included "I had a miscarriage" and "When my grandad died. It was really sad to me as the first major death in my life. It was very unexpected and sad."

Subjects' most positive memories took place at a mean age of 27.78 (*SD* = 13.40; Range = 3-72). In the mean, these memories took place 13.68 years ago (*SD* = 14.34). The descriptions were fairly short (M_{words} = 44.65, *SD* = 25.56; Range = 4-147). Subjects rated their memories as highly positive ($M_{positivity}$ = 6.55, *SD* = 0.85; $M_{negativity}$ = 1.30, *SD* = 0.90), and significant to their life story (*M* = 5.79, *SD* = 1.46). Examples of positive memories included "Giving birth to my son" and "when I married my husband. He is the best partner I could have asked for and I still can't believe he married me."

Function ratings

Before turning to our primary research question, we first examined the reliability of our adaptive and maladaptive sum variables. As expected, we found correlations among the helpful items and among the hurtful items, and both sum variables had good reliability ($\alpha_{helpful} = 0.83$, $\alpha_{hurtful} = 0.86$; see the Supplemental Materials in Appendix A for a detailed analysis of the correlations between the function items and the reliability of the sum variables).

We now turn to our primary research question: to what extent do people's memories serve functions in ways that are adaptive and maladaptive? Using the function sum variables, we first compared the helpful and hurtful function ratings of subjects who described their most negative memories. As the left-hand side of Figure 1 shows, subjects' negative memories were both moderately helpful ($M = 3.26$, $SD = 1.38$) and moderately hurtful ($M = 3.71$, $SD = 1.47$). The relative mixture varied somewhat across the individual functions (see the Supplemental Materials in Appendix A), but overall subjects' memories were slightly more hurtful than they were helpful ($M_{diff} = 0.45$, 95% CI [0.17, 0.72]). These findings suggest that people's most negative memories are neither wholly adaptive nor wholly maladaptive—instead, they tend to serve a mix of adaptive and maladaptive functions.

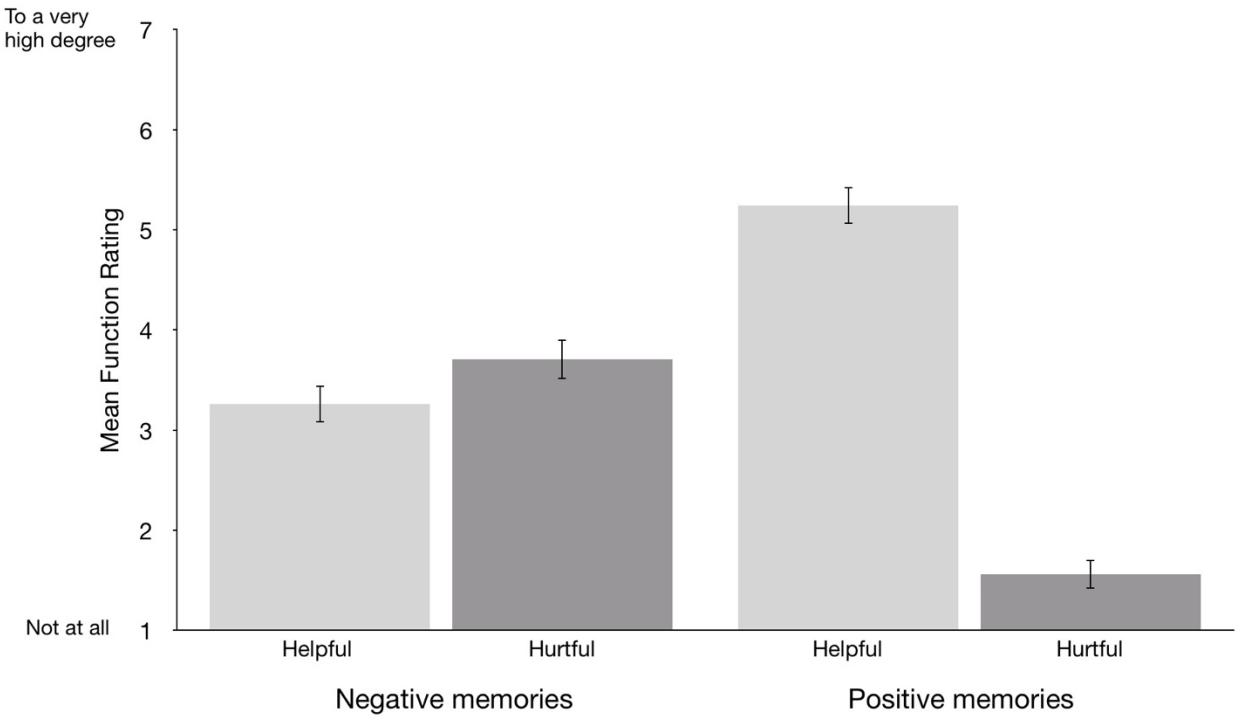

Figure 1. Mean helpful and hurtful function ratings for subjects' positive and negative memories. Error bars represent 95% confidence intervals of the cell means.

But do people's positive memories also serve this mix of functions? They do not. As the right-hand side of Figure 1 shows, subjects' most positive memories tended to be much more helpful (M = 5.24, SD = 1.31) than hurtful (M = 1.56, SD = 1.02; M_{diff} = 3.68 [3.45, 3.92]). In fact, these memories were at floor on hurtful functions. This pattern holds true across the individual functions (see the Supplemental Materials in Appendix A). Furthermore, we found that subjects' positive memories were more helpful than their negative memories (M_{diff} = 1.98 [1.72, 2.24]) and less hurtful (M_{diff} = 2.15 [1.90, 2.39]). These results suggest that unlike people's negative memories, their positive memories tend to be predominantly adaptive.

Willingness to erase the memories

Thus far we have established that people's negative memories serve functions in a mixture of adaptive and maladaptive ways, and that this mixture is not present in positive memories. But do people want to hold on to their negative memories—as The Rock does with his "seven bucks" memory—or would they rather forget them? If people believe the adaptive utility of their memories outweighs the maladaptive effects, we might expect people to want to hold on to them. But on the other hand, if people believe the maladaptive effects of their memories outweigh the adaptive utility, they might want to erase the memories. To answer this question, we analysed subjects' responses to two items. The first item asked subjects to rate how likely they would be to erase their nominated memory if they got the chance. The second item asked them to make a dichotomous yes or no choice about whether they would erase it.

First, we examined responses to these two questions from subjects who provided their most positive memory. Given that these memories are highly positive, and appear to be at floor on maladaptive functions, we expected that subjects would be unlikely to want to erase them. Indeed, subjects were overwhelmingly unwilling to erase their nominated memory—subjects' ratings of how likely they would be to erase their most positive memory were at floor (M = 1.26, SD = 0.91), and only 4 subjects out of 198 said they would erase it when asked to make a dichotomous choice. Perhaps unsurprisingly, these data show that people value holding on to their positive memories.

By contrast, when we examined responses to these two questions from subjects who provided their most negative memory, we found more varied responses. In the mean, it appeared that subjects were moderately willing to erase their most negative memory (M = 3.56, SD = 2.42). But a closer inspection of the distributions revealed a starkly bimodal distribution—subjects tended to be either highly likely or not at all likely to erase their most negative memory

(see the Supplemental Materials in Appendix A for the full distributions). These results show that some people are highly willing to get rid of their most negative memory, whereas others are very reluctant do so. This split is reflected in subjects' responses to the dichotomous choice about whether to erase the memory—61% said they would not erase the memory, while 39% said they would. Despite the fact that these memories were subjects' most negative memories, the majority would not want to erase them. Considered as a whole, these data suggest that many people value holding on to even their most negative memories.

Why, though, did subjects choose not to erase their most negative memory? One possibility is they believed the adaptive utility of these negative memories outweighs whatever maladaptive effects the memories carry with them. If this explanation were correct, we would expect that subjects' willingness to erase a negative memory would be related to the extent to which that memory serves functions in ways that are adaptive and maladaptive. Exploratory results provide evidence for this explanation. More specifically, the more helpful a negative memory was, the less willing subjects were to erase it (r = -0.43 [-0.51, -0.35]). Conversely, the more hurtful a negative memory was, the more willing subjects were to erase it (r = 0.51 [0.43, 0.57]) These results suggest that people want to get rid of negative memories that are maladaptive, but are reluctant to get rid of those that are adaptive. In turn, these results fit with the idea that many people believe the adaptive functions of their negative memories outweigh the maladaptive functions those memories serve.

Alternate explanations

Of course, our design means we cannot determine if adaptive and maladaptive functions are driving people's decisions about whether to erase their memories. One plausible alternative is

that people simply want to erase memories that are highly negative, and that those memories also happen to be high on maladaptive functions and low on adaptive functions. To address this possibility, we conducted an exploratory logistic regression with helpful function, hurtful function, and negative valence predicting subjects' decisions about whether to erase their most negative memory[3]. This analysis showed that hurtful function was the strongest and only significant predictor of people's decisions. More specifically, the more hurtful a memory was, the more likely subjects were to want to erase it (*OR* = 1.36 [1.10, 1.69]). By contrast, the more helpful a memory was, the less likely subjects were to want to erase it, although this effect was not significant and the effect size is plausibly trivial (*OR* = 0.81 [0.64, 1.02]). There was no strong evidence that valence predicted subjects' willingness to erase the memory (*OR* = 1.18 [0.91, 1.56]). These results provide evidence against the idea that valence is driving the relationships between functions and people's willingness to erase their most negative memory. Of course, there is a relationship between valence and functions—negative memories tend to be more maladaptive than positive memories. But these results suggest that people's willingness to erase their memories is more likely driven by the functions the memories serve than by the valence itself.

Another possible explanation for subjects' reluctance to erase their negative memories is that they were wary of the general consequences of erasing a memory. For example, we know that many people believe that changing people's memories in therapy might have unintended negative consequences, and it is possible that some subjects decided not to erase their memory for this reason (Nash, Berkowitz, & Roche, 2016). But this explanation cannot fully account for our results. Based on this explanation alone, we would expect to see similar reluctance across all memories, regardless of function or valence. But we did not see that. Instead, we saw that

subjects' willingness to erase a memory was related to the functions that memory serves, and also that subjects were more willing overall to erase negative memories than positive ones. Therefore, our results do not support this counter-explanation.

Summary

Taken together, this experiment provides evidence that negative memories serve functions in a mix of adaptive and maladaptive ways, and that positive memories are predominantly adaptive. Furthermore, the results show that many people value even their most negative memories, perhaps because they believe the adaptive benefits of these memories outweighs their maladaptive effects.

In this experiment, though, each subject provided only one memory—either their most positive or most negative memory. If people really are weighing up the adaptive and maladaptive functions of a memory when deciding how much they value keeping that memory around, we should expect that, within any one person's memories, the memories they most want to get rid of should be the ones that are most maladaptive. By contrast, the ones they most want to hold on to should be the ones that are most adaptive. Furthermore, this pattern should hold true regardless of the valence of the memory. We addressed this possibility in Experiment 2.

Experiment 2

In Experiment 2, we asked subjects to provide either their five most negative memories or their five most positive memories. Then, we asked them to pick from these five memories the one they would be most likely to erase, and the one they would be least likely to erase. To further understand the extent to which people value their positive and negative memories, we asked a

separate group of subjects to pick from their five nominated memories the one they most want to save forever, and the one they least want to save. We hypothesised that people want to hold on to adaptive memories and get rid of maladaptive memories. If so, subjects' "most likely to erase" memories should be more maladaptive than their "least likely to erase" memories, and also less adaptive. Conversely, subjects' "most likely to save" memories should be less maladaptive and more adaptive than their "least likely to save" memories. Furthermore, these patterns should hold true for the subjects who provided their most positive memories and also those who provided their most negative memories.

Method

Subjects

We recruited workers from the United States and Canada on Amazon's Mechanical Turk platform through TurkPrime (Litman, et al., 2017).[4] Subjects participated in exchange for $0.70 Amazon credit. We aimed to collect data until 400 subjects had completed the survey. Because of the way Mechanical Turk interacts with Qualtrics, 425 subjects completed the survey. Based on our pre-registered criteria, we excluded 12 subjects who did not provide autobiographical memories. We also excluded a further 9 subjects who selected the same memory as their "most likely" and "least likely" memory. The final dataset contained 404 subjects (M_{age} = 39.25, *SD* = 14.10), 142 of whom identified as men, 259 as women, and 3 as neither man nor woman.

Design

We employed a 2 x 2 x 2 mixed design with Memory Valence (positive, negative), and Instructions (erase, save) as between-subjects factors and Memory Choice (most likely, least

likely) as a within-subjects factor.

Procedure

This experiment was approved by the University of Waikato's School of Psychology Research Ethics Committee under delegated authority of the University's Human Research Ethics Committee. We conducted this experiment in accordance with the World Medical Association Declaration of Helsinki.

The procedure for this experiment is displayed in Figure 2. First, subjects completed basic demographics. As in Experiment 1, we told subjects we were interested in people's memories for specific events that took place within 24 hours at a specific time and place that they personally experienced. Then, we asked some subjects to provide their five most negative memories, and other subjects to provide their five most positive memories. Then, using the same instructions as Experiment 1, we told half of the subjects to suppose they could erase one memory. We then asked these subjects to select, from the five memories they had just described, the memory they would be most likely to erase and the one they would be least likely to erase. We told the other half of the subjects to imagine they could "save" a memory—meaning they would always be able to bring to mind the experience, as well as the images and feelings associated with it, even if they lost their memory for all other experiences (see the Supplemental Materials in Appendix A for the full instructions). We asked these subjects to select from their five memories the memory they would be most likely to save and the one they would be least likely to save. We counterbalanced the order of these selections so that some subjects selected their "most likely" memory first and others selected their "least likely" memory first.

After making both their selections, subjects rated (in counterbalanced order) their "most likely to erase[save]" and "least likely to erase[save]" memories on a series of items. First, as a manipulation check, subjects rated the item "If you could actually erase[save] this memory, how likely would you be to do that?" on a scale from 1 (not at all) to 7 (to a very high degree). Next, subjects rated the helpful and hurtful functions of the memory using the same items as in Experiment 1 (see Table 1 for the full list of these function items). Then, subjects rated the valence of their memory on the same two items used in Experiment 1, and reported their age at the time of the event. Finally, we asked subjects to make a yes or no decision about whether they would erase[save] the memory. Subjects completed all the ratings about one memory before rating the other memory.

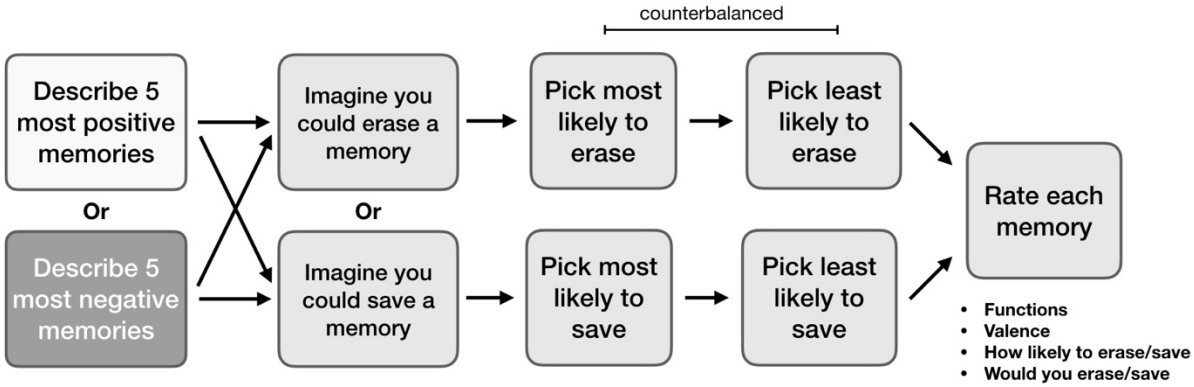

Figure 2. Diagram of the method for Experiment 2.

Results & Discussion

Before turning to our main analyses, we first examined subjects' descriptions and checked that our manipulations were successful.

Descriptives & manipulation checks

Subjects' negative memories took place at a mean age of 24.81 years (*SD* = 13.19, range: 2-70). In the mean, these memories took place 14.49 years ago (*SD* = 13.27). The descriptions were again fairly short (M_{words} = 14.57, *SD* = 15.78, range: 1-100). As expected, subjects rated their negative memories as highly negative ($M_{negativity}$ = 5.27, *SD* = 1.90, $M_{positivity}$ = 2.08, *SD* = 1.65). Examples of negative memories subjects described included being cheated on and the death of a parent.

Subjects' positive memories took place at a mean age of 26.32 years (*SD* = 13.75, range 2-89). In the mean, these memories took place 12.88 years ago (*SD* = 13.10). The descriptions were fairly short (M_{words}= 16.13, *SD* = 17.01, Range = 1-103). As expected, subjects rated their positive memories as highly positive ($M_{positivity}$ = 5.83, *SD* = 1.59; $M_{negativity}$ = 1.79, *SD* = 1.53). Examples of positive memories included graduating college and the birth of a child.

Next, we checked that subjects rated that they would be more likely to erase their "most likely to erase" memories than their "least likely to erase" memories. They did ($M_{mostlikely}$ = 3.93, $M_{leastlikely}$ = 2.15, M_{diff} = 1.78, [1.46, 2.10]). Likewise, subjects who were asked about saving their memories rated that they were more likely to save their "most likely to save" memories than their "least likely to save" memories ($M_{mostlikely}$ = 5.23, $M_{leastlikely}$ = 3.20, M_{diff} = 2.02, [1.72, 2.33]; See Supplemental Materials in Appendix A for a breakdown by valence). These results suggest our manipulations were successful.

Adaptive and Maladaptive function ratings

We now turn to our main research question: to what extent do people's memories serve functions in ways that are adaptive and maladaptive?

Negative memories. First considering subjects' negative memories, we found a pattern that is consistent with Experiment 1: people's negative memories tended to serve functions in a mixture of adaptive and maladaptive ways. As Figure 3 shows, however, the precise mixture of functions varied across memories. More specifically, the left side of the top panel of Figure 3 shows that subjects' "most likely to erase" negative memories tended to be more hurtful than helpful (M_{diff} = 0.93 [0.46, 1.40]) whereas their "least likely to erase" negative memories tended to be more helpful than hurtful (M_{diff} = 1.09 [0.64, 1.54]). Comparing these two sets of memories, we found that subjects' "most likely to erase" negative memories were less helpful than their "least likely to erase" negative memories (M_{diff} = 1.13, [0.82, 1.44]) and also more hurtful (M_{diff} = 0.89, [0.54, 1.23]).

The results from subjects who were asked about saving their memories mirror these results almost exactly, as the left side of the bottom panel of Figure 3 shows. Subjects' "most likely to save" memories tended to be more helpful than hurtful (M_{diff} = 0.95 [0.53, 1.37]), whereas subjects' "least likely to save memories" tended to be more hurtful than helpful (M_{diff} = 0.89 [0.50, 1.27]). Comparing the two sets of memories, we found that subjects' "most likely to save" negative memories were more helpful than their "least likely to save" negative memories (M_{diff} = 1.18, [0.86, 1.49]), and less hurtful (M_{diff} = 0.66, [0.37, 0.95]).

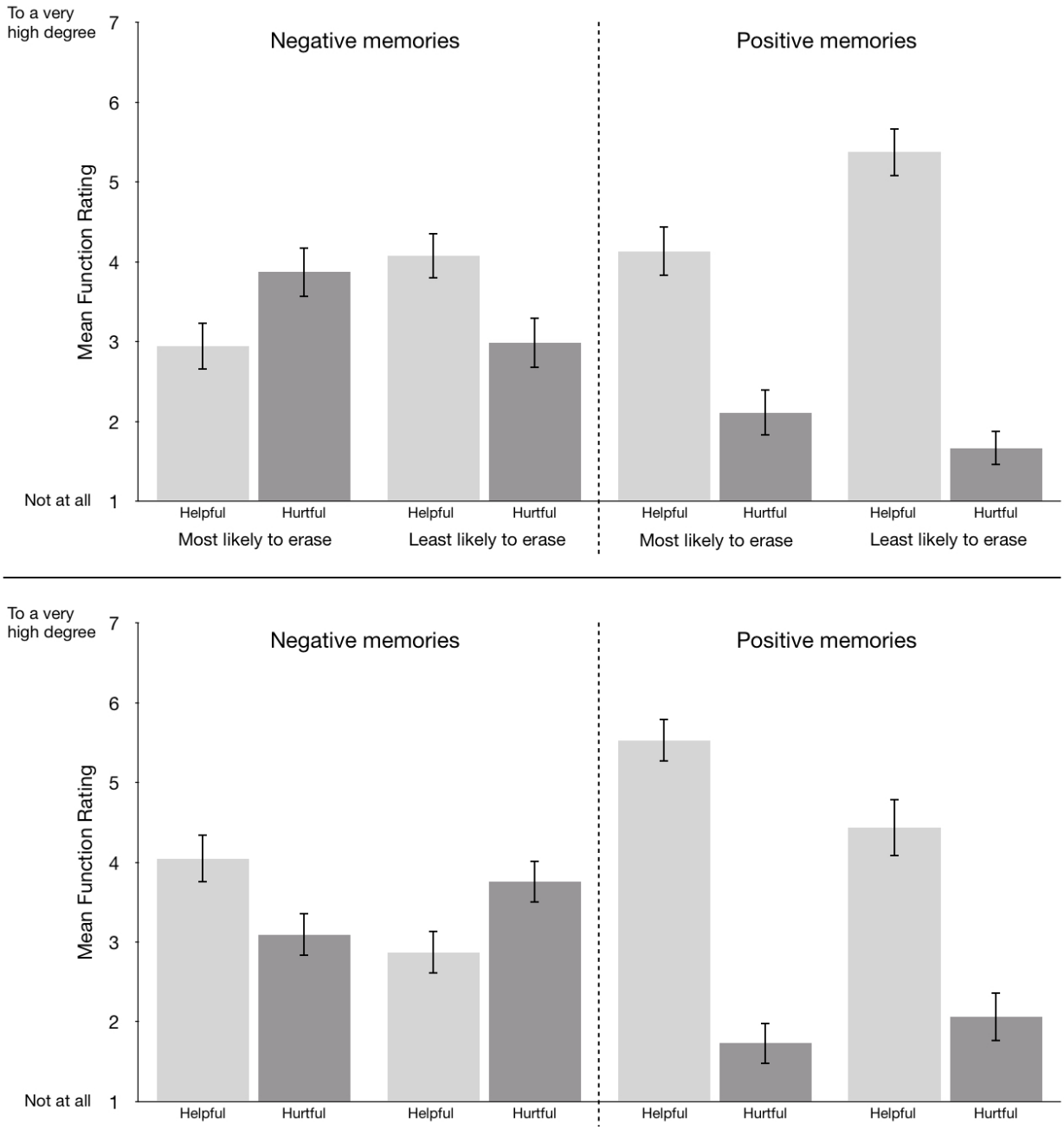

Figure 3. The top panel displays the mean function ratings of subjects who selected the memory they would be most likely to erase and the one they would be least likely to erase. The bottom panel displays the mean function ratings of subjects who selected the memory they would be most likely to save and the one they would be least likely to save. The left-hand side of each panel displays subjects who provided their five most negative memories, while the right-hand side displays subjects who provided their five most positive memories. Light grey bars represent mean helpful function ratings, dark grey bars represent mean hurtful function ratings. Error bars represent 95% confidence intervals of the cell means.

Together, these results provide further support for the idea that negative memories serve functions in ways that have both adaptive and maladaptive effects. These results extend those Experiment 1 by suggesting that although negative memories are often more adaptive than maladaptive, it is also common for them to be more maladaptive than adaptive (see the Supplemental Materials in Appendix A for a breakdown by each individual function). Furthermore, the results show that in addition to being unwilling to erase adaptive negative memories, people also desire to preserve those memories as they are.

But how willing overall were people to want to erase or save their memories? In Experiment 1, only a minority of people reported they would erase their most negative memory. But in this experiment, there were some memories that subjects commonly did not want to hold on to—most subjects (75%) said they would erase their "most likely to erase" negative memory, and few subjects (12%) said they would save their "least likely to save" negative memory. Crucially, these memories tended to be ones that were more hurtful than helpful. By contrast, subjects tended to want to hold on to the memories that were more helpful than hurtful—only a minority of subjects (32%) said they would erase their "least likely to erase" negative memory, and the majority of subjects (60%) said they would save their "most likely to save" negative memory.

Positive memories. In contrast to subjects' negative memories, but consistent with Experiment 1, subjects' positive memories tended to be predominantly adaptive. More specifically, the right side of the top panel of Figure 3 shows that subjects' most likely to erase positive memories were much more helpful than hurtful (M_{diff} = 2.02 [1.59, 2.45]), as were their least likely to erase positive memories (M_{diff} = 3.71 [3.28, 4.13]). Comparing the two sets of memories, we found that subjects' "most likely to erase" positive memories were less helpful than their "least likely

to erase" positive memories (M_{diff} = 1.24, [0.91, 1.57]) and more hurtful (M_{diff} = 0.44, [0.18, 0.70]).

Likewise, as the right side of the bottom panel of Figure 3 shows, subjects' most likely to save positive memories were much more helpful than hurtful (M_{diff} = 3.80 [3.36, 4.24]), as were their least likely to save negative memories (M_{diff} = 2.37 [1.87, 2.87]). Once again, subjects' "most likely to save" positive memories were more helpful than their "least likely to save" positive memories (M_{diff} = 1.10, [0.74, 1.45]), and less hurtful (M_{diff} = 0.34, [0.09, 0.59]).

These results provide further support for the idea that positive memories tend to be primarily adaptive. Furthermore, across both positive and negative memories, people want to hold on to memories that serve adaptive functions and get rid of memories that serve maladaptive functions. Unsurprisingly, few subjects wanted to erase their positive memories—only 17% said they would erase their "most likely to erase" positive memory, and 6% said they would erase their "least likely to save" positive memory. By contrast, most subjects wanted to save their positive memories—97% said they would save their "most likely to save" positive memory, and 78% said they would save their "least likely to save" positive memory. From these two experiments it is clear that most people value holding onto their positive memories, perhaps because these memories are almost exclusively adaptive.

Predicting willingness to save or erase

As in Experiment 1, we ran exploratory logistic regressions to test the possibility that negative valence, rather than adaptive or maladaptive function, was really driving people's choices to save or erase their negative memories. Because we asked each subject to rate two memories, we conducted multi-level models with helpful function, hurtful function, and valence predicting

people's decisions about whether to save[erase] their two memories.

Recall that some subjects were asked about saving their memories, and others were asked about erasing them. Therefore, we conducted separate regressions for subjects in those two conditions. The model predicting subjects' decisions about whether to erase their memories produced results that were largely consistent with Experiment 1. More specifically, helpful function and hurtful function both strongly predicted subjects' decision to erase their memories. The more hurtful a memory was, the more likely subjects were to say "yes" to erasing the memory (*OR* = 3.03 [1.61, 5.70]), and the more helpful a memory was, the less likely they were to say "yes" to erasing it (*OR* = 0.32 [0.16, 0.64]). Valence was a trivial and non-significant predictor of subjects' decisions to erase their memories (*OR* = 1.07 [0.77, 1.48]). These results suggest that people's willingness to erase their memories is more likely driven by the functions the memories serve than by the valence of the memory itself—consistent with Experiment 1.

The model predicting subjects' decisions about whether to save their memories produced a somewhat different pattern. More specifically, helpful function was the strongest and only significant predictor of people's decision to save their memory. The more helpful a memory was, the more likely subjects were to say "yes" to saving it (*OR* = 2.31 [1.65, 3.23]). Unlike the model predicting subjects' decisions to erase their memories, there was no strong evidence that hurtful function predicted people's decisions to save their memories (*OR* = 0.88 [0.68, 1.13]). Perhaps the "erase" framing drew subjects' attention more to maladaptive functions, whereas the "save" framing drew subjects' attention more to the adaptive functions of the memory. Regarding valence, the more negative a memory was, the less likely subjects were to say "yes" to saving it, but this effect was not significant, and size of this effect was plausibly trivial (*OR* = 0.84 [0.69, 1.02]).

Overall, these findings suggest that people want to erase maladaptive memories and save adaptive memories. Furthermore, valence did not account for these relationships.

Summary

Taken together, the results from Experiment 2 provide further evidence that people's memories serve functions in a mixture of adaptive and maladaptive ways. Moreover, the results suggest that people want to get rid of memories that are maladaptive and hold on to memories that are adaptive.

General Discussion

Across two experiments and 814 subjects, we found that people rated their negative memories as moderately adaptive, but also moderately maladaptive. By contrast, people rated their positive memories as predominantly adaptive. Furthermore, we found evidence that the maladaptive effects of a memory are distinct from its valence. We also found that people wanted to hold on to memories that serve functions in adaptive ways and get rid of memories that serve functions in maladaptive ways. Considered together, these findings get us a step closer to the goal of identifying the adaptive and maladaptive effects of people's autobiographical memories.

The experiments documented here have implications for the literature on the functions of autobiographical memories. Our findings extend research showing that some uses of memory—such as bitterness revival and rumination—can be maladaptive. More specifically, these findings demonstrate that the three theorised functions of autobiographical memory can sometimes produce maladaptive outcomes. Why, though, do we have a memory system that often carries with it these maladaptive effects? One possibility is that these effects are a by-product of the

same processes that allow autobiographical memories to serve adaptive functions. After all, it is often the case that maladaptive outcomes can result from generally adaptive processes (e.g., Bruce 1985). For example, although fear conditioning regularly helps people avoid potential threats, in extreme cases it can lead to phobias that cripple people's ability to function (Seligman, 1971). This idea fits with the ecological literature, which suggests that no process or trait is inherently adaptive (Bruce, 1985). Instead, the adaptiveness of a trait depends on the context in which the trait is expressed. Similar ideas have been proposed for false memories—that they are the maladaptive by-product of having a memory system that is flexible enough to update and correct mistakes (Newman & Lindsay, 2009).

Given that we found evidence of these maladaptive effects only in people's most negative memories, it seems likely that the majority of autobiographical memories tend to be more adaptive than maladaptive. But to fully understand the relative adaptive and maladaptive contributions of autobiographical memories, future research should continue to investigate other ways in which autobiographical memories can be maladaptive. For example, although we found little evidence that positive memories are maladaptive, positive memories that produce a sense of nostalgia, or which lead people to become overconfident might also have maladaptive effects.

In investigating people's desire to preserve their memories, these experiments also contribute to our understanding of people's attitudes towards their memories. Our results are consistent with other work suggesting people often value their negative memories—people regularly keep photos and mementos that bring to mind negative experiences, and report they would not take a drug that would dampen a negative memory, even if doing so might reduce the likelihood of developing PTSD (Newman, Berkowitz, Nelson, Garry, & Loftus, 2011; Petrelli & Whittaker 2008). Nonetheless, some of our subjects reported they would want to rid themselves

of negative memories—especially memories that were highly maladaptive. Given the recent efforts to identify drugs that might alter the content of negative memories, it is important to consider both the adaptive and maladaptive effects these memories can have (Brunet et al., 2008; Pitman et al., 2002). Unless these drugs can reduce the maladaptive effects of negative memories while leaving the adaptive functions intact, it might not always be wise to use them (Bluck, 2017).

Our results also highlight the overlap between the literature on autobiographical memory and the literature on clinical cognition. More specifically, the posttraumatic growth literature suggests people who experience a traumatic event often believe they have grown as a result of the experience (Schuettler & Boals, 2011; Tedeschi & Calhoun, 2004). For example, people often report a traumatic experience changed their life path, taught them how strong they are, or increased their closeness with others. Such reports are remarkably similar to the adaptive functions subjects in our experiments commonly reported, and that have been discussed across the autobiographical memory literature (Bauer, McAdams, & Pals, 2008; Bluck et al., 2005; Pillemer, 1992; McAdams et al., 2001). Furthermore, people often report post-traumatic growth even if a traumatic experience also produced maladaptive consequences such as post-traumatic stress symptoms. These reports fit with our finding that any given memory can serve functions in both adaptive and maladaptive ways.

We do not know, however, the extent to which order effects contributed to the relationships between the functions and people's willingness to erase their memories. In Experiment 1, subjects completed the function and valence ratings before rating their willingness to erase that memory. It is possible that rating the functions first encouraged subjects to consider those functions when rating their willingness to erase that memory. In turn, subjects might have

adjusted their willingness based on their function ratings in a way they normally would not have. In Experiment 2, we attempted to address this possibility by reversing the order and first asking people to decide how willing they would be to erase the memory before rating valence and function. That the findings of the two experiments produced similar results provides some evidence against this possibility. Furthermore, if order effects were driving these relationships, it is unclear why we would not also see similar relationships between valence and people's willingness to erase their memories. Therefore, it seems unlikely that order effects can explain the results of these two experiments.

There are, however, at least three limitations to our findings. First, we measured the adaptive and maladaptive forms of each function with only a single, broad item. In this, a first attempt to separate adaptive and maladaptive functions, we operationalized adaptive as "helpful" and maladaptive as "hurtful." But it is possible that when subjects rated the hurtful ways they use their memories, they were referring to ways in which the memories were emotionally painful, but ultimately adaptive. If so, we might expect that negative memories rated as highly hurtful might also be the ones rated as highly helpful. But we found instead that subjects' ratings of hurtful functions were negatively correlated with their ratings of helpful functions. Nonetheless, it is important that future research develops more robust measures of the ways in which memories are maladaptive.

A second limitation is that we asked people for events that took place within 24 hours, and at a specific time and place. There is evidence, however, that recurring events and events that take place over an extended time can serve functions differently to specific events (Waters, Bauer, & Fivush, 2014). To establish a broad understanding of how autobiographical memories

serve functions in ways that are adaptive and maladaptive, future work should investigate the relative mix of functions served by these different types of memories.

A third limitation is that our measures of function rely on subjects' self-reports. In this way, our work here suffers from the same limitation that plagues the field as a whole: we do not know the degree to which the functions people reported accurately reflect the functions their memories actually serve. We are, of course, not the first to raise this limitation (Hyman & Faries, 1992). If we are to move forward as a field, it is worth thinking about ways to incorporate behavioural measures into studies of autobiographical memory functions.

Taken together, these two experiments provide evidence that memories can serve directive, self, and social functions in ways that are maladaptive. In doing so, our findings stress the importance of taking a broader view of functions that distinguishes between their adaptive and maladaptive forms—especially when investigating negative memories. If we, as a field, conflate adaptive and maladaptive use of memory, or focus primarily on ways in which people's memories are adaptive, we risk inflating the reported frequency of adaptive functions. More broadly, such an approach would hinder our efforts to fully understand the ways in which people's memories affect their behaviour, identity, and relationships.

Author Notes

1. This exclusion rate is lower than that of many other published studies run on Mechanical Turk, including those from our own laboratory. This low rate could be due to the stringent criteria we used for this study, which required at least a 99% approval rating.
2. We did not exclude subjects on the basis of the length of their description because some subjects provided short descriptions (e.g. "getting married") that appeared to be genuine autobiographical memories.
3. The reason we employed a logistic regression with subjects' dichotomous choice as the dependent measure is that the bimodal distribution of subjects' ratings of their likelihood to erase the memory made those data inappropriate for linear regression. In addition, because there was very little variance in the maladaptive functions of subjects' positive memories (which were at floor) we restricted these analyses to negative memories only.
4. The data for Experiment 2 were collected before the data for Experiment 1.

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Disclosure statement

The authors report no conflicts of interest.

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Chapter 3: People draw on the consequences of others' negative experiences to make unwarranted appraisals about those experiences

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Abstract

People often talk about the consequences of their negative experiences with others in ways that serve important social functions. But to fully understand this social function, it is vital to understand how listeners appraise the event being shared with them. We hypothesized people might draw on the consequences of others' events to appraise what those experiences were like at the time. In three pre-registered experiments, we asked subjects to read someone else's first-person account of a negative event. For some subjects, this account ended in a statement suggesting the event led either to growth or harm. We found that subjects who read that the event led to growth tended to think the event was less negative at the time than subjects who read nothing about consequences. Taken together, our findings suggest that people draw on the consequences of other people's negative events to make unwarranted appraisals about those events.

Keywords: Autobiographical memory, Social function, Decision-making, Causal reasoning, Traumatic memory

General audience summary

In the months and years following a negative event, people will often talk with others about the event and its consequences. These "others" must decide how to respond—for example, what support or advice to provide to the person sharing the memory. When these others learn of the consequences of the event, does it affect their judgments of what the event was like at the time? We address that question in three experiments. In each experiment, we asked people to read someone else's first-person account of a negative event. We manipulated the consequences reported in that account—some people read that the event had harmful consequences, some read that the event led to psychological growth, and some read an account with no report of consequences. Compared to people who had not read a report of consequences, those who had read the event led to growth tended to think the event was less negative at the time. They also thought the event would have caused less intense symptoms of distress. Conversely, those who had read that the event led to harm tended to think the event would have caused more symptoms of distress than did people who had not read the report of consequences. Taken together, our findings suggest that people draw on the consequences of others' negative events to make unwarranted judgments about those events.

People draw on the consequences of others' negative experiences to make unwarranted appraisals about those experiences

A participant in one of our studies relayed to us the most negative event he has experienced. "I was driving to school early in the morning," he wrote. "I began nodding off on the highway. I was two or three blocks from school and I fell asleep on a long straight road. When I woke up, I had crashed through a barbed wire fence and into a telephone pole. My shirt was bloodied. I was crying. The smell of the engine fluids just permeated. I was taken to the hospital. No serious injuries, but I was rather lucky to be alive."

In the months and years following a negative event such as this one, people will often talk about it with others (Pennebaker, Zech, & Rimé, 2001; Pillemer, 1992). Sharing memories in this way can elicit empathy from others, and help forge and maintain relationships—important social functions. From the research on these social functions of memory, we understand much about when and why people share their memories (Alea & Bluck, 2003; Pillemer, 1992). Clearly, though, social functions involve not just the person sharing the memory, but also the people on the other end. After all, these "receivers" of the memory need to decide what to take away from the memory, and how to respond. For example, people listening to a family member recount a negative event need to decide what support, advice, and feedback to provide. And in a court setting, jurors watching or reading witness testimony need to evaluate that testimony in order to reach a verdict. These decisions often depend on people's interpretation of what happened at the time of the event. For example, in one study, subjects thought that a man who missed his plane by 5 minutes would have been more upset than if he had missed it by 30 minutes (Kahneman, Slovic, & Tversky, 1982). And in another study, subjects who read that a man was shot at a store

he rarely visited tended to think the man deserves less compensation than subjects who read he was shot at his regular store (Miller & McFarland, 1986). It is important, therefore, that we understand the factors that affect people's appraisals of others' experiences.

One factor that might affect these appraisals is the sharer's own report of the consequences of the event. Sometimes, people might report the event caused them harm—for example, the participant above might report having repeated, intrusive thoughts about the crash, or that it has led him to feel disconnected from other people (American Psychiatric Association, 2013; Burnell, Rasmussen, & Garry, 2020). But other times, people might report the event caused them to grow—for example, this participant might report that the crash led him to realize he is stronger than he thought, or that it made him feel a greater sense of appreciation for life (Tedeschi & Calhoun, 2004). When others learn of these consequences, does it affect their appraisals of what the event was like at the time? That is the question we address in the experiments reported here.

In fact, the consequences of negative events tell us little about what those events were like at the time. For instance, the harm people report after a negative event depends on a variety of factors, such as their general emotional reactivity, how they remember the event, and how they regulate their emotions when thinking about the event (Rubin, Dennis, & Beckham, 2011). As a result, people who experience similar events can have very different responses (Bonanno & Mancini, 2012). Likewise, reports of posttraumatic growth tell us little about how negative an event was. In fact, people report growing from all manner of negative events—from the trivial, such as breaking the screen on their phone, to Criterion A traumas (Boals & Schuler, 2019; Tedeschi & Calhoun, 2004). Taken together, the data suggest people have little empirical

foundation for drawing on the consequences of another person's event when making appraisals of the event itself.

Yet the judgment and decision-making literatures provide reasons to expect people might draw on the consequences in exactly this way. Broadly, we know that people often rely on their knowledge of the world when making judgments, and that this tendency can produce errors (Kahneman, Slovic, & Tversky, 1982). Along similar lines, we know that people draw on their beliefs or "implicit theories" about the world when appraising their own past (Ross, 1989). For example, people tend to believe that moral and political views stay relatively consistent over time. As a result, when people change their political affiliation, they often misremember their past affiliation as aligning with their current affiliation (Reiter, 1980). Perhaps, then, people might draw on their beliefs about the world when appraising other people's experiences. Consistent with this idea, one recent study found that clinical psychologists tend to associate negative events with harmful consequences, and that this association can lead to memory errors (Weine & Kim, 2018). In that study, clinicians who read that a client had extreme symptoms of post-traumatic stress tended to misremember the event as more negative than it really was. Conversely, clinicians who read that the client had only mild symptoms tended to misremember the event as less negative than it was.

But it remains unclear whether laypeople would fall victim to these same mistakes. After all, clinicians frequently encounter people who are suffering harmful consequences, a situation that would lead to the overrepresentation of negative consequences in clinicians' beliefs about negative events (Tversky & Kahneman, 1983). By contrast, laypeople might encounter a wider set of responses to negative events, which should lead to more representative beliefs about the

consequences of these events. Even so, negative events that had harmful consequences should elicit strong emotions and encourage rehearsal, and therefore would still be more memorable than negative events without such consequences (Talarico, Bohn, & Wessel, 2019; Talarico, LaBar, & Rubin, 2004; Talmi, Schimmack, Paterson, & Moscovitch, 2007). We might expect, therefore, that even laypeople would tend to believe that negative events reliably lead to negative consequences.

If laypeople do hold such a belief, we might expect that when they learn someone has grown from a negative event, this information would conflict with that belief. To resolve this conflict, people might reason that the event couldn't have been all that negative at the time, and adjust their appraisal of the event accordingly. Similarly, when people learn that someone has been harmed by a negative event, they might think that information is evidence the event was particularly negative, and adjust their appraisal of the event to fit that "evidence."

To what extent, then, do laypeople rely on reported consequences of other people's experiences to make appraisals about what those events were like at the time? Across three pre-registered experiments, we asked subjects to read someone else's first-person accounts of a negative event. We then manipulated whether that account included a statement reporting posttraumatic growth, harm, or neither, and measured subjects' appraisals of the event. Across all three experiments, our findings converge on the idea that people draw on the consequences of negative events to make appraisals about how negative those events were at the time.

Experiment 1

In Experiment 1, we asked subjects to read a genuine memory report of someone else's negative experience. We manipulated the consequences of the report by appending a description of posttraumatic growth, of harm, or neither. Our primary interest was in the extent to which subjects would use these reports of consequences to make appraisals of what the event was like at the time. The experiment was approved by the University of Waikato's School of Psychology Research Ethics Committee under the delegated authority of the University's Human Research Ethics Committee. The experiment was conducted in accordance with the ethical provisions of the World Medical Association Declaration of Helsinki. The experiment was administered online using Qualtrics (https://www.qualtrics.com/).

Method

This experiment was pre-registered, as were Experiments 2 and 3. The pre-registrations, materials, and data for all three experiments are available on the Open Science Framework (https://osf.io/82trp).

Subjects

We recruited subjects from the United States and Canada via Amazon's Mechanical Turk platform (https://www.mturk.com/) through TurkPrime (Litman, Robinson, & Abberbock, 2017). Subjects participated in exchange for $0.30 Amazon credit. Not knowing how large the effects of our manipulation might be, we aimed to collect data until we had complete responses from 600 subjects. Because of the way Mechanical Turk interacts with Qualtrics, 626 subjects completed the survey. According to our pre-registered criteria, we then excluded 4 subjects who failed the

attention check. Of the remaining 622 subjects, 41 (7%) failed to correctly identify which ending sentence (if any) they had read (harm = 9%, control = 3%, growth = 8%). These data suggest those 41 subjects did not attend to the memory report, so we excluded them from the analyses. The overall patterns do not change when these subjects are included. For completeness, we report the results with these subjects included in the Supplemental Materials in Appendix B. Therefore, our final sample consisted of 581 subjects (191 who read the growth consequence, 201 who read the harm consequence, and 189 who read nothing about consequences).

Design

We manipulated Consequences (harm, control, growth) between subjects.

Procedure

First, subjects read a description of one of four negative memories. The memory reports were drawn from a prior study in which we had asked people for the negative memory that bothers them the most now. One report described a car crash, one described the suicide of a father, one described witnessing a friend drowning, and one described being in a tornado (Taylor, Jordan, Zajac, Takarangi, & Garry, 2020). We told subjects the memory report was from a participant in one of our other studies, and that we would refer to this participant as "Participant 7" (P7) for the purposes of maintaining anonymity. The memory reports ranged between 60 and 168 words (M = 100.75; see the Supplemental Materials in Appendix B for the full memory reports and a breakdown of the results separated by memory report).

Regardless of which memory report subjects read, we manipulated the consequences of the event by adding a sentence to the end of the report. Some subjects read an added sentence

suggesting the event led to growth: “As a result of this experience I realised I’m stronger than I thought I was.” Other subjects read an added sentence suggesting the event led to harm: “As a result of this experience I realised I’m not as strong as I thought I was.” A third control group read the memory with no added ending sentence. Note that these added endings describe Participant 7’s subjective beliefs about the consequences of the event, which may or may not reflect its true consequences. In an earlier pilot study, we had found subjects rated all three versions of the memories as highly plausible and easy to understand. The results of this pilot study can be found in the Supplemental Materials in Appendix B.

Recall we hypothesized that people might draw on the reported consequences to make appraisals about what that event was like at the time—for example, after hearing another person’s report of growth, people might reason that the event couldn’t have been all that negative. We addressed this possibility in two ways. First, we asked subjects about the characteristics of the event that P7 experienced—subjects rated the valence and intensity of the event itself. Second, we asked subjects about P7’s emotional response at the time of the event—subjects rated the valence and intensity of the feelings P7 would have experienced at the time (see Table 1 for the full wording of these items). Subjects completed these two sets of ratings in counterbalanced order. We included an attention check at the end of these two sets of items: “Compared to now this is not a real question please select option five.”

We also included a series of items measuring the extent to which subjects used the consequences of the event to appraise P7’s personality. But because those results are not central to our primary research question, we report them in the Supplemental Materials in Appendix B.

Next, subjects completed a three-alternative forced-choice manipulation check asking them which sentence had appeared in the memory description they read earlier. There were always three options: the sentence suggesting growth, the sentence suggesting harm, and a third option which was “None of the above.” Finally, subjects completed basic demographics and reported what they thought the purpose of the study was.

Table 1

Items from Experiments 1 and 2

Experiment 1

Think about the event itself that Participant 7 described.

The event that Participant 7 experienced was… (1 = *Extremely negative*, 7 = *Extremely positive*)

The event that Participant 7 experienced was… (1 = *Not at all intense*, 7 = *Extremely intense*)

Think about Participant 7's feelings at the time of the event.

Participant 7's feelings at the time were… (1 = *Extremely negative*, 7 = *Extremely positive*)

Participant 7's feelings at the time were… (1 = *Not at all intense*, 7 = *Extremely intense*)

Experiment 2

This memory is significant for Participant 7's life because it imparts an important message for them or represents an anchor, critical juncture, or a turning point (1 = *Not at all*, 7 = *Completely*)

Think about the event itself that Participant 7 described.

The event that Participant 7 experienced was negative (1 = *Not at all*, 7 = *Extremely*)

The event that Participant 7 experienced was positive (1 = *Not at all*, 7 = *Extremely*)

The event that Participant 7 experienced was intense (1 = *Not at all*, 7 = *Extremely*)

Think about Participant 7's feelings at the time of the event.

Participant 7's feelings at the time were negative. (1 = *Not at all*, 7 = *Extremely*)

Participant 7's feelings at the time were positive (1 = *Not at all*, 7 = *Extremely*)

Participant 7's feelings at the time were intense (1 = *Not at all*, 7 = *Extremely*)

Results & Discussion

Our primary question was: To what extent do laypeople rely on the consequences of other people's negative events to make appraisals of what the events were like at the time? Recall we addressed this question in two ways: by asking about the valence of the event itself, and by asking about P7's emotional response at the time the event occurred.

Let us first turn to subjects' ratings of the valence of the event, which are displayed in the left panel of Figure 1. As the figure shows, across all three conditions subjects tended to rate the event as negative. But more importantly, the reported consequences mattered: subjects who read the growth consequence rated the event itself as less negative than subjects who read the harm consequence, or who read nothing about consequences, $M_{\text{diff(harm-growth)}} = 0.45$, 95% CI [0.20, 0.70], $M_{\text{diff(control-growth)}} = 0.55$ [0.30, 0.80]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was plausibly no different from zero, $M_{\text{diff(control-harm)}} = 0.10$ [-0.15, 0.35]. The reports of consequences did not affect subjects' ratings of how intense the event was (see the Supplemental Materials in Appendix B for a full breakdown).

We found a similar pattern when we examined subjects' ratings of P7's emotional response at the time the event occurred. These data are displayed in the right panel of Figure 1. Across all three conditions, subjects rated P7's feelings at the time of the event as negative. But again, the reported consequences mattered: subjects who read the growth consequence rated P7's feelings at the time of the event as being less negative than subjects who read the harm

consequence or who read nothing about consequences, $M_{diff(harm\text{-}growth)}$ = 0.95, 95% CI [0.63, 1.27], $M_{diff(control\text{-}growth)}$ = 0.73 [0.41, 1.05]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was plausibly no different from zero, $M_{diff(harm\text{-}control)}$ = 0.22 [-0.11, 0.55]. We did find, however, that subjects who read the harm consequence rated P7's feelings as more intense than subjects who read nothing about consequences, $M_{diff(harm\text{-}control)}$ = 0.39 [0.05, 0.74]. See the Supplemental Materials in Appendix B for a full breakdown of subjects' intensity ratings.

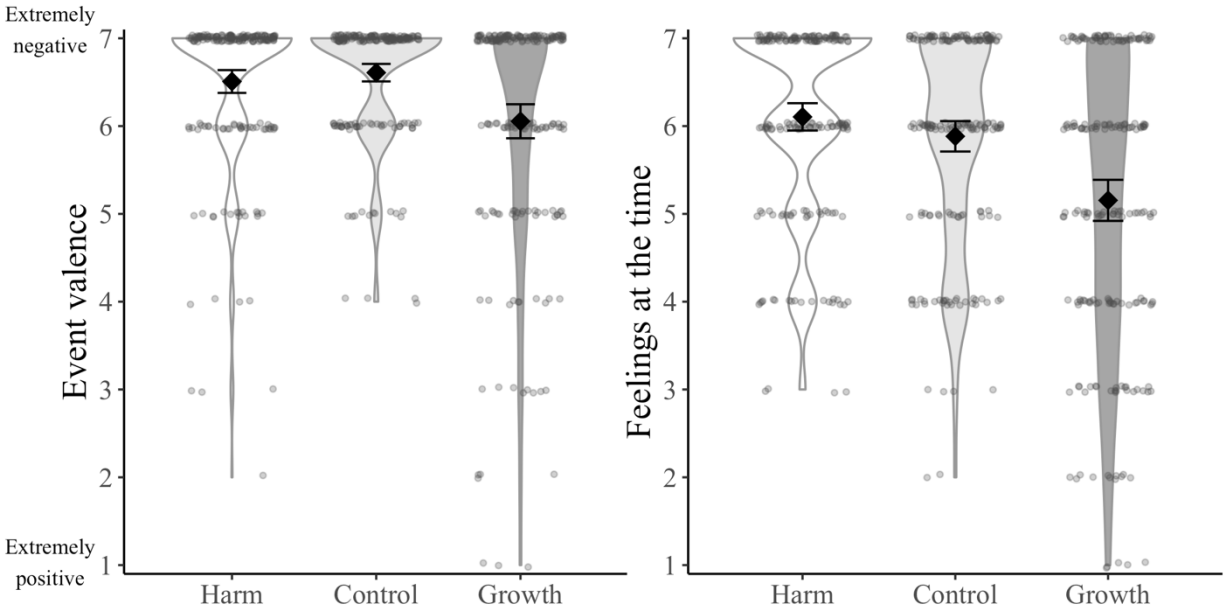

Figure 1. Violin plots of subjects' valence ratings from Experiment 1, split by condition. The left panel displays subjects' ratings of the valence of the event, the right panel displays subjects' ratings of the valence of P7's feelings at the time. Dots represent individual data points, diamonds represent the cell means, and error bars represent the 95% CI around the cell mean.

Together, both measures provide evidence for the idea that when people read about someone else's negative event, they draw on reports of growth to make appraisals about what the event was like at the time. But what are we to make of the finding that reports of harm had no effect on people's judgments about how negative the event was? It is possible that even without

any information about consequences people tend to assume that these negative events would have had harmful consequences. If that is the case, it makes sense that the report of harm would have done little to change subjects' understanding of the events. But it is also possible that these results were driven by a ceiling effect—even when P7 reported nothing about consequences, subjects rated the event as highly negative, which left little room for the harmful consequences to push people's ratings higher. We attempted to address these possible explanations in Experiment 2.

Summary

Taken together, these results show that when someone reports growing from a negative event, others tend to judge the event as being less negative at the time it happened. But one could argue that this finding is not surprising because these appraisals are warranted and logical. To see why, consider what a subject might make of the statement that "as a result of this experience I realized I'm stronger than I thought I was." It is plausible the subject might reason that the basis for this realization was that P7 was less distressed than he or she expected to be during the event itself. And if P7 was not that distressed during the event, it makes sense to infer that the event was not that negative at the time. This logic would be reasonable, and could cause the pattern of results we see here. In Experiment 2, we address this counter-explanation by making it clear that the growth or harm P7 reports was not a realization that happened at the time of the event, but instead arose only after considerable reflection. In addition, to better understand how the consequences reported by P7 affect subjects' appraisals of the event, we asked subjects to rate how significant the event would have been to P7's life story.

Experiment 2

Method

Subjects

We recruited workers on Amazon's Mechanical Turk platform in exchange for $0.30 Amazon credit. In Experiment 1 we were able to estimate effect sizes with good precision, so we again aimed to collect data until we had complete responses from 600 subjects. From a null hypothesis significance testing perspective, in Experiment 1 the differences between subjects who read about growth and subjects in the other two conditions were large (d's > 0.49). Therefore, maintaining this sample size in Experiment 2 gave us greater than 99% power to detect an effect of the same size. Because of the way Mechanical Turk interacts with Qualtrics, 630 subjects completed the survey. It was always our intention to collect data from 600 subjects, but we mistakenly wrote in our pre-registration that our intended sample size was 300 subjects. According to our pre-registered criteria, we again excluded 6 subjects who failed the attention check. Once more, we also excluded a further 70 (11%) who failed to correctly identify which ending sentence (if any) they had read (harm = 17%, control = 6%, growth = 11%), leaving us with a final sample of 554 subjects (169 who read the growth consequence, 195 who read the harm consequence, and 190 who read nothing about consequences).

Design

As in Experiment 1, we manipulated Consequences (harm, control, growth) between subjects.

Procedure

The procedure for Experiment 2 was the same as in Experiment 1, with a few exceptions. We dropped the Big Five measure, and dropped the tornado memory because it was considerably longer than the other three reports and was the only report that referenced how old "P7" was at the time of the event. Therefore, subjects read one of three negative memories: a car crash, the suicide of a father, or a friend drowning. Once again, we manipulated the consequences of the event by adding a sentence to the end of the memory. This time, however, the growth consequence was "I have reflected on this experience a lot and have come to realize that because I went through it, I have since changed for the better." The harm consequence was "I have reflected on this experience a lot and have come to realize that because I went through it, I have since changed for the worse." A third control group read the memory with no added consequence.

Next, subjects completed a series of ratings about the event P7 described. These ratings were the same as in Experiment 1, except that the items measuring the valence of the event and the valence of P7's feelings were each split into two items—one assessing positive valence and one assessing negative valence (see Table 1). We made this change in an effort to increase the variance in subjects' responses and reduce the possible ceiling effect seen in Experiment 1. Subjects also rated the intensity of the event and of P7's feelings, as in Experiment 1. We report the results of these intensity items in the Supplemental Materials in Appendix B.

Subjects then rated how significant the event would have been to P7's life story on one item: "This memory is significant for Participant 7's life because it imparts an important message for them or represents an anchor, critical juncture, or a turning point" (1 = *Not at all*, 7 =

Completely; Rubin, Schrauf, & Greenberg, 2003). Finally, subjects answered basic demographic questions and reported what they thought the purpose of the study was.

Results & Discussion

Before returning to our primary question, we first examined subjects' ratings of how significant the event would have been to P7's life story. We found that, compared to control subjects, subjects who read either the growth consequence or the harm consequence rated the event as more significant, $M_{diff(growth\text{-}control)} = 0.45$, 95% CI [0.22, 0.69], $M_{diff(harm\text{-}control)} = 0.54$ [0.30, 0.79]. Descriptive statistics for this measure can be found in Table 2. Given that subjects in those two groups had read an additional sentence explicitly stating that P7 has reflected on the experience a lot and that the event changed P7, this finding is not entirely surprising. Nonetheless, these data provide further evidence that subjects attended to the endings and considered them when making ratings about the event.

Table 2

Significance ratings from Experiments 2 and 3

Consequence	Experiment 2	Experiment 3
	M (*SD*)	*M* (*SD*)
Harm	6.52 (0.86)	6.03 (1.15)
Control	5.98 (1.18)	5.69 (1.38)
Growth	6.43 (0.86)	6.34 (0.89)

We next returned to our main question: To what extent do people rely on the consequences of other people's experiences to make appraisals of what those events were like at the time? Once again, we addressed this question in two ways: by asking about the

characteristics of the event itself, and by asking about P7's emotional response at the time the event occurred.

First, we examined subjects' ratings of the event itself. We created a combined measure of subjects' ratings of the valence of the event by reverse coding the item asking subjects how positive the event was and then calculating the mean of this reverse-coded item and the item asking subjects how negative the event was. The two event valence items were highly correlated, $r(552) = -0.80$, and the combined measure had excellent internal consistency ($\alpha = 0.89$). The overall patterns do not change when these items are considered separately. The same is true of the two feelings valence items, $r(552) = -0.76$, $\alpha = 0.86$. The data from this combined measure are displayed in the left panel of Figure 2. As the figure shows, we found a very similar pattern

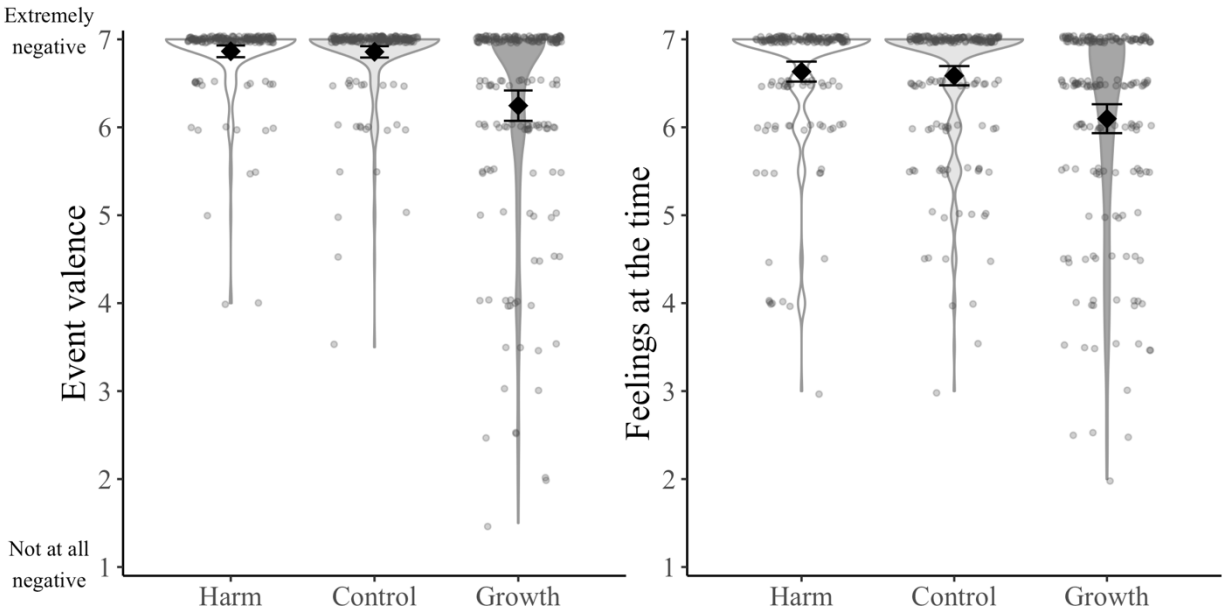

Figure 2. Violin plots of subjects' valence ratings from Experiment 2, split by condition. The left panel displays subjects' ratings of the valence of the event, the right panel displays subjects' ratings of the valence of P7's feelings at the time. Dots represent individual data points, diamonds represent the cell means, and error bars represent the 95% CI around the cell mean.

to Experiment 1. More specifically, subjects across all three conditions rated the event as negative, and we again found some evidence that the ending mattered: subjects who read the growth consequence rated the event itself as less negative than subjects who read the harm consequence or who read nothing about the consequences, $M_{diff(harm\text{-}growth)} = 0.62$, 95% CI [0.42, 0.82], $M_{diff(control\text{-}growth)} = 0.61$ [0.42, 0.81]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(harm\text{-}control)} = 0.01$ [-0.20, 0.21]. As the figure shows, we were not successful in reducing the ceiling effect in subjects' ratings.

We again found a similar pattern when we turned to subjects' ratings of P7's emotional response to the event. Here, too, we created a combined measure of subjects' ratings by reverse coding the item asking subjects how positive P7's feelings were at the time and then calculating the mean of this reverse-coded item and the item asking subjects how negative P7's feelings were at the time. The data from this combined measure are displayed in the right panel of Figure 2. Subjects rated P7's feelings at the time of the event as negative across all three conditions. But as in Experiment 1, subjects who read the growth consequence rated P7's feelings at the time as being less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{diff(harm\text{-}growth)} = 0.54$, 95% CI [0.31, 0.76], $M_{diff(control\text{-}growth)} = 0.49$ [0.27, 0.71]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was again trivial, $M_{diff(control\text{-}harm)} = 0.05$ [-0.18, 0.28].

Overall, these results suggest that people drew on the consequences of the event to make appraisals about what the event was like at the time. Perhaps most crucial for our purposes is that in this experiment it was clear the consequences P7 reported came about after the event, rather

than during the event itself. For this reason, the information about these consequences should not logically support appraisals of the event itself. Therefore, our findings provide evidence that people draw on the consequences even when doing so is unwarranted.

Considered together, Experiments 1 and 2 tell us that if, for example, someone reports growing from a car crash, people tend to judge the crash as less negative at the time it occurred. These results raise the possibility that people think extremely negative events are unlikely to lead to growth. Of course, that does not mean a report of growth will lead people to think a negative event was a joyous experience. After all, subjects in these experiments still tended to rate the events as at least somewhat negative. This pattern is hardly surprising—subjects had just read an account of the event itself. This account would provide evidence the event was, in fact, negative. Nonetheless, reading a report of growth led subjects to adjust their appraisals of the event towards it being less negative.

If people do believe that negative events are unlikely to lead to growth, they might also think that growth is a sign that the event would not have been particularly distressing in the months following the event. But this appraisal, too, would be unwarranted. After all, the literature suggests reports of growth and post-traumatic stress symptoms often go hand-in-hand (Liu, Wang, Li, Gong, & Liu, 2017). To what extent, then, do people use reports of growth to make appraisals about the distress others would have experienced following negative events? We set out to answer this question in Experiment 3 by asking subjects to rate the symptoms of distress P7 would have experienced in the months following the event.

Experiment 3

Method

Subjects

We recruited workers on Amazon's Mechanical Turk platform, who participated in exchange for $0.30 Amazon credit. We aimed to collect data until we had 450 complete responses, after exclusions. In Experiments 1 and 2, the differences between control subjects and subjects who read about growth were all large ($d > 0.49$). Using the smallest of these effect sizes ($d = 0.496$), maintaining a sample size of 600 would have given us greater than 99% power to detect an effect of that size. Reducing the sample size to 450 still left us with greater than 98% power. On that basis, we settled on 450 overall. Because of the way Mechanical Turk interacts with Qualtrics, 469 subjects completed the survey. According to our pre-registered criteria, we excluded 42 subjects who failed the attention check, and 2 subjects who provided a nonsensical description of the event they had read. Because substantially more subjects failed these attention checks than we anticipated based on the first two experiments, our sample was somewhat smaller than we planned (427). Once again, we then excluded a further 49 (11%) who failed to correctly identify which ending sentence (if any) they had read (harm = 14%, control = 6%, growth = 15%), leaving us with a final sample of 378 subjects (120 who read the growth consequence, 141 who read the harm consequence, and 117 who read nothing about consequences).

Design

As in the first two experiments, we manipulated Consequences (harm, control, growth) between subjects.

Procedure

The procedure for Experiment 3 was the same as Experiment 2, except we did not ask subjects about what the event was like at the time. Instead, we asked subjects to report the symptoms of distress they thought P7 would have experienced in the months following the event. To do so, we modified the Impact of Events Scale – Revised (IES-R; Weiss and Marmar, 1997), such that subjects rated—on a scale from 0 (*not at all*) to 4 (*extremely*)—how intensely they thought P7 would have been affected by each of 22 symptoms in the months following the event. Examples of these symptoms include "Any reminder brought back feelings about it" and "I was jumpy and easily startled." We also included an attention check in this block of items: "I struggled to this is not a real question, please select moderately." The full instructions and list of items can be found in the Supplemental Materials in Appendix B. As in Experiment 2, subjects also rated how significant the event would have been to P7's life story. Finally, as an additional attention check, we also asked subjects to describe the event they had read.

Results & Discussion

In line with Experiment 2, we found subjects who read the growth consequence rated the event as more significant to P7's life story than subjects who read nothing about consequences, $M_{\text{diff(growth-control)}} = 0.65$, 95% CI [0.31, 0.98]. Subjects who read the harm consequence rated the event as slightly more significant to P7's life story than subjects who read nothing about consequences, but the size of this effect was plausibly close to zero, $M_{\text{diff(harm-control)}} = 0.33$ [-0.02, 0.68].

We next turned to our primary question: To what extent would people draw on other people's reports of growth to make appraisals about the distress those people experienced in response to a negative event? To answer this question, we followed the usual practice for scoring the IES-R and summed together, for each subject, their ratings about the 22 symptoms. We then took this new sum—which could range between 0 and 88—and classified it according to whether the subject read the growth consequence, the harm consequence, or nothing about consequences. This measure had excellent internal consistency ($\alpha = 0.94$). We display these results in Figure 3.

As the figure shows, subjects who read the growth consequence thought P7 would have experienced less intense symptoms of distress in the months following the event than subjects who read the harm consequence or who read nothing about consequences, $M_{\text{diff(harm-growth)}} = 11.10$, 95% CI [6.61, 15.59], $M_{\text{diff(control-growth)}} = 5.41$ [0.88, 9.93]. These results suggest that subjects were using P7's report of growth to make appraisals about his or her symptoms of distress in the months following the event—consistent with the findings from the first two experiments. Furthermore, we found that subjects who read the harm consequence thought that P7 would have experienced more intense symptoms of distress in the months following the event than subjects who read nothing about consequences, $M_{\text{diff(harm-control)}} = 5.69$ [0.99, 10.39]. These

results suggest that subjects drew on reports of harmful consequences to make appraisals of P7's experience. Furthermore, these results provide some evidence that the lack of any effect of the harmful consequence on subjects' ratings in the first two experiments was driven by a ceiling effect. These patterns hold true across each of the subscale scores (see the Supplemental Materials in Appendix B).

So far, we have examined how subjects' ratings of symptoms depended on the consequences they read. But the absolute level of these symptom ratings is also informative. If we again turn to Figure 3, the horizontal line (at a score of 33) represents the level of symptoms

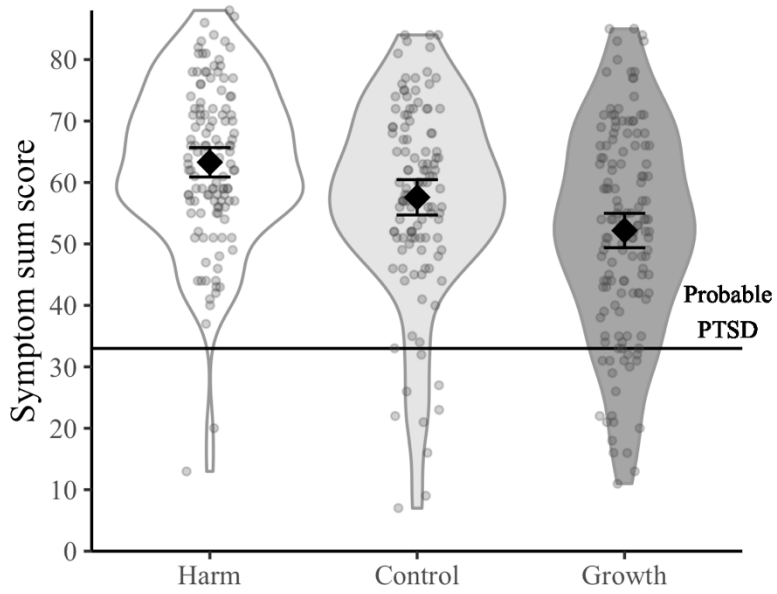

Figure 3. Violin plot of symptom ratings split by condition. Dots represent individual data points, diamonds represent the cell means, and error bars represent the 95% CI around the cell means.

on the self-scored version of the IES-R that would indicate the probable presence of posttraumatic stress disorder (Creamer, Bell, & Failla, 2003). As Figure 3 shows, subjects in all three conditions tended to rate P7's symptoms as being well above this cutoff level, (M_{harm} = 63,

$M_{control}$ = 58, M_{growth} = 52). In fact, 92% of all subjects rated P7's symptoms above this cutoff. These high symptom ratings also hold true across all three memory reports—91% who read the car crash report rated symptoms above cutoff, 93% who read the father's suicide report, and 92% who read the friend drowning report. These results fit with the possibility subjects believe negative events like these reliably lead to severe symptoms of distress—despite the fact the literature suggests that such extreme distress is rare (Bromet, Karam, Koenen, & Stein, 2018).

General Discussion

Across three experiments and 1513 subjects, we investigated the extent to which people draw on the consequences of other people's negative events to make appraisals about what those events were like at the time. We found that people who read someone grew from a traumatic event tended to rate that event as less negative than people who read the same event with no report of consequences. Moreover, they expected that person to experience fewer symptoms of distress in the subsequent months. In addition, people who read that someone was harmed by a traumatic event tended to expect that person to experience more severe symptoms of distress than people who read the same event with no report of consequences. These results converge on the idea that people use information about the consequences of other people's experiences to reason backwards, making unwarranted appraisals about what the events were like at the time.

A critic might argue, however, that the way subjects adjusted their appraisals about the event was actually quite reasonable, given the information subjects had about the consequences. After all, even among distressing events, there is a general tendency for events at the extreme to result in more harmful consequences than their less extreme counterparts (Rind, Tromovitch, & Bauserman, 1998). But relying on these kinds of general tendencies when making judgments can

often produce errors (Kahneman, Slovic, & Tversky, 1982). For instance, harm is not a reliable sign that an event was particularly negative at the time. In fact, the harm caused by an event is more a function of how people remember that event than what the event was like at the time, which in turn depends on a number of characteristics—such as how intensely that person tends to experience emotions or how often that person ruminates about negative events (Rubin, Dennis, & Beckham, 2011). But even if there is some merit in drawing on a report of harm to decide that an event was highly negative, there is no merit in drawing on a report of growth to decide an event was less negative. If anything, the evidence suggests that the more negative an event was, the more people think they have grown as a result of that event—a pattern that goes against the appraisals subjects made in our experiments (Liu, Wang, Li, Gong, & Liu, 2017).

Why, then, would subjects rely on people's reports of consequences when making these appraisals? One explanation is that subjects drew on their general beliefs that traumatic events reliably lead to harmful consequences. This explanation fits with the finding from Experiment 3 that subjects across all three conditions expected P7 to experience high levels of symptoms of distress. If subjects did draw on such a belief, Participant 7's statement of growth would have conflicted with this belief. How would subjects resolve such a conflict? One possibility is that subjects would update their beliefs about traumatic events to fit this new evidence that traumatic events can lead to growth. But this possibility would not explain why subjects adjusted their appraisals of what the event was like at the time. That pattern of results instead fits with another possibility: that subjects held on to their beliefs about the consequences of traumatic events and changed their appraisals of what the event was like at the time—in other words, they changed their interpretation of the evidence to fit their beliefs. To the extent that people believe traumatic events reliably lead to harmful consequences, this belief would not square with the research. In

fact, the majority of people who experience negative events like the ones depicted in our materials actually tend to respond with resilience, and rarely go on to report lasting symptoms of distress (Bonanno, 2004; Bromet, Karam, Koenen, & Stein, 2018; Galatzer-Levy, Huang, & Bonanno, 2018). How people come to hold these inaccurate beliefs, and how they might be corrected are important questions for future research to address.

The idea that people might believe traumatic events reliably lead to harmful consequences is reminiscent of the affective forecasting literature, in which people are asked to predict how they would respond to a positive or negative event if it were to happen to them in the future (Wilson & Gilbert, 2003). Typically, people overestimate their reaction to the event—so, in the case of negative events, people overestimate how much distress the event will cause them. Yet we might still expect people to be more optimistic about their own chances of growing from a traumatic event than they are about others' chances of growing from a similar event. After all, people tend to be more optimistic about their own future than they are about others' futures Weinstein (1980). Moreover, people view themselves as improving over time more so than other people (Wilson & Ross, 2001). One avenue for future research, then, would be to compare people's predictions about how they might respond to a traumatic event to their predictions of how others might respond to that event.

To what extent, though, are these effects likely to be practically meaningful? One could argue that the effects reported here are relatively small—after all, even when subjects read an event led to growth, they still tended to rate the events as negative. But there are reasons to think these effects might be more pronounced in real-world situations. In these experiments, we designed our materials to provide a strong test of our hypothesis—the memory reports described

Criterion A events that were unambiguously terrible, and we added only a short, one-sentence description of the consequences. When the circumstances of an event are more ambiguous, or when the report of consequences is more extensive, people might be even more likely to adjust their appraisals of the event on the basis of the consequences. After all, we know that under conditions of uncertainty, people tend to rely more on causal inferences, and decision-making tends to be particularly swayed by heuristics (Tversky & Kahneman, 1974; Tversky & Kahneman, 1982). Nonetheless, the extent to which the effects reported here have real-world consequences for the actions of family members, friends, and jurors is an empirical question, and our hope is that these experiments prompt future research on this topic.

In these experiments, we aimed to tap into subjects' appraisals of what negative events were like at the time they happened. But it remains unclear how reports of consequences affect listeners' appraisals of how the memories affect the rememberer in the long term. For example, a report of growth might lead listeners to conclude the memory continues to serve helpful functions for the rememberer, while a report of harm might lead them to conclude it continues to serve harmful functions. In future, it might be useful to give subjects the opportunity to appraise both the event at the time and its later effects on the rememberer's thinking and behavior. Doing so might better illuminate the relationships between people’s appraisals of what an event was like at the time and their appraisals of the subsequent effects that memory has on thinking and behavior.

There are, of course, several limitations to these experiments. First, we used only a small set of memory reports across all three experiments. Although these reports described a range of different events, and we found similar patterns across these events, we do not know the extent to

which these effects generalize to other events. Second, the memory reports featured short, broad statements of consequences; other ways of describing growth or harm might produce different effects. For instance, a more specific report of growth that steps subjects through the process of how that growth came about might make it easier to understand how one could grow from a negative event. In that case, the report of growth might be less likely to change subjects' appraisals of what the event was like at the time. Third, as one of our dependent measures in Experiments 1 and 2, we asked subjects to rate the extent to which "the event Participant 7 experienced" was positive or negative. Our aim here was to tap into subjects' appraisals of what the event was like at the time it happened. But it is possible some subjects interpreted "the event" as encompassing both the event itself and its subsequent consequences. To the extent that some subjects interpreted the question this way, it would be perfectly reasonable for those subjects to adjust their ratings on the basis of Participant 7's report of consequences. Finally, we did not tell subjects how much time had passed between the event and when the memory report was written. This information might have important effects on the extent to which people would draw on the consequences, because people are especially likely to draw causal links between events and subsequent consequences when those consequences occur soon after the event (Lagnado & Sloman, 2006).

These results have implications for our understanding of the functions of autobiographical memory (Alea & Bluck, 2003; Pillemer, 1992). More specifically, the results demonstrate that when people share their own appraisal of how an event has affected them, listeners use that information to make appraisals of both the event itself and the people sharing the memory. If, in turn, listeners tend be less empathetic or less likely to realize that someone is still dealing with distress, this situation could be an example of how memories can serve a maladaptive social

function (Burnell, Rasmussen, & Garry, 2020). Furthermore, there is evidence that people extract lessons from other people's memories, and use those memories to guide their own behaviour—a clear example of a directive function (Pillemer, Steiner, Kuwabara, Thomsen, & Svob, 2015). To fully understand these functions, it is important that future research continue to investigate the factors that affect how people appraise and use the memories that others share with them.

These results also add to a literature showing that the consequences reported by victims in court can affect how willing jurors are to find the defendant guilty in criminal cases, and how much liability jurors attribute to the defendant in civil cases (Davis, Kerr, Stasser, Meek, & Holt, 1977; Greene, Johns, & Bowman, 1999). Although some have theorized that these effects might reflect jurors' desire to seek vengeance for the victim's suffering (Davis, Kerr, Stasser, Meek, & Holt, 1977), our findings suggest the consequences reported by the victim might alter jurors' interpretations of the facts of the case. This possibility fits with work showing that jurors often develop a story of the case, and adjust their interpretation of new facts to fit within this story (Carlson & Russo, 2001; Pennington & Hastie, 1992).

Taken together, the three experiments reported here show that people use the consequences of others' experiences to make unwarranted appraisals of what those experiences were like at the time. These findings raise the possibility that people hold beliefs about negative events that do not square with reality, and highlight the importance of understanding how people interpret and use the memories others share with them.

Author contributions

R. Burnell and M. Garry developed the study concept together. R. Burnell created the experimental materials, organized data collection, and performed all data analyses. R. Burnell drafted the manuscript, and M. Garry provided critical revisions.

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Data availability

All numerical data have been made available via the Open Science Framework, along with the analysis script (https://osf.io/82trp). Our ethical approval precludes us from making subjects' written responses publicly available, but these responses are available on request.

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Chapter 4: Memories people no longer believe in can still affect them in helpful and harmful ways

Manuscript under review at *Memory and Cognition*:

Burnell, R., Nash, R. A., Umanath, S., & Garry, M. (2021). Memories people no longer believe in can still affect them in helpful and harmful ways. Manuscript under review at *Memory & Cognition*.

Abstract

People can come to "remember" experiences they never had, and these false memories—much like memories for real experiences—can serve a variety of helpful and harmful functions. Sometimes, though, people realize one of their memories is false, and retract their belief in it. These "retracted memories" continue to have many of the same phenomenological characteristics as their believed memories (e.g. Mazzoni et al., 2010). But can they also continue to serve functions? Across four experiments, we asked subjects to rate the extent to which their retracted memories serve helpful and harmful functions, and compared these functions to those served by "genuine" autobiographical memories. We found that people's retracted memories still served both helpful and harmful functions, and to a similar extent as their genuine memories. Furthermore, we found only weak relationships between people's belief in their memories and the extent to which those memories served functions. These results suggest memories can serve functions even in the absence of belief, and highlight the potential for false memories to affect people's thinking and behavior even after people have retracted them.

Keywords: False memory, Memory Functions, Autobiographical memory

Memories people no longer believe in can still affect them in helpful and harmful ways

A participant in one of our studies recounted a vivid memory of an accident that occurred while he was renovating his home. During the renovations, he told us, a piece of metal flew into his eye. The doctors explained that although his eyesight would be unaffected, they could not remove the metal. But a few years later, when this man was getting an MRI scan, he learned there was no piece of metal in his eye. He came to realize his memory was completely false; there had been no accident, and no trip to the doctor. These false memories—like real memories—can be very compelling, and affect people's thinking and behavior in both helpful and harmful ways (Bernstein, Laney, Morris, & Loftus, 2005; Laney, Morris, Bernstein, Wakefield, & Loftus, 2008; Pillemer, 1992). For example, our participant's memory might have led him to be more cautious in his home repairs or to worry about the metal lurking in his eye. But even after he realized the accident never really happened, this man still retained a vivid "memory" of the event. Could this memory, once retracted, still affect his behavior?

This question is important to answer, because this man's experience is far from an isolated case. In fact, the literature suggests approximately 20% of adults can think of at least one "memory" of an event they now realize never really happened (Mazzoni, Scoboria, & Harvey, 2010). These "memories" have been referred to in the literature as "nonbelieved memories," and are typically defined as "a vivid memory for an event that you used to believe was true, however for some reason you stopped believing that the memory was in fact true. However, the nonbelieved memory continues to feel similar to an actual memory for a true event" (Mazzoni, Scoboria, & Harvey, 2010; Scoboria, Talarico, & Pascal, 2015). These sorts of memories

comprise a class of memories of interest for a variety of theoretical and practical reasons (Otgaar, Scoboria, & Mazzoni, 2015).

But are these memories best described as "nonbelieved memories?" It is true that, as a package, people are no longer willing to call the memories real. Yet people often report belief in at least some aspects of these memories—a finding that does not square with the term "nonbelieved" (Scoboria, Nash, & Mazzoni, 2017). Of course, this continued belief is hardly surprising in light of the work showing false memories typically feature plausible arrangements of people, places, and objects (Hyman, Husband, & Billings, 1995; Hyman & Kleinkneckt, 1999; Mazzoni, Loftus, & Kirsch, 2001). Also, the term "nonbelieved memories" does not convey a crucial feature of these memories—that people once believed in the parts of the memory they eventually realized were not real. To address these two concerns, we turned to the false memory literature, in which the term "retracted" has long been used to describe memories people used to believe, but no longer do (Lief & Fetkewicz, 1995; Ost, 2017). "Retracted memories" can accommodate memories in which people hold some belief, but which don't, ultimately, meet the threshold to be endorsed as real. Moreover, the term "retracted" echoes usage in legal settings, in which retracting means to formally withdraw a legal document that had been put forward. For all these reasons, we suggest the term "retracted memories" would better capture the class of memories people have come to realize are false. It is therefore the term we adopt here.

To understand the potential for these retracted memories to affect people's thinking and behavior, we first need to consider the effects of "genuine" autobiographical memories. The literature suggests that autobiographical memories have at least three broad helpful functions (Bluck, Alea, Habermas, & Rubin, 2005; Pillemer, 1992). First, they *direct* people's thinking and

behavior—for example, by providing lessons that people can use to solve problems and plan for the future (Addis, Wong, & Schacter, 2007; Pillemer, 2003). Second, they help people maintain a coherent and positive sense of *self*—for instance, the memory of an academic success might give people confidence that they are intelligent and capable (Conway, 2005; Ross & Wilson, 2003). Third, people share their memories with others in ways that help forge and maintain vital *social* relationships—for example, people might discuss an emotional experience to elicit empathy from friends or family (Alea & Bluck, 2003). Recent evidence suggests memories can also serve harmful versions of these functions—for example, leading people to make the wrong decision or to have a negative sense of self (Burnell, Rasmussen, & Garry, 2020). Could retracted memories still serve these functions, helpful and harmful, even after people have retracted them? That is the question we address here.

On the one hand, there are reasons to think retracted memories might not continue to serve functions. From an evolutionary perspective, it would not be particularly adaptive for people to rely on memories they know are wrong (Nairne, Pandeirada, & Thompson, 2008; Scoboria, Mazzoni, & Boucher, 2017). After all, it has been suggested that a key evolutionary advantage of memory is that it enables organisms to remember their past experiences and adjust their subsequent behavior accordingly (Klein, Cosmides, Tooby, & Chance, 2002). For example, humans' ability to remember where to find food and water provides obvious survival advantages (Ginsburg & Jablonka, 2010). But if these memories were wrong, relying on them might not be adaptive—there would be little utility in seeking out a watering hole that never existed. In fact, relying on these memories might even be maladaptive, leading to unnecessary expenditure of time and energy. Therefore, when people realize one of their autobiographical memories is false, we might expect them to stop relying on it. Indeed, there is some evidence for this idea. In one

study, some subjects were led to falsely remember reading a "lure" word from a Deese-Roediger-McDermott list (Deese, 1959; Otgaar, Moldoveanu, Wang, & Howe, 2017; Roediger & McDermott, 1995). Later, when asked to solve a problem related to the lure word, subjects' performance depended on whether they believed in this false memory. Subjects who believed they saw the lure word tended to be faster at solving the problems than subjects who never developed this false memory. But more importantly, subjects who initially believed they saw the lure word, but were then told their memory was wrong, did not show this advantage. These findings fit with the idea that when people stop believing in a memory, that memory is less likely to guide their thinking and behavior.

On the other hand, there are reasons to think retracted memories might continue to serve functions. For one thing, when people imagine events that might happen in the future, they clearly do not believe those events have happened. Yet these future thoughts can have profound effects on thinking and behavior (Daniel, Stanton, & Epstein, 2013; Suddendorf & Corballis, 2007; see also Garry, Manning, Loftus, & Sherman, 1996; Sanson, Newman, & Garry, 2018). Perhaps, then, the vivid phenomenological characteristics of these thoughts help drive them to serve functions. Consistent with this idea, vivid phenomenological characteristics have been linked with the functions of memories. Autobiographical memories often contain valuable perceptual, spatial, and temporal information people can draw on, and which helps cue memories when they are needed (Pillemer, 1992; Schacter & Madore, 2016; Tulving, 1985; Williams, 2007). Therefore, if retracted memories retain these episodic characteristics, they might continue to serve functions. Indeed, when people retract their belief in a memory, many of the characteristics of that "memory"—including the sense of reliving that accompanies it—remain relatively unaffected (Mazzoni, Scoboria, & Harvey, 2010; Scoboria et al., 2014). Why? One

possible explanation is that belief is not an inherent or stable property of a memory. Instead, it is an attribution people make in the moment, based on factors such as the phenomenological characteristics of that memory, whether it makes logical sense, and whether it fits with other supporting memories (Johnson, Foley, Suengas, & Raye, 1988; Johnson, Hashtroudi, & Lindsay, 1993; Sanson, Cardwell, Rasmussen, & Garry, 2020; Taylor, Jordan, Zajac, Takarangi, & Garry, 2020). Therefore, if belief is simply an attribution, retracting a memory should have minimal impact on the characteristics of that memory. And if these phenomenological characteristics are what drives memories to serve functions, we might expect retracted memories to continue serving functions.

To what extent, then, do retracted memories serve functions? If belief in memories is important for those memories to serve functions, we should expect retracted memories to serve functions to a lesser extent than "believed" memories. But if functions depend at least in part on phenomenological characteristics, retracted memories should continue to serve at least some functions. Across four pre-registered experiments, we addressed this question by asking people to report the helpful and harmful functions of their retracted memories. We then compared these functions to those served by their believed memories.

Experiment 1

In Experiment 1, we measured the helpful and harmful functions of people's retracted memories, and compared these functions to those served by memories that people still believe. This Experiment was pre-registered; the pre-registrations, supplemental materials, and data for all experiments reported in this paper are available on the Open Science Framework (https://osf.io/q3sjm/?view_only=6ae3a6f255df46b98c53bcd50b6afb7a). These experiments

were approved by the University of Waikato's School of Psychology Research Ethics Committee under the delegated authority of the University's Human Research Ethics Committee.

Method

Subjects

We recruited workers on Amazon's Mechanical Turk platform (MTurk; https://www.mturk.com/) through TurkPrime (Litman, Robinson, & Abberbock, 2017)[2]. Subjects participated in exchange for Amazon credit. We aimed to collect data until 400 subjects had completed the survey. Because of the way MTurk interacts with Qualtrics, 414 subjects completed the survey. According to our pre-registered criteria, we then excluded 16 subjects who did not provide an autobiographical memory—for example, one subject simply wrote "good." In addition to these pre-registered exclusions, we excluded a further 14 who clearly misunderstood the instruction to provide a retracted memory—for example, several subjects wrote about negative experiences they wish had never happened. Finally, we excluded 7 subjects who provided a believed memory outside the requested 4-10 age range[3], leaving us with our final sample of 377 subjects.

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[2] We found similar results in an in-person pilot study we conducted with undergraduates—see the Supplemental Materials for a summary of this pilot.

[3] The pattern does not change when these subjects are included.

Design

We employed a quasi-experimental design with Memory (retracted, believed) as a between-subjects factor.

Procedure

First, we provided subjects with a description of a retracted memory, adapted from the literature (Mazzoni et al., 2010):

"Sometimes people have a memory for an event, but they stop believing the event really happened to them. Nevertheless, their 'memory' for the event continues to feel like a real memory."

Then, we asked subjects whether they have one of these memories. Subjects who said "yes" were asked to describe the memory. Subjects who said "no" served as our comparison group—these subjects provided a "believed" memory that occurred between age 4-10. We used this age range in an attempt to match the age of these believed memories to the age of the retracted memories, which mostly fell within this age range in one of the landmark studies of retracted memories (Mazzoni et al., 2010).

Next, we asked subjects to rate their nominated memory on four pairs of items that measure the extent to which a memory is helpful and harmful, such as "This memory guides my thinking and behavior in ways that help me" and "This memory guides my thinking and behavior in ways that hurt me" (Burnell et al., 2020; Rasmussen & Berntsen, 2009). These items and their anchors appear in Table 1. Then, subjects rated their belief in the memory on a single item, and reported how old they were when the event "occurred" (see Table 1). Finally, subjects who

described a retracted memory were asked when and why they stopped believing in the memory. Because the reasons why subjects stopped believing in their memories are not central to our research question, we report those results in the Supplemental Materials in Appendix C.

Table 1

Function, belief, and valence items from Experiments 1, 2, and 3

Helpful functions
This memory guides my thinking and behavior in ways that help me (1 = *Not at all*, 7 = *To a very high degree*)
This memory tells me about my identity in ways that help me (1 = *Not at all*, 7 = *To a very high degree*)
I share this memory with other people in ways that help me (1 = *Not at all*, 7 = *To a very high degree*)
This memory gives me a sense of belonging with other people (1 = *Not at all*, 7 = *To a very high degree*; Experiments 1 & 2 only)
Harmful functions
This memory guides my thinking and behavior in ways that hurt me (1 = *Not at all*, 7 = *To a very high degree*)
This memory tells me about my identity in ways that hurt me (1 = *Not at all*, 7 = *To a very high degree*)
I share this memory with other people in ways that hurt me (1 = *Not at all*, 7 = *To a very high degree*)
This memory gives me a sense of disconnection from other people (1 = *Not at all*, 7 = *To a very high degree*; Experiments 1 & 2 only)
Belief
I believe this event really occurred in the way I remember it, and that I have not imagined or fabricated anything that did not occur (1 = *100% imaginary*, 7 = *100% real*)
Valence (Experiments 2 and 3 only)
The feelings I experience as I recall the event are positive (1 = *Not at all*, 7 = *Extremely*)
The feelings I experience as I recall the event are negative (1 = *Not at all*, 7 = *Extremely*)

Results

Before turning to our primary research question, we first classified subjects according to whether they reported having a retracted memory. We found that 106 people (28%) reported having a retracted memory, and 271 people (72%) reported they do not have any. Examples of subjects' retracted memories include "I remember being chased by geese at my 8th birthday party in a park, but I feel like I may have gotten that memory from a television show" and "I remember really driving my parent's car when I was a little kid with my younger sister holding the pedals." In the mean, subjects' descriptions were 36.19 words long (*SD* = 25.53, *Mdn* = 28, range = 4-127). Examples of subjects' believed memories include "When I was 7 a friend accidentally hit me with a metal bat and I had to go to the hospital to receive stitches" and "I remember my 5th birthday party. We had a pinata and a ton of people came. I remember it was probably the biggest party I had as a child." In the mean, subjects' descriptions were 38.22 words long (*SD* = 24.03, *Mdn* = 34, range = 3-147).

As expected, subjects believed their retracted memories less than the believed memories (see Table 2). This finding, which suggests residual belief in some retracted memories, fits with prior work (Scoboria et al., 2014; Scoboria, et al., 2017). Subjects believed in their retracted memories for a mean of 9.09 years (*SD* = 9.35) before retracting them, which in turn occurred 12.38 years (*SD* = 10.65) prior to the study. The retracted memories also "occurred" at a later age than subjects' believed memories ($M_{\text{retracted}}$ = 13.63, *SD* = 10.47, *Mdn* = 10.50, range = 0-59; M_{believed} = 6.49, *SD* = 1.76, *Mdn* = 6, range = 4-10).

Table 2

Subjects' belief ratings for each experiment

Experiment	Believed			Retracted			M_{diff}	95% CI
	M	*Mdn*	*SD*	*M*	*Mdn*	*SD*		
Experiment 1	6.24	7.00	1.24	4.51	5.00	1.94	1.73	[1.33, 2.14]
Experiment 2	6.41	7.00	1.07	3.81	4.00	2.06	2.60	[2.17, 3.02]
Experiment 3	5.96	7.00	1.42	3.67	4.00	1.99	2.29	[2.02, 2.55]
Experiment 4	5.84	6.00	1.16	3.98	4.00	1.50	1.86	[1.67, 2.05]

We now turn to our primary question: To what extent do people's retracted memories serve helpful and harmful functions? To answer this question, we created a measure of helpful function by taking the mean of the items measuring the helpful directive, self, and social functions for each memory. Likewise, we created a measure of harmful function by taking the mean of the items measuring the harmful directive, self, and social functions. Both measures had good internal reliability ($\alpha_{helpful} = 0.85$, $\alpha_{harmful} = 0.88$). We display the results of these two measures in Figure 1—the left side displays subjects' ratings of their retracted memories, and the right side displays subjects' ratings of their believed memories. As the distribution on the left side of the figure shows, many subjects rated their retracted memories as at least moderately helpful and harmful. Furthermore, if we compare these ratings to subjects' ratings of their believed memories, we see the two types of memories were rated as similarly helpful, $M_{retracted} = 3.06$; $M_{believed} = 3.18$; $M_{diff} = 0.12$, 95% CI [-0.27, 0.51]. Likewise, subjects' believed and retracted memories were rated as similarly harmful, $M_{retracted} = 2.49$; $M_{believed} = 2.18$; $M_{diff} = 0.32$,

95% CI [-0.02, 0.66]. These results suggest that many people think their retracted memories continue to serve helpful and harmful functions.

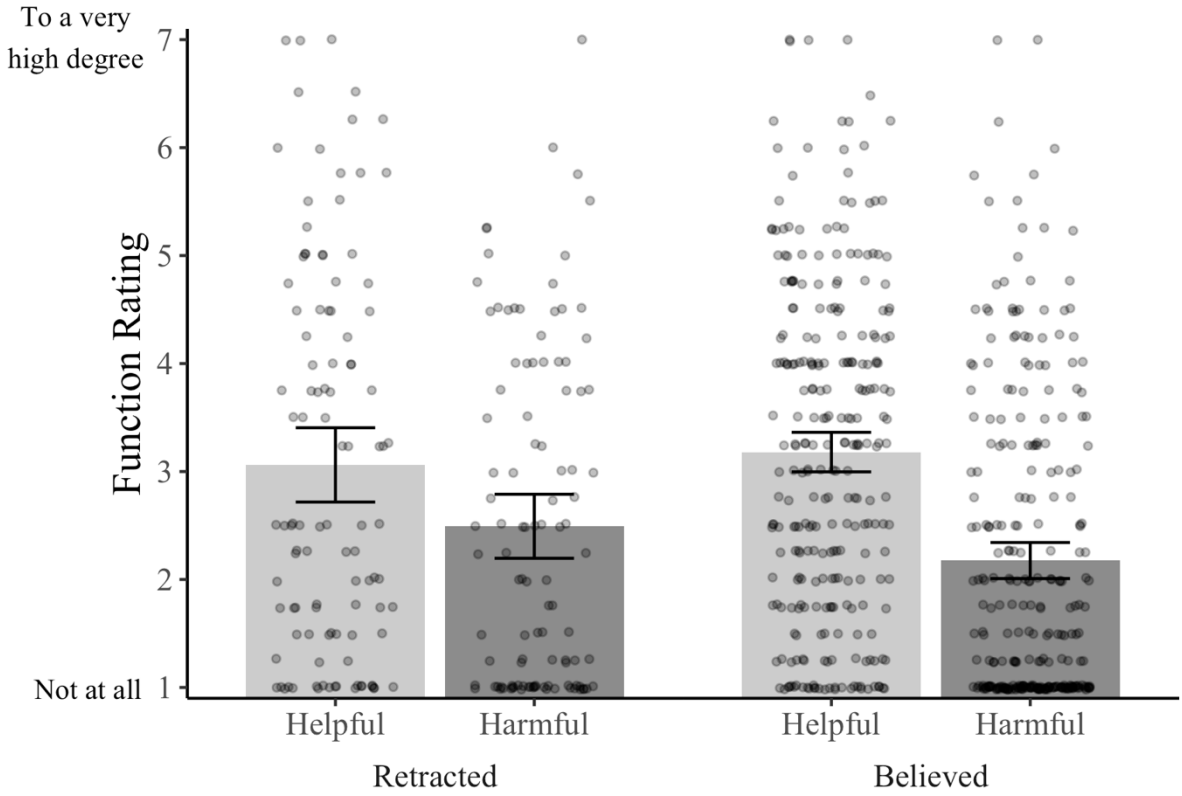

Figure 1. Subjects' ratings from Experiment 1 of the extent to which their nominated memory serves helpful and harmful functions. Bars represent the mean values; dots represent individual data points. Error bars represent the 95% CIs around the cell means.

One interpretation of these findings is that people do not need to believe a memory is "real" for that memory to serve functions. But there is another possible explanation. As we reported earlier, subjects reported some residual belief in their retracted memories (see the Supplemental Materials in Appendix C for the distribution). For this reason, it is possible that the

retracted memories served functions only because subjects still held some belief in them. If this account were true, we might expect the memories subjects believed most would be the ones that were the most helpful or harmful. Indeed, exploratory analyses provided some evidence for this account. For instance, among subjects' retracted memories, the more people reported believing in their memory, the more helpful they rated that memory as being, $r(104) = 0.34$, 95% CI [0.16, 0.50]. Likewise, the more people reported believing in their memory, the more harmful they rated that memory as being, although this relationship was plausibly no different from zero, $r(104) = 0.17$, 95% CI [-0.02, 0.35]. These findings raise the possibility that the extent to which people believe in a memory is related to the functions that memory serves. But given our relatively small sample of retracted memories and the wide confidence intervals around these correlations, it is difficult to draw conclusions (Schönbrodt & Perugini, 2013).

One limitation of these data is that subjects' retracted memories tended to be for events that "occurred" at a later age than the believed events. To the extent that recent events might be more vivid and more relevant to people's current situation, these differences in how long ago the believed and retracted events occurred might be masking differences between believed and retracted memories that would otherwise be apparent. There were two main reasons that subjects' retracted and believed memories were not well-matched on age. First, subjects tended to provide a believed memory from the lower end of the 4-10 age range we gave them—perhaps because our instructions encouraged a search starting at age 4. Second, there was a wider spread in the ages at which subjects' retracted memories "occurred" than we anticipated based on prior research (Mazzoni et al., 2010; see the Supplemental Materials in Appendix C for a full breakdown of the age distribution). Therefore, we next sought to replicate Experiment 1 using a

comparison group of believed memories that more closely matched the retracted memories. Experiment 2 was not pre-registered, but followed the same analytic approach as Experiment 1.

Experiment 2

Method

Subjects

We recruited workers on MTurk through TurkPrime (Litman et al., 2017). Subjects participated in exchange for Amazon credit. We aimed to collect data until 400 subjects had completed the survey. Because of the way MTurk interacts with Qualtrics, 414 subjects completed the survey. As in Experiment 1, we excluded 17 subjects who did not provide an autobiographical memory and a further 14 who misunderstood the instruction to provide a retracted memory, leaving us with our final sample of 383 subjects.

Design

We again employed a quasi-experimental design with Memory (retracted, believed) as a between-subjects factor.

Procedure

The method for Experiment 2 was the same as in Experiment 1, with three exceptions. First, given the wide range of belief ratings we saw in Experiment 1, we attempted to clarify the definition of a retracted memory. We provided subjects with the following description:

Sometimes people have a memory for an event, but they come to realize the event never happened at all—their "memory" was completely false. Nevertheless, their "memory" for the event continues to feel like a real memory, even though they know the event didn't really happen.

Second, we sought to elicit an age distribution of believed memories that was closer to that of the retracted memories. To do so, we asked subjects who did not have any retracted memories to describe a "believed" memory that occurred before the age of 15. Third, recent work suggests negative memories, in particular, are often harmful (Burnell et al., 2020). Therefore, we asked subjects to rate the valence of their memory on two items: one measuring the extent to which the memory elicits positive feelings, and one measuring the extent to which the memory elicits negative feelings (see Table 1).

Results

As in Experiment 1, we classified subjects according to whether they reported having a retracted memory. In this experiment, 101 people (26%) reported having one, and 282 people (74%) reported not having any. An example of a retracted memory was: "I remember going to a theme park with my family when I was younger and I remember stuff we did but they tell me that we never went anywhere." Subjects' descriptions of their retracted memories were 39.55 words long in the mean (*SD* = 22.12, *Mdn* = 34, range = 5-109). An example of a believed memory was: "I remember seeing my grandma the last time before she died hoping it would not be the last." Subjects' descriptions of their believed memories were 41.27 words long in the mean (*SD* = 24.73, *Mdn* = 36.50, range = 4-174).

Once again, subjects' retracted memories were believed less than subjects' believed memories (see Table 2). Our revised instructions elicited memories that were believed less than

in Experiment 1. In the mean, the retracted memories were believed for 7.04 years (*SD* = 7.72), and were retracted 12.67 years ago (*SD* = 11.80). Our revised instructions also brought the age distributions closer together than in Experiment 1, but the retracted memories still occurred later than the believed memories, $M_{retracted}$ = 14.99, *SD* = 12.60, *Mdn* = 8, range = 1-55; $M_{believed}$ = 10.08, *SD* = 3.36, *Mdn* = 11, range = 1-15.

Next, we returned to our primary research question: to what extent do retracted memories serve functions in helpful and harmful ways? As Figure 2 shows, we replicated the findings of Experiment 1. More specifically, many subjects reported their retracted memories serve helpful and harmful functions to at least a moderate degree. Furthermore, we again found no evidence that people think their retracted memories are less harmful than believed memories, $M_{retracted}$ = 2.32; $M_{believed}$ = 2.23 M_{diff} = 0.09, 95% CI [-0.22, 0.40]. We did, however, find that the retracted memories tended to be rated as slightly less helpful than believed memories, $M_{retracted}$ = 2.97; $M_{believed}$ = 3.35; M_{diff} = 0.38, 95% CI [0.06, 0.71]. Together, these results provide further evidence that people think their retracted memories continue to serve helpful and harmful functions.

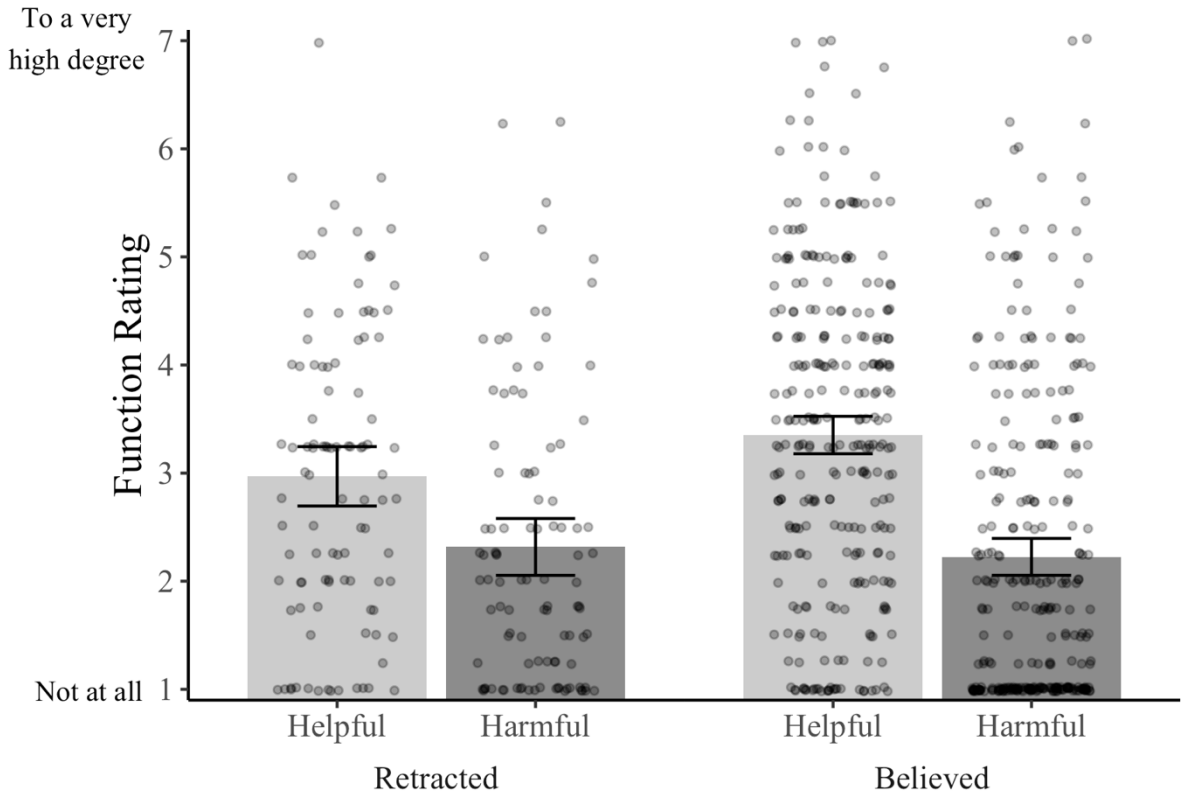

Figure 2. Subjects' ratings from Experiment 2 of the extent to which their nominated memory serves helpful and harmful functions. Bars represent the mean values; dots represent individual data points, and error bars represent the 95% CIs around the cell means.

As in Experiment 1, we next examined the relationship between subjects' belief in their retracted memories and the degree to which those memories serve functions. In this experiment, we found no evidence of a relationship between belief and helpful functions—the correlation between these two variables was plausibly no different from zero, $r(99) = 0.16$, 95% CI [-0.03, 0.35]. Likewise, the relationship between belief and harmful function was plausibly zero, $r(99) = 0.07$, 95% CI [-0.13, 0.26]. Taken together, we found no compelling evidence to suggest that belief is important for memories to serve functions.

But subjects' retracted and believed memories were still not well matched for how long ago the events "occurred." Therefore, in Experiment 3, we yoked subjects' believed memories to their retracted memories to ensure the two types of memories were matched on age.

Experiment 3

To allow us to easily yoke subjects' believed memories to their retracted memories, we switched to a within-subjects design—when subjects reported having a retracted memory, we asked them to describe both that memory and a believed memory that "occurred" around the same time. In addition, to examine the relationships between the phenomenological characteristics of people's retracted memories and the functions those memories serve, we added a series of items measuring phenomenological characteristics from the Autobiographical Memory Questionnaire (Rubin, Schrauf, & Greenberg, 2003, 2004). Finally, we markedly increased our sample size so we could draw stronger conclusions from the correlations between belief and functions. This experiment was pre-registered.

Method

Subjects

We recruited workers on MTurk through TurkPrime (Litman et al., 2017). Subjects participated in exchange for Amazon credit. We aimed to collect data until 800 subjects had completed the survey to ensure we had a big enough sample of retracted memories to establish stable correlations between belief and functions (Schönbrodt & Perugini, 2013). Because of the way MTurk interacts with Qualtrics, 827 subjects completed the survey. According to our pre-registered criteria, we excluded 40 subjects who failed both attention checks, 13 who did not

provide an autobiographical memory, and 67 who misunderstood the instruction to provide a retracted memory, leaving us with our final sample of 707 subjects.

Design

We manipulated Memory (retracted, believed) within subjects.

Procedure

First, we asked subjects if they have any retracted memories, using the same instructions as in Experiment 2. Subjects who said "yes" were asked to describe the memory, and then to report how old they were at the time the "event" happened. We then asked those same subjects to describe a memory they really do believe that happened at the same age. If they could not think of one, we asked them to choose an event that occurred as close to that age as possible. Subjects who did not have any retracted memories rated two believed memories, but because the data from these subjects is not central to our research question, we report those data in the Supplemental Materials in Appendix C.

Next, subjects rated each memory, in counterbalanced order, on a series of scales—completing the full set of scales for one memory before rating the other. First, subjects rated the functions of the memory and their belief in it using the items from Experiments 1 and 2. We removed the function items asking about belonging/disconnection from others because the social belonging function is less agreed upon in the literature (Rasmussen & Berntsen, 2009). Then, subjects completed 17 items measuring the phenomenological characteristics of the memory, such how vivid the memory is, and the extent to which it is accompanied by a sense of reliving

(see the Supplemental Materials in Appendix C for the full list of items and the results for each item; Rubin et al. 2003). Finally, subjects reported when and why they retracted the memory.

Results

Once again, we classified subjects according to whether they reported having a retracted memory. A larger percentage of subjects reported having a retracted memory than in the first two experiments: 321 people (45%) reported they have one, and 386 people (55%) reported they do not have any. Recall that in this experiment, our key comparison was within subjects—we asked subjects who had a retracted memory to report both that memory and a believed memory from a similar time. For this reason, we report here only the data from subjects who reported having a retracted memory.

In the mean, subjects' descriptions of their retracted memories were 33.30 words long (*SD* = 21.51, *Mdn* = 29, range = 4-130). Subjects' descriptions of these believed memories were 25.18 words long in the mean (*SD* = 17.54, *Mdn* = 21, range = 2-109).

As in Experiments 1 and 2, subjects believed their retracted memories less than their believed memories (see Table 2). In the mean, the retracted memories were believed for 5.94 years (*SD* = 7.31), and were retracted 15.88 years ago (*SD* = 12.27). Unlike Experiments 1 and 2, subjects' believed memories and retracted memories "occurred" at a similar age ($M_{\text{retracted}}$ = 14.67, *SD* = 12.75, *Mdn* = 10, range = 0-68; M_{believed} = 14.61, *SD* = 12.32, *Mdn* = 10, range = 1-68).

Now, we return to our primary question. As the distributions in Figure 3 show, we found converging evidence for the idea that many retracted memories serve helpful and harmful

functions. In contrast to Experiment 1, but consistent with Experiment 2, subjects rated their retracted memories as less helpful than their believed memories, $M_{retracted} = 3.00$; $M_{believed} = 3.74$; $M_{diff} = 0.74$, 95% CI [0.55, 0.93]. Subjects' believed and retracted memories were rated as similarly harmful, $M_{retracted} = 2.27$; $M_{believed} = 2.26$; $M_{diff} = 0.01$, 95% CI [-0.13, 0.16].

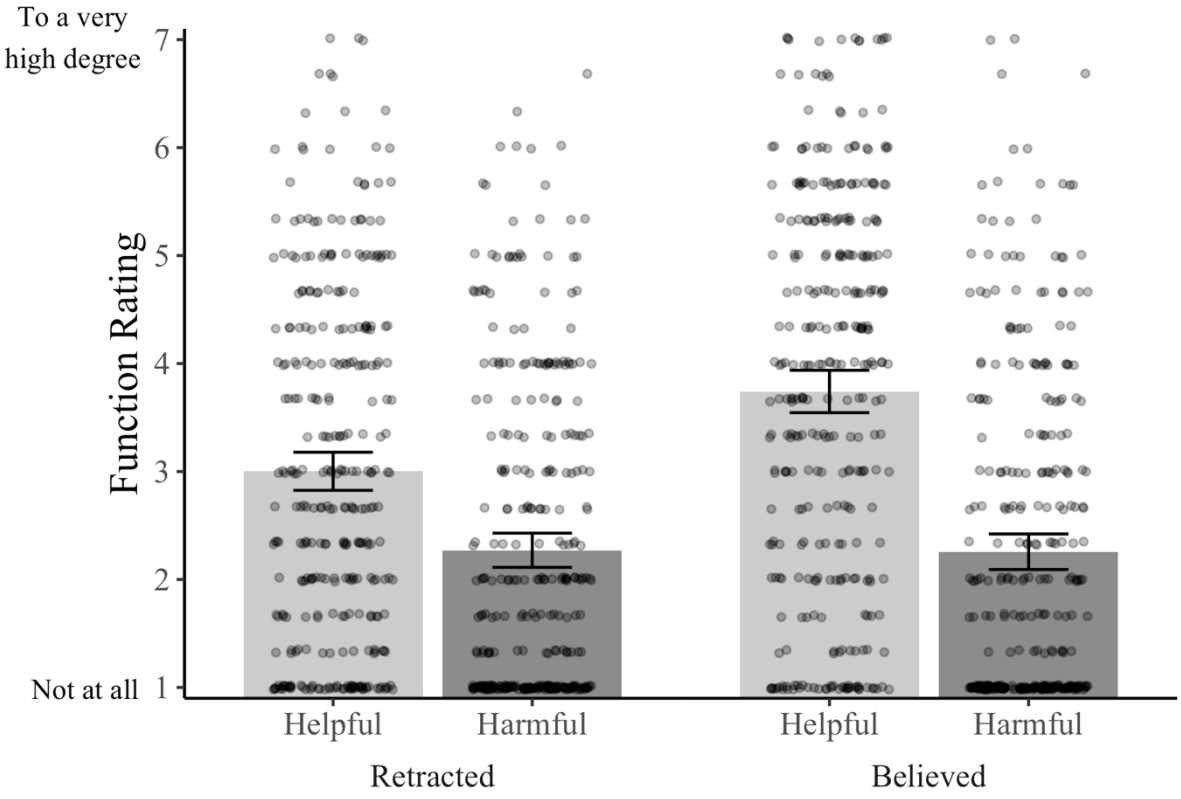

Figure 3. Subjects' ratings from Experiment 3 of the extent to which their believed and retracted memories serve helpful and harmful functions. Bars represent the mean values; dots represent individual data points, and error bars represent the 95% CIs around the cell means.

These differences in helpful functions once again raise the possibility that belief in a memory is important for that memory to serve helpful functions. Consistent with this idea, we found that the more people believed in a retracted memory, the more helpful it tended to be,

$r(319) = 0.37$, 95% CI [0.27, 0.46]. We also found that that the more people believed in a retracted memory, the more harmful it tended to be, although this relationship was less strong, $r(319) = 0.14$, 95% CI [0.03, 0.25]. These results suggest belief might be related to the functions memories serve.

But there is an important counter-explanation for these results. Because of our design, we were not able to manipulate belief independently of other memory characteristics. In fact, we found that subjects' retracted memories were also different from believed memories in phenomenology—a finding consistent with previous work (Mazzoni et al., 2010). For example, retracted memories were rated as less vivid than believed memories, $M_{\text{retracted}} = 4.92$; $M_{\text{believed}} = 5.46$; $M_{\text{diff}} = 0.54$, 95% CI [0.36, 0.72] and were accompanied by a less intense sense of reliving, $M_{\text{retracted}} = 4.47$; $M_{\text{believed}} = 5.04$; $M_{\text{diff}} = 0.56$, 95% CI [0.38, 0.75]. To get a better picture of the relationship between belief and the functions of memory, it is important to consider the contribution of the phenomenology of memory.

Therefore, we conducted exploratory regressions to further investigate how the functions of retracted memories are related to belief and two key components of phenomenology: reliving and vividness (Rubin, Deffler, & Umanath, 2019). We conducted two linear regressions using the data from subjects' retracted memories: one with belief, vividness, and reliving predicting helpful function, and one with belief, vividness, and reliving predicting harmful function. As Table 3 shows, both belief and reliving were independently related to the helpful functions served by subjects' retracted memories such that the more people believed in a memory, and the more the memory was accompanied by a sense of reliving, the more helpful people rated it. In addition, belief was related to harmful functions such that the more people believed in a memory,

the more harmful they rated it—although the size of this effect is plausibly very small. These results are consistent with the hypothesis that belief is important for memories to serve functions, and suggest that a sense of reliving might also be important—at least for helpful functions.

Table 3

Standardized Beta estimates from the regressions from Experiment 3 predicting helpful and harmful functions among subjects' retracted memories

	Reliving		Vividness		Belief	
Dependent Measure	*β* [95% CI]	*p*	*β* [95% CI]	*p*	*β* [95% CI]	*p*
Helpful Function	0.21 [0.09, 0.32]	.001	0.09 [-0.04, 0.21]	.162	0.27 [0.19, 0.36]	<.001
Harmful Function	0.03 [-0.08, 0.15]	.635	0.04 [-0.09, 0.16]	.589	0.12 [0.03, 0.20]	.045

Given that we found no evidence that phenomenology is related to harmful functions, what other factors might drive memories to serve these harmful functions? One recent study found evidence of harmful functions only in memories of negative events, a finding that might suggest the valence of a memory is important (Burnell et al., 2020). Because a fair number of the retracted memories in this study were negative—30.53% were rated above the midpoint on the item assessing negative feelings—we conducted exploratory correlations between the extent to which a memory elicits negative feelings and the extent to which it serves harmful functions. We found that the more a memory elicited negative feelings, the more harmful it was rated, $r(319) = 0.42$, 95% CI [0.33, 0.51]. Furthermore, adding negative feelings to the regression model predicting harmful functions showed that this relationship held even after accounting for belief, reliving, and vividness ($p < .001$; see the Supplemental Materials in Appendix C for the full regression table). By contrast, the relationship between negative feelings and helpful functions was trivial, $r(319) = 0.04$, 95% CI [-0.07, 0.15]. These findings suggest that characteristics

specific to negative memories, such as the emotions those memories elicit or the kinds of events that these memories depict, might be important for memories to serve harmful functions.

Taken together, these first three experiments provide some evidence that belief is related to the helpful functions a memory serves—or, at least, to the functions people think the memory serves. But this possibility merits further investigation, for several reasons. First, the regression analyses we conducted in this experiment were exploratory. Second, we have so far used only single-item measures of belief, reliving, and vividness that might not capture all aspects of those constructs. Third, we have so far treated helpful functions as one unitary construct. But it is possible the relationships between belief and functions might be different for different functions. For example, people might not draw on retracted memories when making decisions, but might still talk about those memories with others to forge relationships—after all, people often embellish or even lie about their experiences when talking to others (Marsh & Tversky, 2004).

Therefore, in Experiment 4, we sought to conduct a more robust, pre-registered investigation of the relationships between belief, reliving, and helpful functions. And to ensure we gathered memories with a wide enough range of belief to see meaningful relationships, we broadened our memory prompt instructions—rather than asking people for a memory they have completely retracted, we asked them for the memory about which they have the most doubts[4].

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[4] A pilot study established this prompt elicits memories held with varying degrees of belief, see the Supplemental Materials.

Experiment 4

Experiment 4 departed from the previous experiments in a number of ways. First, rather than asking people for retracted memories, we asked them for the memory they have the most doubts about. Second, we employed multi-item measures of belief, reliving, and vividness adapted from the Autobiographical Memory Questionnaire (see Rubin et al., 2019). Third, to better enable us to separately examine directive, self, and social functions, we used a different measure of functions: the Thinking About Life Events questionnaire, which includes five items measuring each of the directive, self, and social functions (TALE; Bluck & Alea, 2011). This experiment was pre-registered.

Method

Subjects

We recruited workers on MTurk through TurkPrime (Litman et al., 2017). Subjects participated in exchange for Amazon credit. Because we anticipated most subjects would be able to think of a memory they doubt, we aimed to collect data until 400 subjects had completed the survey. Because of the way MTurk interacts with Qualtrics, 413 subjects completed the survey. According to our pre-registered criteria, we excluded 13 subjects who failed both attention checks, 90 subjects who failed to provide two autobiographical memories, and 14 subjects who reported they could not think of a memory they doubt, leaving us with our final sample of 298 subjects.

Design

We manipulated Memory (doubted, believed) within-subjects.

Procedure

First, we provided subjects with a description of a doubted memory: "Sometimes people have doubts about particular memories of their past experiences—that is, they doubt whether the events they remember really happened at all."

Then, we asked subjects to describe the memory they have the most doubts about. To provide a believed memory comparison, we asked subjects to describe a memory that happened to them during their early childhood[5].

Next, subjects rated the functions, belief, and phenomenology of each memory. Subjects made these three sets of ratings in counterbalanced order, and completed all ratings for one memory before rating the other.

Functions. Subjects rated the functions of their memory on the TALE (Bluck & Alea, 2011). We adapted this questionnaire to ask about a specific memory (see the Supplemental Materials in Appendix C). In this scale, subjects complete 15 items that ask about how often they

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[5] We used this prompt, rather than yoking the believed memories to the retracted memories as we did in Experiment 3, so as to counterbalance the order in which people provided and rated the two memories. In Experiment 3, we piloted this prompt among subjects who did not have any retracted memories (see the Supplemental Materials).

think or talk about the memory for a series of reasons, on a scale from 1 (almost never) to 5 (very frequently). Five of the items ask about reasons that map on to the directive function, five about reasons that map onto the self function, and five about reasons that map onto the social function. Note that this scale measures only helpful functions—we did not include a measure of harmful functions because in Experiment 3 belief was only a weak predictor of harmful functions and we found no evidence that vividness or reliving predicts harmful functions.

Belief. Subjects rated their belief in the memory on the three items from Rubin et al. (2019). The first of these items was the belief item from Experiments 1-3. The second was "My memory of the event is an accurate reflection of the event as a neutral observer would report it and is not distorted by my beliefs, motives, and expectations" (1 = 100% distorted, 7 = 100% accurate). The third was "Would you be confident enough in your memory of the event to testify in a court of law?" (1 = Not at all, 7 = As much as any memory).

Phenomenology. Subjects rated the sense of reliving produced by the memory using three items from Rubin et al. (2019), all rated from 1 (not at all) to 7 (as if it were happening now): "While remembering, it is as if I am living the occurrence again."; "While remembering, it is as if I am mentally traveling back to the time and place of the occurrence."; and "While remembering, it is as if I am experiencing the same feelings, emotions, and/or atmosphere again." Subjects rated the vividness of the memory using two items, also from Rubin et al., on a scale from 1 (not at all) to 7 (as vivid as if it were happening now): "While remembering, I can see everything in my mind." and "While remembering, the actions, objects, and/or people that are involved in the memory are as clear now as they were when the event occurred."

Results

We first checked that subjects' doubted memories were rated lower on belief than their "believed" memories from a similar time. They were, $M_{doubted}$ = 3.98; $M_{believed}$ = 5.84; M_{diff} = 1.86, 95% CI [1.67, 2.05]. Examples of subjects' doubted memories include "I have a memory about my learning to ride a bike. I remember my dad teaching me to ride the bike when I was 5 years old, but my aunt said that my dad was out of town and she taught me. My aunt has been known to stir up trouble so I am not really sure if I can believe her. My dad said that he taught me" and "I have doubts about my memory of my grandmother's death."

Before we addressed our primary aim, we next examined subjects' ratings of the functions served by their doubted memories. Recall that in this experiment, we used a function scale that measures only the degree to which a memory is helpful. We created a sum variable for each of the directive, self, and social functions by taking the mean of the 5 items from the TALE measuring that function. We display these function sum variables for the doubted and believed memories in Figure 4. As the figure shows, subjects rated the functions of the two types of memory as remarkably similar. More specifically, we found no difference between doubted and believed memories in terms of directive functions, $M_{doubted}$ = 1.93, $M_{believed}$ = 1.86, M_{diff} = 0.07, 95% CI [-0.03, 0.17]; self functions, $M_{doubted}$ = 1.88, $M_{believed}$ = 1.84, M_{diff} = 0.04, 95% CI [-0.07, 0.14]; or social functions, $M_{doubted}$ = 1.83, $M_{believed}$ = 1.90, M_{diff} = 0.07, 95% CI [-0.03, 0.17]. These results replicate the findings of the previous experiments, and provide further support for the idea that memories can serve functions even when people doubt the veracity of the memories.

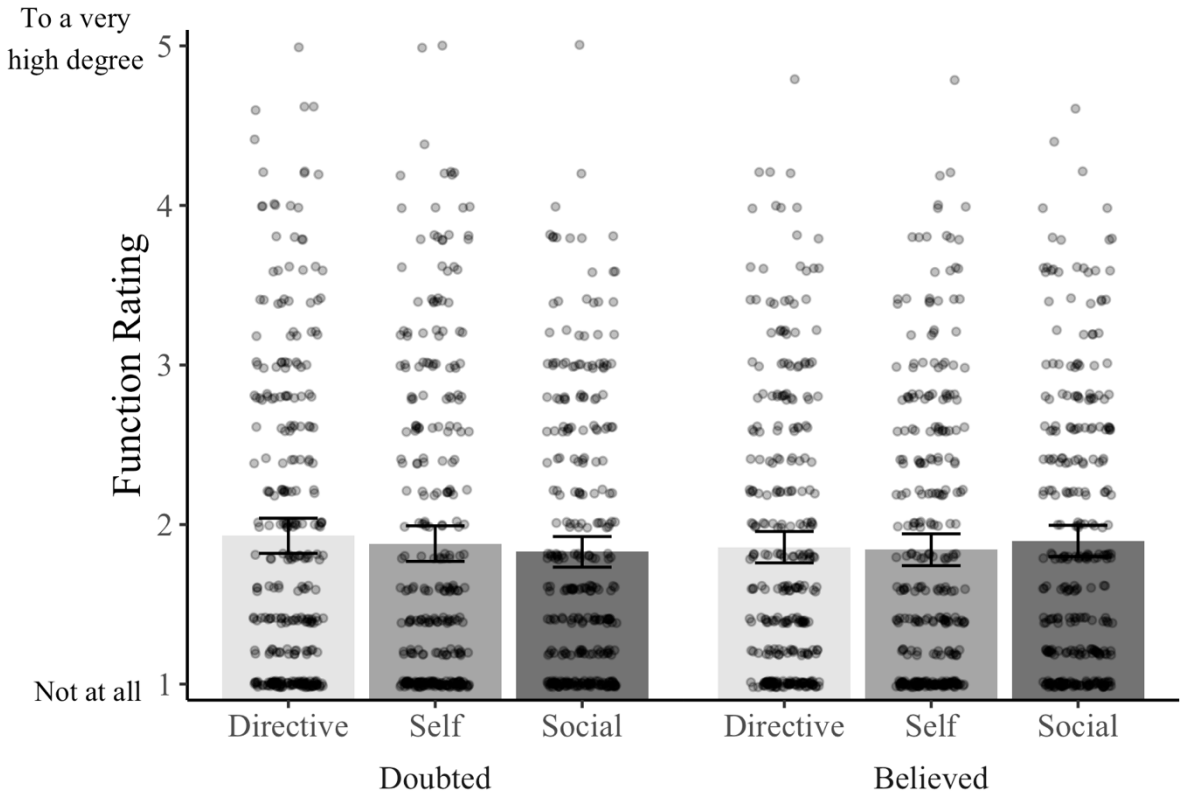

Figure 4. Subjects' ratings from Experiment 4 of the extent to which their believed and doubted memories serve helpful and harmful functions. Bars represent the mean values; dots represent individual data points, and error bars represent the 95% CIs around the cell means.

Next, we addressed our primary aim: to investigate the relationships among belief, recollection, and self-reported helpful functions. To do so, we created a sum variable for reliving by calculating the mean of the three items measuring reliving, and a sum variable for vividness by calculating the mean of the two items measuring vividness. Then, for each type of memory (doubted and believed), we conducted three pre-registered linear regressions—one for each function—with belief, vividness, and reliving as predictors.

We first consider the results from the regressions conducted on subjects' ratings of their doubted memories, displayed in the top half of Table 4. As the table shows, reliving predicted the directive and self functions of subjects' doubted memories, such that the more a memory was accompanied by a sense of reliving, the more it tended to serve those two functions. There was again no evidence that vividness was related to the functions of these doubted memories. These findings are consistent with the pattern we found in Experiment 3. But in contrast to Experiment 3, we found no evidence that belief predicted the functions of doubted memories.

We next consider the regressions conducted on subjects' ratings of their believed memories, displayed in the bottom half of Table 4. Here, too, we found that reliving predicted the directive and self functions, such that the more a believed memory was accompanied by a sense of reliving, the more it tended to serve those functions. We also found that belief predicted the directive and social functions of subjects' believed memories, such that the more subjects believed in a memory, the less it tended to serve these functions. This pattern of results is the opposite of what we would expect if belief in a memory is important for that memory to serve functions—and provides some evidence against this hypothesis.

Taken together, we did not find evidence to suggest that belief is important for memories to serve functions. Instead, the most consistent finding from these regression analyses was that the more a memory was accompanied by a sense of reliving, the more people rated it as serving directive and self functions.

Table 4

Standardized Beta estimates for the regressions from Experiment 4

Dependent Measure	Reliving		Vividness		Belief	
	β [95% CI]	*p*	*β* [95% CI]	*p*	*β* [95% CI]	*p*
Doubted Memories						
Directive function	0.14 [0.02, 0.25]	.018*	-0.03 [-0.14, 0.07]	.550	0.09 [-0.03, 0.20]	.138
Self function	0.13 [0.02, 0.25]	.026*	-0.02 [-0.13, 0.08]	.650	0.05 [-0.07, 0.16]	.441
Social function	0.02 [-0.08, 0.12]	.669	0.05 [-0.04, 0.14]	.284	-0.01 [-0.11, 0.10]	.910
Believed Memories						
Directive function	0.14 [0.04, 0.25]	.007*	0.07 [-0.04, 0.17]	.231	-0.18 [-0.31, -0.05]	.007*
Self function	0.21 [0.11, 0.31]	<.001*	0.02 [-0.08, 0.13]	.665	-0.11 [-0.24, 0.02]	.084
Social function	0.05 [-0.06, 0.15]	.372	0.09 [-0.02, 0.20]	.120	-0.14 [-0.27, -0.01]	.041*

Meta analyses

Across the four experiments, our findings about the relationships between belief and functions were inconsistent. For example, in Experiment 1 we found a moderate positive correlation between belief and helpful function, but in Experiment 2 that relationship was smaller and plausibly zero. Therefore, to obtain more precise estimates of the strength of these relationships, we followed recommendations from Cumming (2014) and conducted two exploratory (not pre-registered) mini meta-analyses.

First, we conducted a meta-analysis of the relationships between belief and helpful functions across the four experiments. As the top panel of Figure 5 shows, this analysis suggested there was a small, positive correlation between belief and helpful functions. Next, we conducted a meta-analysis of the relationships between belief and harmful functions across the

first three experiments (we did not measure harmful functions in Experiment 4). As the bottom panel of Figure 5 shows, we also found a small positive relationship between belief and harmful functions. Given that the four experiments differed in some aspects of their design, the overall

effect size estimates should be considered with some caution. But across the board, the results suggest belief is, at best, weakly related to the functions people think their memories serve.

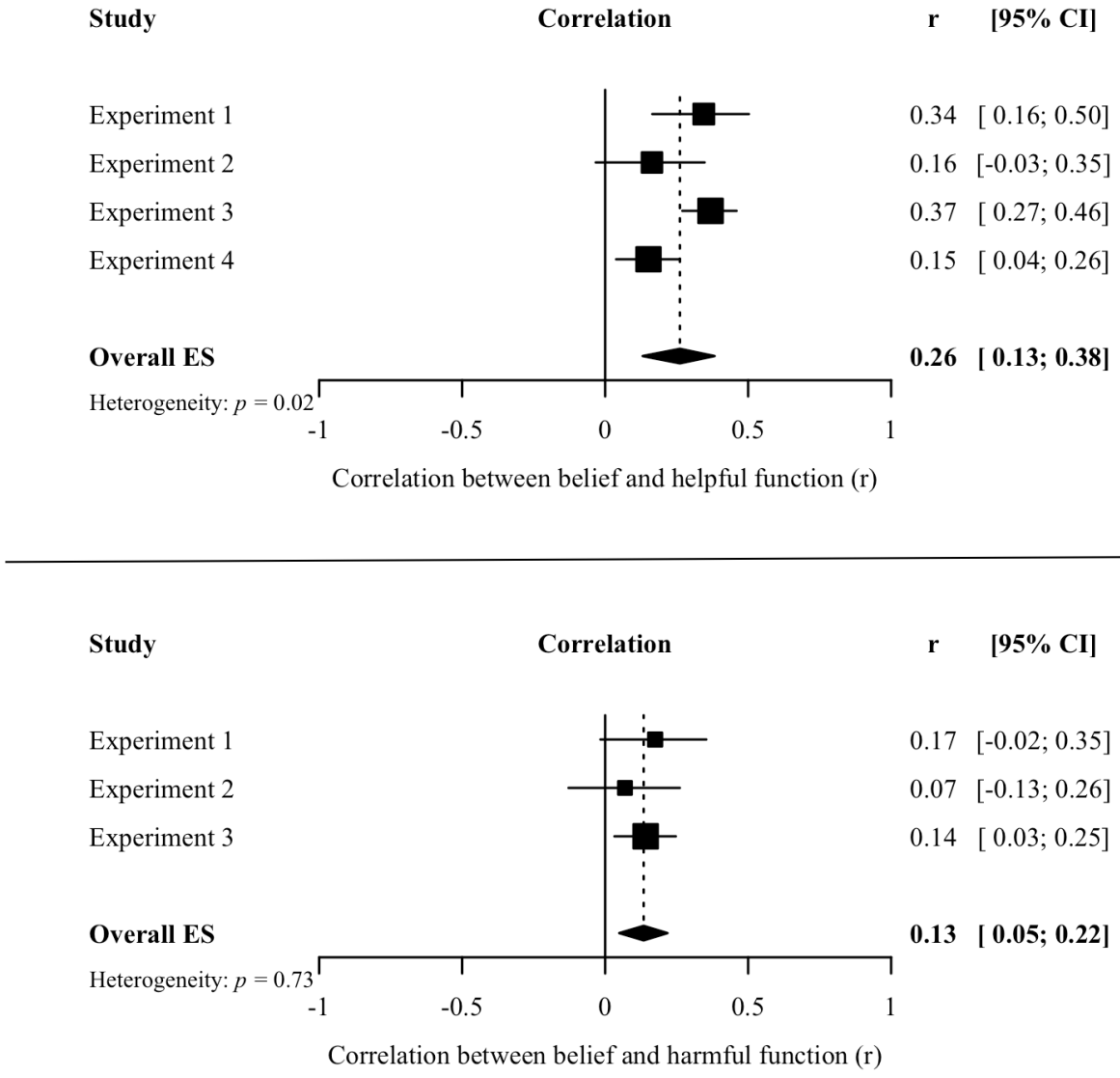

Figure 5. Forest plots of the relationships between belief and functions. The top panel displays the forest plot of the correlations between belief and helpful functions. The bottom panel displays the forest plot of the correlations between belief and harmful functions. Squares represent the correlations for each experiment, diamonds represent the overall effect size estimate from the meta-analyses.

General Discussion

Across four experiments, we investigated the extent to which retracted memories continue to serve functions. We consistently found evidence that people think their retracted memories serve helpful and harmful functions, and found only weak relationships between people's belief in a memory and the reported functions of the memory. We also found in both Experiments 3 and 4 that the more a memory was accompanied by a sense of reliving, the more helpful it tended to be—even after controlling for subjects' belief in the memory.

Taken together, our findings do not support the hypothesis that belief is important for memories to serve functions. If belief were important, we would expect the memories people have retracted to serve functions less than the memories they still believe. But we instead found that people think their retracted memories continue to serve functions to a similar degree as believed memories. In addition, the mini meta-analyses showed that belief was, at best, only weakly related to helpful and harmful functions. Moreover, in Experiment 4 these relationships did not hold after controlling for vividness and sense of reliving. Considered together, our data fit with the idea that believing a memory is "real" is not a pre-requisite for that memory to serve functions.

Our findings do, however, support the hypothesis that the phenomenology of memory plays a role in at least some memory functions—we consistently found relationships between a sense of reliving and ratings of helpful functions, even after controlling for subjects' belief in the memory. These findings are consistent with other literatures showing that both thoughts about the future and counterfactuals about the past can evoke emotions and influence behavior, even though people do not believe those events have happened (Daniel et al., 2013; Rasmussen & Berntsen, 2013; Roese, 1994). These findings also extend work investigating the relationships

between memory characteristics (Rubin et al., 2019). But we found no evidence that the phenomenology of memory plays a role in harmful functions—neither reliving nor vividness predicted ratings of harmful functions in Experiment 3. Our results raise the possibility that helpful and harmful functions are driven by different factors. In support of this possibility, we found that the negative feelings elicited by a memory were related to subjects' ratings of harmful functions, but there was no such relationship with helpful functions. If it is the case that different factors drive helpful and harmful functions, what would such a pattern suggest? One interpretation is that helpful and harmful functions are not entirely parallel, and might be better thought of as distinct functions—albeit with some conceptual similarities.

Of course, our quasi-experimental designs make it difficult to establish causality, so it is important that future research manipulates factors that might drive memories to serve functions. One way to further investigate the role of belief would be to implant false memories and measure the effects of those memories, after debriefing, on people's behavior. For instance, in one study, subjects were led to believe they loved asparagus the first time they tried it (Laney et al., 2008). This false memory influenced subjects' behavior, leading them to rate asparagus as more appealing than subjects without the false memory. Researchers could use this paradigm to measure the extent to which these effects continue after subjects learn their asparagus memory is false. Such an experiment would provide a stronger test of how important it is for people to believe a memory for that memory to serve functions.

In this study, we investigated how the characteristics of a memory are related to the functions served by that memory. But it would also be useful to investigate how the characteristics of the person recalling the memory are related to the functions of that memory.

After all, we know that some people place more importance on their memories than others, and also that people's emotion regulation strategies during memory recall vary markedly (see Rubin, Dennis, & Beckham, 2011). Therefore, in much the same way that two people who experience similar traumas can have very different responses, two people who have similar memories might be affected by those memories in different ways (Bonanno, 2004). By furthering our understanding of how memory functions are related to both the characteristics of memories and the characteristics of the people remembering them, we might be better able to reduce any harmful effects memories might have.

These experiments, of course, have several limitations. First, we investigated the role of belief in functions by comparing retracted memories to ones people still believed. But we found that these memories differed not only in belief, but in phenomenology—for example, believed memories were accompanied by a stronger sense of reliving. Although we attempted to address this limitation by controlling for reliving and vividness in our regression models, the differences in phenomenology between retracted and believed memories made it difficult to isolate the effects of belief. Second, our findings rely on subjects' self-reports of the functions their memories serve. Although this approach is commonly used in the literature, it is a complex metacognitive task that requires subjects to bring to mind occasions during which they had previously thought about the memory, and then to evaluate how the memory affected their thinking and behavior on those occasions (Bluck & Alea, 2011). Because of the complexity and retrospective nature of this task, behavioral evidence would address these issues more directly. Third, we asked people only about the functions their memories currently serve. It is therefore impossible to know with any degree of precision how, if at all, people's memories changed when they were retracted. One possibility is that these memories continued to serve the same functions

as they did before the retraction. It is also possible that some functions have reduced, while other new functions arose—for example, people might have stopped relying on the memory itself when making decisions, but might now be less trusting of their memories in general.

Our findings also resonate with the idea that a memory does not need to be a faithful representation of a personal experience in order be useful (Johnson & Sherman, 1990). A clear demonstration of this idea is that people sometimes draw on both memories of fictional stories and "vicarious memories" of other people's experiences when making decisions (Bandura, 2006; Pillemer, Steiner, Kuwabara, Thomsen, & Svob, 2015; Yang, 2018). And even when we consider people's own autobiographical memories, the objective truth of what happened is not always that important. For example, when people share their memories with others, they often tweak, embellish, or lie about their experiences to engage or impress those listening (Marsh & Tversky, 2004; McCann & Higgins, 1992). Furthermore, the way people remember and interpret past events changes over time depending on their circumstances and goals (Conway, 2005; Johnson & Sherman, 1990). Some memory distortions might even be adaptive. For example, when considering memories of successes and failures from a similar time, people tend to judge the failures as further in the past—a tendency that might help people maintain a positive view of their current self (Wilson & Ross, 2003). The data reported here further support these ideas by providing evidence that retracted memories might serve functions even though people no longer believe the events happened.

To the best of our knowledge, this study is the first to investigate the effects of real-world retracted memories on people's thinking and behavior. We have long known that false memories can have a range of helpful and harmful effects, but our findings suggest that these effects might

continue even after someone realizes a memory is false (Bernstein et al., 2005; Laney et al., 2008). In doing so, our results highlight the potential for false memories to do both lasting good and lasting harm. For this reason, one could interpret our findings as evidence that studies that implant false memories have the potential to produce memories that are harmful to subjects even after debriefing. But there are a number of reasons to think such a scenario is unlikely. First, false memory studies do not implant the kinds of extremely negative memories that our data suggest are most likely to be harmful (Clark, Nash, Fincham, & Mazzoni, 2012). Second, in false memory studies, subjects typically learn their memory is false only days or weeks after coming to believe in it. By contrast, subjects in these experiments tended to have believed in their retracted memories for many years before retracting them. Finally, research shows that people tend to find participating in false memory studies both enjoyable and valuable (Murphy, Loftus, Grady, Levine, & Greene, 2020).

Our findings also have implications for our understanding of how common false memories are. The data we report here are at odds with recent claims that false memories are rare, and occur only as a consequence of highly suggestive procedures (Brewin, Andrews, & Mickes, 2020). Across four experiments, we found that some 26% to 45% of people have at least one memory they now believe to be false. These proportions provide further support for the idea that misinformation can be readily incorporated into people's memories (Johnson et al., 1988; Mazzoni et al., 2010). It is possible that some subjects had incorrectly retracted memories of events that really did happen (Scoboria et al., 2014). But people are generally unwilling to invest effort in questioning the accuracy of their memories, so it is unlikely they would have done so without compelling reasons (Nash, Wade, Garry, & Adelman, 2017; Wade, Nash, & Garry, 2014). Moreover, because it is often difficult to distinguish real from false memories, it is likely

that some people have yet to realize, or may never realize, that they harbour false memories that should be retracted. (Johnson et al., 1993). Therefore, our data might actually underestimate the frequency of false memories in the general population.

Taken together, our data show that people think their retracted memories serve both helpful and harmful functions. These results highlight the potential for false memories to have lasting effects on thinking and behavior, even after they have been retracted.

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Chapter 5: Collective memories serve similar functions to autobiographical memories

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Abstract

People from the same country often hold shared, culturally-shaped memories about important events from that country's history, known as collective memories (Wertsch & Roediger, 2008). Although empirical research has started to shed light on the properties of these memories, none has systematically examined their functions. To what extent do collective memories serve functions? We hypothesized that collective memories serve functions for a collective similar to those that autobiographical memories serve for individuals—directive, identity, and social functions. We conducted two experiments using adapted versions of the Thinking About Life Experiences questionnaire (Bluck & Alea, 2011) in which we asked people to rate the functions of their collective memories. Across both experiments, we found evidence that collective memories serve directive, identity, and social functions for the collective. These results suggest collective memories perform important roles in their collectives.

Keywords: Collective memory, Memory functions, Autobiographical memory, Nationally relevant memories

General audience summary

People from the same country often hold shared, culturally-shaped memories about important events from that country's history, known as collective memories. Research has started to shed light on how these shared memories form and the characteristics these memories tend to have. But we still don't know what functions these memories serve for the groups who hold them. To address this gap, we looked to research that has investigated the functions people's own personal memories serve for them as individuals. We adapted a questionnaire that measures the functions of people's personal memories (the Thinking About Life Experiences questionnaire) and used this adapted questionnaire to conduct two studies in which we asked people to rate the functions their country's collective memories serve for the country. In the first study, we asked people to rate the functions of their collective memories, in general. In the second study, we asked people to rate the functions of specific historical events. Across both studies, we found evidence that these collective memories serve at least three functions: they guide the decision making of the country, help shape the country's identity, and help the country form and maintain relationships with other countries. These results suggest collective memories perform important roles in their collectives, and highlight the similarities between shared, culturally-important memories and people's own personal memories.

Collective memories serve similar functions to autobiographical memories

If you were to ask Americans about important events from their country's history, you would probably find a remarkable amount of overlap in their answers (Choi, Abel, Siqi-Liu, & Umanath, in press; Taylor, Burton-Wood, & Garry, 2017). In fact, work from history, sociology, anthropology, and political science demonstrates that people from the same country often hold shared memories of important events from that country's history (Bodnar, 1994; Cole, 2001; Zerubavel, 2003). These "collective memories" are part of a broader set of schemas, beliefs, and views that groups hold about their collective past (Dudai, 2002). However, these memories are not simply accurate, objective accounts of past events. Instead, they are biased and often emotionally-charged accounts of the past that can be shaped by a complex combination of political, social, and cultural factors (Hirst & Manier, 2008; Wertsch & Roediger, 2008). But what functions do collective memories serve for the groups who hold them?

Across the world, collective memories regularly feature in conversations, jokes, and formal education, and are often transmitted from one generation to the next (Svob, Brown, Takšić, Katulić, & Žauhar, 2016). It stands to reason that memories worthy of this amount of time and attention probably serve some useful functions. Consistent with this idea, theoretical accounts of collective memories suggest they play an important role in forming and maintaining the identity of the collective—that is, collective memories help people have a feeling of belonging and connection within their group (Hirst & Manier, 2008; Wertsch & Roediger, 2008). In addition, collective memories might provide a framework that guides groups' decision making (Abel, Umanath, Wertsch, & Roediger, 2018; Pillemer, 1992). For example, in ancient Rome, the collective memory of the city being sacked by Gauls in the third century B.C.E. was

described as giving Romans “nightmares which lasted for centuries” and had lasting effects on Roman foreign policy (Rosenberger, 2003; Williams, 2001, p. 221). If collective memories do indeed have such profound effects on the collectives who hold them, it is important to understand when and how they might do so. This understanding requires systematic empirical work about the functions served by collective memories. But we have been unable to find any such published work. Therefore, we set out to answer these questions: What functions do collective memories serve? And to what extent?

To answer these questions, we began with the extensive literature on the functions of autobiographical memories. After all, collective memories have properties that are similar in many ways to those of autobiographical memories. For example, Americans’ collective memories for US Presidents show a similar pattern of forgetting to autobiographical memories (Roediger & DeSoto, 2014; Roediger & DeSoto, 2016). Specifically, more recent presidents tend to be remembered better than earlier ones, with a couple of exceptions: the first few presidents (Washington, Adams, Jefferson) are well-remembered, as are presidents who played a distinctive role in the history of the country, such as President Lincoln. These recency, primacy, and distinctiveness effects closely resemble those seen in autobiographical memory (Baddeley & Hitch, 1977; Sehulster, 1989; von Restorff, 1933). In addition, collective memories are often distilled to a small number of important events, not unlike people’s narratives of their own life story (Bartlett, 1932; McAdams, 2001; Wertsch, 2002; Zaromb, Butler, Agarwal, & Roediger, 2014). Finally, much like autobiographical memories, collective memories can become distorted, perhaps to help the group maintain a positive identity (Baumeister & Hastings, 1997; D’Argembeau & Van der Linden, 2008). For example, shameful events perpetrated by a group are sometimes minimized or even removed entirely from that group’s collective memory (Sahdra

& Ross, 2007). Given these similarities in the properties of collective and autobiographical memories, we might also expect them to serve similar functions.

The autobiographical memory literature suggests that autobiographical memories serve at least three main functions (Bluck, Alea, Habermas, & Rubin, 2005; Pillemer, 1992). First, they help people maintain a coherent sense of *identity* across time (Conway & Pleydell-Pearce, 2000; Wilson & Ross, 2003). For instance, recalling the memory of a good deed might reassure someone that he or she is a good person. Second, autobiographical memories *direct* people's behavior; for example, the memory of failing a test might prompt a student to study harder in future (Pillemer, 2003). Third, autobiographical memories encourage *social bonding* with others, such as by increasing intimacy or highlighting shared interests (Alea & Bluck, 2003). These functions are remarkably similar to the theorized functions of collective memories. Take, for instance, the identity function of autobiographical memories, which conceptually maps on to the theorized role that collective memories play in forming the identity of the collective. Likewise, the directive function maps on to the idea that collective memories can guide the decision-making of the group. Finally, collective memories might serve a function akin to the social function when shared between groups—such as when two nations commemorate an event that was important to both nations, or when politicians harken back to previous examples of co-operation between nations. Given these conceptual similarities, measures of autobiographical memory functions might provide a useful starting point for developing measures of collective memory functions.

Therefore, we created a measure for the functions of collective memories by drawing on the Thinking About Life Events questionnaire (TALE)—a well-known scale that asks people to

report the extent to which their autobiographical memories serve directive, identity, and social functions (Bluck & Alea, 2011). Of course, it is essentially impossible to ask a collective directly about the functions of its memories. We instead must ask the individual people who make up the collective, who are likely to have at least some insight into the identity and behavior of their group. For this reason, a logical initial approach would be to ask people from a particular collective about the ways in which their collective memories serve functions for that collective.

Taken together, there are good reasons to expect that collective memories might serve directive, identity and social functions much like their autobiographical counterparts. But there are also reasons to expect collective memories might be markedly less functional than autobiographical memories. For instance, many collective memories are of events people did not personally experience. As a result, these memories would not be accompanied by episodic details such as the sense of reliving—details that are thought to be important for memories to serve functions (Pillemer, 1992). The idea is that episodic details are useful pieces of information in and of themselves, and also act as memory cues that help the memory come to mind when it is needed (Schacter & Madore, 2016; Tulving, 1985). Consistent with this idea, there is evidence that people who have an impaired ability to mentally time travel back to past experiences tend to be worse at using their autobiographical memories to solve problems (Sheldon, McAndrews, & Moscovitch, 2011). Perhaps, then, collective memories might serve functions less than autobiographical memories—at least to the extent they lack the episodic details that accompany many autobiographical memories.

To investigate the functions of collective memories, we asked subjects to report the functions of important memories from their country's history. We then compared these reports to

subjects' reports of the functions of their own autobiographical memories. Across two experiments, our results converge on the idea that, at the very least, collective memories serve directive, identity, and social functions—much like people's autobiographical memories.

Experiment 1

Our primary question in Experiment 1 was: to what extent do collective memories serve directive, identity, and social functions. To address this question, we adapted a well-known instrument, the TALE (Bluck & Alea, 2011), which measures how often autobiographical memories serve directive, identity, and social functions. The TALE has good psychometric properties (Bluck & Alea, 2011), and a factor structure that maps onto the three functions. In practice, the TALE therefore generates three subscales, each producing a mean score. We created a "Collective TALE" to measure how often a country's collective memories serve directive, identity, and social functions for the people of that country. Subjects completed both the original TALE and the collective TALE so we could compare the functions of people's autobiographical and collective memories. This experiment was pre-registered, as was Experiment 2. The pre-registrations, materials, and data for the two experiments can be found on the Open Science Framework (https://osf.io/rfjq3/?view_only=258b9602cf1548df93c90f478a0ee0c9). These experiments were approved by the University of Waikato's School of Psychology Research Ethics Committee under the delegated authority of the University's Human Research Ethics Committee, and by the Claremont McKenna College Institutional Review Board.

Methods

Subjects

We recruited workers from the United States and Canada on Amazon's Mechanical Turk platform through TurkPrime (Litman, Robinson, & Abberbock, 2017). Subjects participated in exchange for Amazon credit. We aimed to collect data until 300 subjects had completed the survey. Because of the way Mechanical Turk interacts with TurkPrime, 310 subjects completed the survey. According to our pre-registered criteria, we then excluded 19 subjects who failed one or both of the attention checks, leaving us with our final sample of 291 subjects. The mean age of these subjects was 41.15 (*SD* = 13.29, range 19-76), 110 of whom identified as men, 179 as women, and 2 as gender diverse. All but 5 subjects reported their primary language as English, all but 15 subjects grew up in the USA, and all but 5 reported they currently live in the USA. In addition, all but 16 subjects reported the country they most identify with is the USA.

Design

We manipulated Memory Type (collective, autobiographical) within subjects.

Materials and Procedure

Subjects completed both the original TALE and the Collective TALE, in counterbalanced order. Half the subjects saw the original TALE first, which is displayed in the left side of Table 1. The first part of this scale asks subjects two questions that broadly tap into how often they think back over and talk about their autobiographical memories. The second part asks subjects to complete 15 items about how often they think or talk about their autobiographical memories for various reasons, on a scale from 1 (almost never) to 5 (very frequently). Five of the items map on to the directive function (e.g. "when I want to remember a lesson I learned in the past"), five map onto the identity function (e.g. "when I want to feel that I am the same person that I was

before"), and five about reasons that map onto the social function (e.g. "when I want to develop a closer relationship with someone"). We also included an attention check within this block ("when I want to this is not a real question please select Seldom").

These subjects then completed the Collective TALE we created. The items on this scale parallel those of the original TALE, adapted to ask about the functions a collective memory serves for the collective. The first part of the scale asks subjects two questions that broadly tap into how often people of their country think back over their country's history and talk with people from another country about their own country's history. The second part asks subjects to complete 15 items about how often people of their country think back over or talk about periods of their history, once again on a scale from 1 (almost never) to 5 (very frequently). These items map onto those in the original TALE, with one exception: for the sake of intelligibility, we replaced the item "when I want to develop more intimacy in a relationship" with "when we want to develop a new relationship with another country." As in the original TALE, we included an attention check within this block ("when we want to this is not a real question please select Often").

The other half of subjects also completed the same two scales, but in the opposite order. Once subjects had completed both scales, we asked them to report their age and gender. Finally, we asked them to report their first and primary languages, where they grew up, where they currently live, and with which country they most strongly identify.

Table 1

Items from the original (Bluck & Alea, 2011) and collective versions of the TALE.

Autobiographical Memory Version	Collective Memory Version
Think and talk about items	
In general, how often do you think back over your life?	In general, how often do people from your country think back over your country's history?
In general, how often do you talk to others about what's happened in your life?	In general, how often do people from your country talk to others about your country's history?
Prompt	
I think back over or talk about my life or certain periods of my life…	People of my country tend to think back over or talk about certain periods of our history…
Identity Function Items	
when I want to feel that I am the same person that I was before.	when we want to feel that our country is the same as it was before.
when I am concerned about whether I am still the same type of person that I was earlier.	when we are concerned about whether our country is still the same kind of place that it was earlier.
when I am concerned about whether my values have changed over time.	when we are concerned about whether our values have changed over time.
when I am concerned about whether my beliefs have changed over time.	when we are concerned about whether our beliefs have changed over time.
when I want to understand how I have changed from who I was before.	when we want to understand how we have changed from who we were before.
Directive Function Items	
when I want to remember something that someone else said or did that might help me now.	when we want to remember something that another country said or did that might help us now.
when I believe that thinking about the past can help guide my future.	when we believe that thinking about our country's past can help guide our future.
when I want to try to learn from my past mistakes.	when we want to try to learn from our past mistakes.
when I need to make a life choice and I am uncertain which path to take.	when we need to make an important choice and we are uncertain which path to take.
when I want to remember a lesson I learned in the past.	when we want to remember a lesson we learned in the past.
Social Function Items	
when I hope to also find out what another person is like.	when we hope to find out what another country is like.
when I want to develop more intimacy in a relationship.	when we want to develop a new relationship with another country.
when I want to develop a closer relationship with someone.	when we want to develop a closer relationship with another country.
when I want to maintain a friendship by sharing memories with friends.	when we want to maintain friendships with other countries by sharing memories with them.
when I hope to also learn more about another person's life.	when we hope to learn more about another country's history.

Results

Before turning to our primary research question, we first determined how often, in a general sense, people think and talk about their autobiographical and collective memories. To do so, we examined subjects' responses to the two broad items from the beginning of both the original and Collective versions of the TALE. As the top half of Table 2 shows, subjects reported that they think about their autobiographical memories moderately often, and that people of their country think about their country's history more often, $M_{diff} = 0.51$, 95% CI [0.38, 0.64]. Likewise, subjects reported they talk about their memories moderately often, and that people of their country talk about their country's history more often, $M_{diff} = 0.20$, 95% CI [0.06, 0.34]. Together, these results fit with the idea that people often think and talk about collective memories.

Table 2

Subjects' ratings of how often they think and talk about their autobiographical and collective memories.

Rating	Autobiographical	Collective
	M (*SD*)	*M* (*SD*)
Experiment 1		
Think about	3.27 (0.99)	3.78 (0.82)
Talk about	2.78 (0.94	2.98 (0.95)
Experiment 2		
Think about	2.98 (1.05)	3.53 (0.98)
Talk about	2.82 (0.99)	2.61 (1.10)

We next checked the measurement properties of the Collective TALE and set out to determine if it showed the same factor structure as the original TALE. That is, we calculated Cronbach's alpha for each subscale and also conducted an exploratory factor analysis, assuming three factors. We used a Promax rotation because the literature on the functions of

autobiographical memory clearly shows the three functions are correlated with one another (Bluck & Alea, 2011). We found that the three subscales had good reliability ($\alpha_{\text{directive}} = 0.81$, $\alpha_{\text{identity}} = 0.88$, $\alpha_{\text{social}} = 0.82$). Furthermore, the results of the factor analysis (which can be found in the Supplemental Materials in Appendix D) showed that all but one of the items loaded as expected. One directive item unexpectedly loaded more strongly on the social factor than the directive factor ("when we want to remember something another country said or did that might help us now"). When this item is dropped from the analysis, the overall pattern does not change, so the analyses reported here use the item groupings from the original TALE—as we pre-registered.

Having established the Collective TALE has good measurement properties, we next turned to our main research question: To what extent do collective memories serve functions? To answer this question, we calculated, for each subject, three subscale scores for the Collective TALE—one for each function—as well as the corresponding subscale scores for the original TALE. Each subscale score was calculated by taking the mean of the five items that make up that subscale. These data are displayed in Figure 1. First, let us consider the right-hand side of the figure, which depicts the distribution of subjects' ratings of the functions of their collective memories. As the figure shows, subjects rated their country's collective memories as serving all three functions moderately often. These distributions support the hypothesis that collective memories serve identity, directive, and social functions for the collectives who hold them.

But recall that we hypothesized collective memories might serve functions less than autobiographical memories. Therefore, we next compared the functions served by collective memories to those served by autobiographical memories (displayed in the left-hand side of

Figure 1). We found that subjects reported their autobiographical memories serve directive and social functions more often than their country's memories do for the country, $M_{diff(directive)} = 0.15$, 95% CI [0.05, 0.25], $M_{diff(social)} = 0.29$, 95% CI [0.18, 0.40]. By contrast, subjects reported that their collective memories serve identity functions for their collective more often than their autobiographical memories do for themselves, $M_{diff(identity)} = 0.42$, 95% CI [0.31, 0.53]. Taken together, these findings suggest that collective and autobiographical memories might serve directive, identity, and social functions to different degrees.

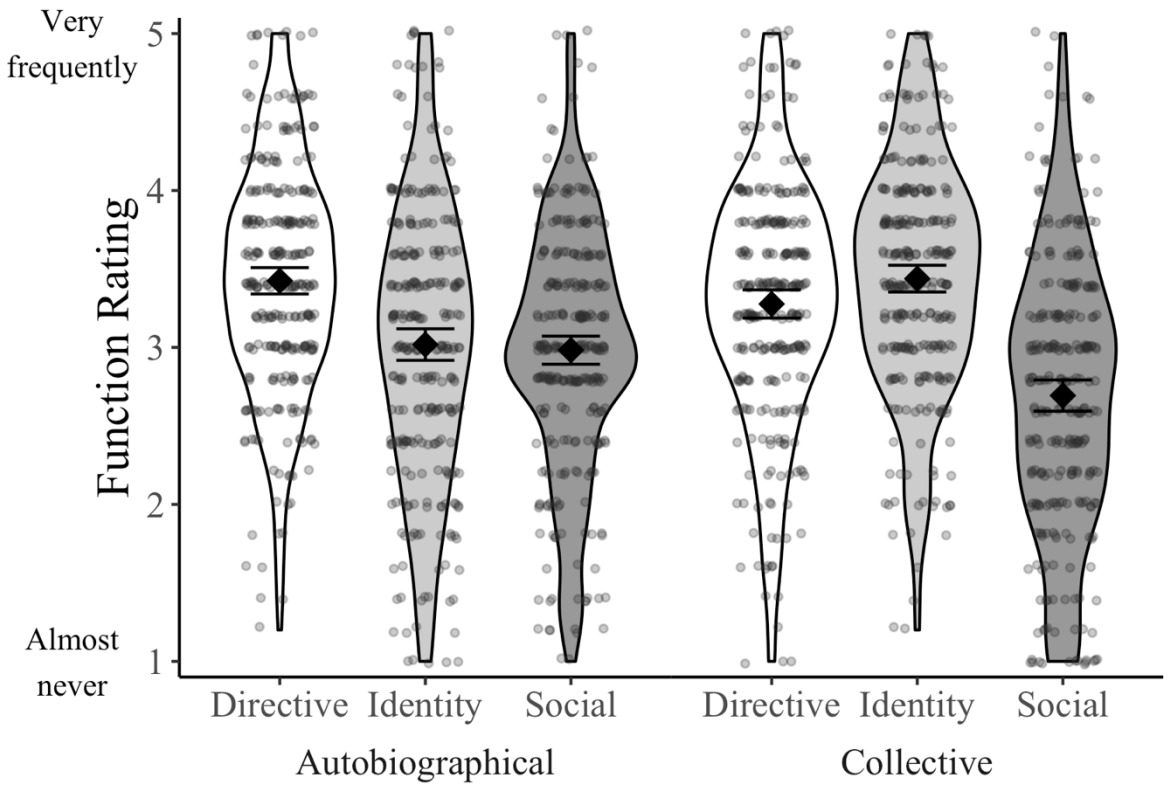

Figure 1. Violin plot of function ratings for autobiographical and collective memories from Experiment 1. Dots represent individual data points, diamonds represent the cell means, and error bars represent the 95% CIs around those cell means.

One limitation of this experiment is that we asked subjects to report the functions of their collective memories as a whole. This task is highly abstract and requires subjects to think

broadly about their country's history in a way that they normally might not. We addressed this limitation in Experiment 2 by asking subjects about specific events from their country's history, an extension of prior work that has investigated the functions of specific autobiographical memories (Hyman & Faries, 1992; Rasmussen & Berntsen, 2009). This approach also fits with work that has investigated the characteristics of collective memories by asking about specific memories (Roediger & DeSoto, 2016; Zaromb et al., 2014). If we found the same pattern as in Experiment 1, it would provide converging evidence that collective memories serve directive, identity, and social functions.

Experiment 2

In Experiment 2, we asked subjects about the functions of specific collective memories. We selected five specific collective memories from the most important events Americans nominated when asked what historical events shaped their country's identity (Choi et al., in press; Taylor et al., 2017). We presented subjects with one of these events and asked them to rate the extent to which that memory serves directive, identity, and social functions for the country. We then compared these reports to subjects' reports of the functions of an important memory from their own life.

Methods

Subjects

We recruited workers from the United States on Amazon's Mechanical Turk platform through TurkPrime (Litman et al., 2017). Subjects participated in exchange for Amazon credit. We aimed to collect data until 500 subjects had completed the survey. Because of the way

Mechanical Turk interacts with TurkPrime, 510 subjects completed the survey. According to our pre-registered criteria, we then excluded 27 subjects who failed the attention check, and 5 subjects who did not provide a genuine autobiographical memory. We also excluded a further 12 who reported living outside the US, leaving us with our final sample of 466 subjects. The mean age of these subjects was 41.88 (*SD* = 13.26, range 18-78), 164 of whom identified as men, 300 as women, and 2 as gender diverse. All but 3 subjects reported their primary language as English, and all but 16 subjects grew up in the USA. In addition, all but 21 subjects reported the country they most identify with is the USA—the pattens do not change if these subjects are excluded.

Design

We manipulated Memory Function (collective, autobiographical) within subjects.

Materials and Procedure

The procedure for Experiment 2 was similar to that of Experiment 1. Subjects completed two rating scales, in counterbalanced order: the original TALE and the Collective TALE. We adapted the instructions for both versions of the scale to refer to one specific memory.

Half the subjects completed this new, "specific autobiographical memory" version of the original TALE first. They were asked to describe "an important event from any point in your life that has helped shape your identity." and rated the adapted questions (e.g. "when I want to feel that I am the same person that I was before"; see the Supplemental Materials in Appendix D for the full instructions). We used this prompt because it mirrors the prompt used in prior work to elicit the collective events described below (Choi et al., in press; Taylor et al., 2017).

These subjects then completed the "specific collective memory" version of the Collective TALE. They read a brief description of one of five events from American history: World War 2, The American Civil War, The American Revolutionary War, The September 11 attacks, or the signing of the Declaration of Independence (see Supplemental Materials in Appendix D for the full descriptions). These descriptions were between 44 and 61 words (M = 51.2), and were adapted from Wikipedia and other encyclopaedias. Then, they rated the adapted questions (for example, "when we as a country want to feel that our country is the same as it was before").

The other half of subjects completed the same two scales, but in the opposite order. Once subjects had completed both scales, we asked them to report their age and gender. Finally, we asked subjects to report a range of demographics, including the country they live in now and the country with which they most strongly identify.

Results

Before addressing the primary question in Experiment 2, we again determined how often people think and talk about their autobiographical and collective memories in a broad sense. As the bottom half of Table 2 shows, these results were similar to those in Experiment 1. That is, subjects reported they think about their nominated autobiographical memory moderately often, and that people of their country think about the historical event slightly more, M_{diff} = 0.55, 95% CI [0.43, 0.67]. Subjects reported they talk about their nominated autobiographical memory moderately often. But in contrast to Experiment 1, they reported that people of their country talk about the respective historical events slightly less often, M_{diff} = 0.21, 95% CI [0.08, 0.34]. Next, we once again checked the measurement properties of the Collective TALE. As we found in Experiment 1, the three subscales had good reliability ($a_{directive}$ = 0.88, $a_{identity}$ = 0.89, a_{social} =

0.84). Moreover, the results from the exploratory factor analysis were similar to Experiment 1 (see the Supplemental Materials in Appendix D).

We next returned to our primary question: To what extent do collective memories serve functions? As the distributions on the right-hand side of Figure 1 show, we replicated the findings from Experiment 1. More specifically, subjects rated their country's specific collective memories as serving all three functions moderately often. This pattern provides converging evidence that collective memories serve identity, directive, and social functions for the collectives who hold them.

When we compared subjects' ratings on the specific collective TALE to their ratings on the specific autobiographical TALE, we again found that subjects rated their autobiographical memories as serving social functions for them more often than their country's memories do for the country, $M_{diff} = 0.17$, 95% CI [0.07, 0.26]. Unlike Experiment 1, subjects reported that their country's collective memories serve directive functions slightly more often than their nominated autobiographical memories, $M_{diff} = 0.13$, 95% CI [0.03, 0.24]. But once again, subjects reported that their collective memories serve identity functions for their country more often than their autobiographical memories do for themselves, $M_{diff} = 0.38$, 95% CI [0.27, 0.48]. These differences again raise the possibility that collective and autobiographical memories might differ in the degree to which they serve functions.

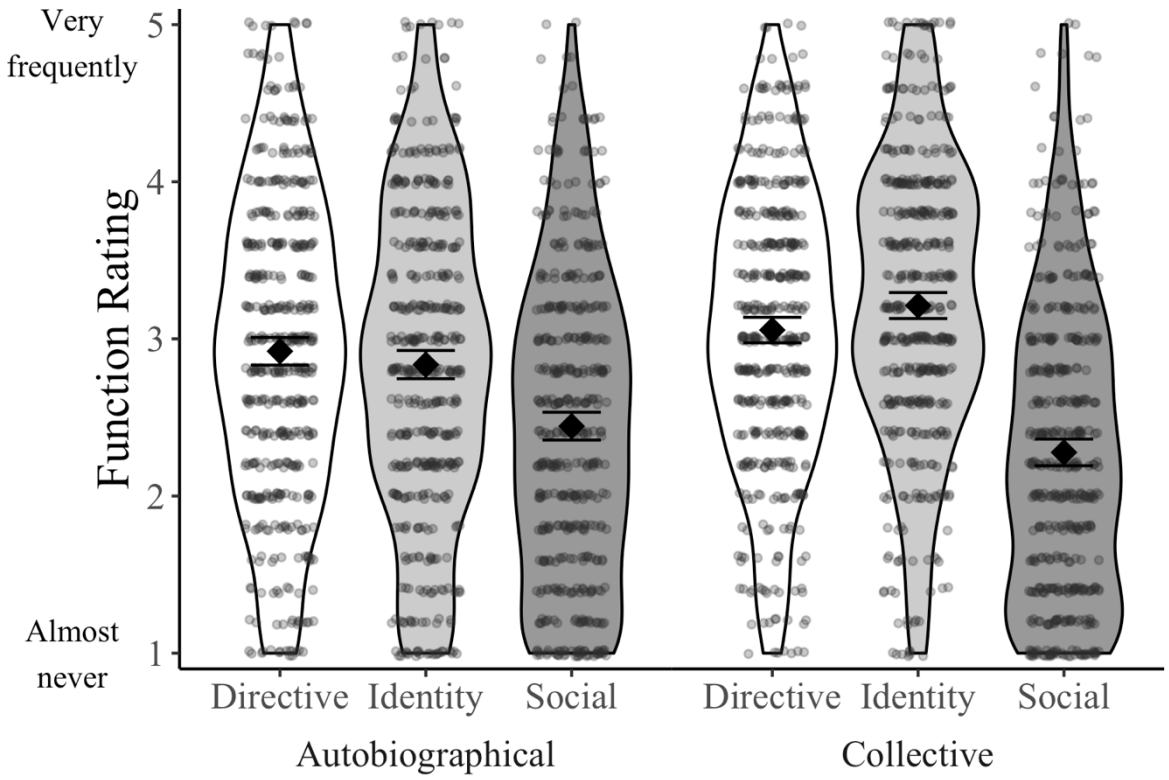

Figure 2. Violin plot of function ratings for autobiographical and collective memories from Experiment 2. Dots represent individual data points, diamonds represent the cell means, and error bars represent the 95% CIs around those cell means.

Thus far we have examined the functions of collective memories by collapsing across the set of five specific memories. But there are also reasons to expect the functions of these specific memories might differ. First, the events differ markedly in when they occurred. For example, the Revolutionary War occurred more than two centuries ago, whereas the September 11 attacks occurred only two decades ago. We might therefore expect the more recent events to be more relevant to the group's current thinking and behavior. Second, the events differ in the emotions they evoke—for instance, Americans are proud of the Declaration of Independence, and celebrate it each year, while the Civil War is an event many Americans are ashamed of (Choi et

al., in press). We know from the literature on autobiographical memories that both the age of a memory and the emotions it evokes are related to the functions the memory serves (Burnell, Rasmussen, & Garry, 2020; Rasmussen & Berntsen, 2009). To what extent, then, do the collective memories of different events serve different functions?

To answer this question, we examined the functions of the 5 collective events separately, and display those data in Figure 3. On the whole, the patterns were quite similar across the different events, though there were notable differences. For instance, subjects rated the memories of the two most recent events—World War II and the September 11 attacks—as serving directive functions more than the other three memories. Subjects also rated World War II as serving social functions more than the other four memories. In addition, the Civil War tended to serve social functions less than the other four memories—perhaps because it is a controversial topic even today (Cook, 2017). Finally, World War 2 was unique in that it served directive functions more than identity, $M_{\text{diff}} = 0.16$ [0.10, 0.22]. These results suggest that directive, identity, and social

functions tend to be common across different collective memories, but also fit with the idea that more recent collective memories might serve directive function more than older memories.

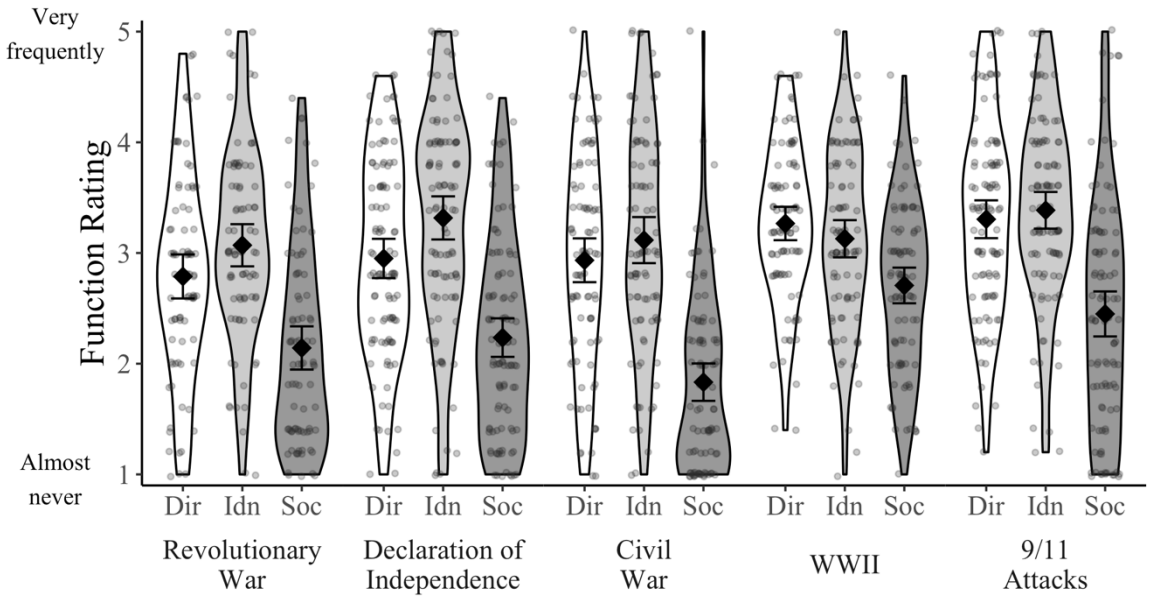

Figure 3. Violin plot of directive (Dir), identity (Idn), and social (Soc) function ratings for each collective event from Experiment 2. The events are displayed in order from oldest to most recent. Dots represent individual data points, diamonds represent the cell means, and error bars represent the 95% CIs around those cell means.

General Discussion

Across two experiments and 757 subjects, we investigated the extent to which collective memories serve functions akin to the directive, identity, and social functions served by autobiographical memories. In Experiment 1, we asked subjects to rate the functions of their collective memories, in general. In Experiment 2, we asked subjects to rate the functions of specific collective memories. Across both experiments, subjects reported that their collective memories serve directive, identity, and social functions moderately often—much like their autobiographical memories. Taken together, these results support the hypothesis that collective

memories serve—at a minimum—directive, identity, and social functions for the collectives that hold them.

But the fact that subjects rated their collective memories as serving functions moderately often in both studies raises a counter-explanation for the results: that subjects were not sure how to evaluate how often their collective memories serve functions, and simply chose the middle of the scale, interpreting it as an "I don't know" response, or perhaps a "best fit" option for communicating "I don't know." After all, it is reasonable to wonder if the task is difficult conceptually—subjects needed to take the perspective of the people from their country as a whole and then think through how the memory (or memories) served the group. But a look at the distributions (displayed in Figures 1 and 2) shows that subjects were not simply selecting the middle of the scale. Instead, their responses were spread across the whole scale, with many subjects reporting that collective memories frequently serve functions. Furthermore, if subjects were simply unsure how to respond, we should expect to see similar ratings across all functions and across all events (Experiment 2). But that is not what we saw; instead, subjects consistently tended to rate directive and identity functions higher than social functions. Moreover, in Experiment 2 we saw variation across the different events. This counter-explanation, therefore, does not adequately explain our results.

Our findings provide empirical support for existing theoretical perspectives on the functions of collective memories. More specifically, the findings fit with suggestions that historical events play an important role in shaping the identity of groups and convey useful lessons that guide the decision making of collectives (Assmann & Czaplicka, 1995; Hirst, Yamashiro, & Coman, 2018; Wertsch & Roediger, 2008). Furthermore, we found evidence that

groups believe they use collective memories to help them forge and maintain relationships with other groups. These three functions were common across important historical events, regardless of whether those events were old (e.g. The Revolutionary War), or more recent (e.g. the September 11 attacks).

Our findings also add to a growing body of evidence that autobiographical and collective memories share many characteristics. Given that some of the collective events we studied occurred long before subjects were even born, these similarities have implications for how we might understand the functions of memory. In particular, these data suggest that memories might serve directive, identity, and social functions even in the absence of episodic recollection. Such a possibility does not, of course, mean episodic recollection plays no part in memory functions. After all, empirical studies suggest that episodic information in autobiographical memories can help people solve problems (Sheldon et al., 2011). To the extent that recollection plays some part, we might expect collective memories for events people lived through to serve functions to a greater extent than ones people did not live through. Our data provide tentative support for this possibility: the only event that occurred in our subjects' lifetimes was the September 11 attacks, and their self-reports suggested their memory for this event served directive and identity functions more than any other memory, and social functions more than three of the four other memories. But such a possibility is purely preliminary, tempered by the fact that we had limited experimental control, which precludes us from drawing causal conclusions.

Collective memories might also serve functions that autobiographical memories do not. As a first attempt at investigating the functions of these memories, we used the framework from the autobiographical memory literature (Bluck et al., 2005; Pillemer, 1992). But it is reasonable

to speculate that the functions of collective memories are much more complex than our data suggest. For example, we measured the extent to which collective memories are shared with other collectives—an "outward-facing" social function that maps on to the (outward-facing) social function served by autobiographical memories. But for collective memories to become a shared cultural narrative, they need to be shared among the members of the collective, which could be thought of as an "inward-facing" social function (Cuc, Ozuru, Manier, & Hirst, 2006; Rajaram & Maswood, 2017). Another possible function of collective memories is that they allow collectives to pass knowledge from one generation to the next—a function that might be especially prominent among older adults (Mergler & Goldstein, 1983; Svob et al., 2016). Finally, although collective memories might serve functions for the group as a whole, these memories might also serve distinct functions for the individual people who make up that group. To fully understand the effects collective memories have on the groups who hold them, it is important that future work investigates the extent to which collective memories have benefits beyond those reported here.

Of course, collective memories might not always be entirely beneficial. Many collective memories, including some of those we examined in Experiment 2, are of negative events. Although our findings suggest even these negative collective memories can serve functions, they might also carry with them maladaptive effects—much like autobiographical memories (Burnell, et al., 2020). For example, the memory of the September 11 attacks led many Americans to be fearful of travel and contributed to America's decision to go to war in Iraq (Goodrich, 2002; McCartney, 2004; Pillemer, 2003). The extent to which collective memories might be harmful for the collectives who hold them is an empirical question that we hope future work can address.

There are, naturally, several limitations to our conclusions. First, the factor structure of the collective version of the TALE did not perfectly align with that of the original version. Although the structure was very similar, we found that one directive item loaded only weakly on the expected factor in both experiments. For this reason, it is worth investigating the possibility that the precise ways in which collective memories serve directive, identity, and social functions might be different from the ways in which autobiographical memories serve these functions. Second, our samples consisted entirely of American and Canadian subjects. The extent to which these findings generalize to other cultures is an important issue for future research to address. For example, in China, the past is viewed as a particularly important source of knowledge and guidance (Wang, 2008). Therefore, we might expect collective memories to serve directive functions more in China than in the United States. Third, in these Experiments we chose nations as the collectives to investigate. It remains unclear whether the functions of collective memories held by other kinds of collectives (such as a family or cultural group) are similar. In addition, the idea of a collective memory relies on the assumption that there is some consensus among the collective about that event. But in a group as large as a nation, this assumption might not always hold—for example, young and old Americans have very different attitudes towards the events of World War 2 (Zaromb et al., 2014). How consensus (or a lack thereof) might affect the functions of collective memories is another interesting avenue for future research.

Taken together, the experiments we report here provide evidence that collective memories serve directive, identity, and social functions. They also add to a growing body of literature showing that collective memories and autobiographical memories are similar in a variety of ways. Although this study is only the first step towards understanding the functions of collective

memories, our findings provide a foothold from which to investigate further the effects of these memories on the collectives who hold them.

Author contributions

R. Burnell, S. Umanath, and M. Garry developed the study concept and design together. R. Burnell & S. Umanath created the experimental materials. R. Burnell organized data collection, and performed all data analyses. R. Burnell drafted the manuscript with S. Umanath. M. Garry provided critical revisions.

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Data availability

All numerical data have been made available via the Open Science Framework, along with the analysis script (https://osf.io/rfjq3/?view_only=258b9602cf1548df93c90f478a0ee0c9). Our ethical approval precludes us from making subjects' written responses publicly available, but these responses are available on request.

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Chapter 6: General Discussion

Summary of the findings

The primary aim of this thesis was to further our understanding of the functions of autobiographical memory. To do this, we conducted eleven experiments reported across four manuscripts. In the first manuscript, we developed a measure of autobiographical memory functions that separates adaptive and maladaptive outcomes. Using this measure, we asked people to rate the functions of their most positive and most negative memories. We found that people's positive memories are primarily adaptive, whereas their negative memories serve a mix of adaptive and maladaptive functions. These findings demonstrate that autobiographical memories can sometimes serve functions in ways that are maladaptive.

In the second manuscript, we focused on the social function of autobiographical memories—specifically on how people appraise the memories others share with them. We found that when someone reports growing from a negative event, others tend to appraise that event as less negative than they otherwise would. In turn, these appraisals could have maladaptive outcomes if they lead others to provide less support or empathy to the person sharing the memory.

In the third manuscript, we sought to better understand the factors that drive memories to serve particular functions. We asked people to rate the adaptive and maladaptive functions of their retracted memories. We then compared these functions to the functions of believed memories. We found that people's retracted memories continue to serve functions to a similar

extent as their believed memories. This finding suggests it is not necessary for people to believe in a memory for that memory to serve functions. We also found that a sense of reliving was the characteristic most reliably associated with the extent to which memories serve functions.

In the fourth manuscript, we investigated the extent to which collective memories for important historical events serve functions for the collectives who hold them. We found evidence that collective memories serve directive, self, and social functions—much like autobiographical memories.

Considered together, these four sets of experiments broaden our understanding of the functions of autobiographical memories, and highlight the need for more nuanced measures of memory functions.

Adaptive and Maladaptive Functions

A key finding from the experiments reported here is that the functions of autobiographical memory are not always adaptive. For example, memories might direct people's behaviour in ways that have maladaptive outcomes if the memories lead people to make poor decisions or engage in harmful behaviors. Likewise, memories could affect people's sense of self in maladaptive ways—for instance when people incorporate the memory of a failure or traumatic experience into their sense of self in a way that contributes to a negative self-concept. Finally, sharing a memory in social situations could be maladaptive if listeners appraise the memory in a way that hurts the relationship. Indeed, subjects in our first set of experiments frequently reported that their most negative memories serve these maladaptive functions.

One might wonder, then, whether these findings challenge the idea that the directive, self, and social functions of memory provide benefits that would boost humans' survival chances. But it is clear from the evolutionary literature that even when traits are adaptive on the whole, they can sometimes be maladaptive (Darwin, 1859). And in the case of autobiographical memories, there are reasons to think these maladaptive functions might be relatively rare—or, at least, less common than adaptive functions. For instance, people rated even their most negative memories—the memories we might expect to be most maladaptive—as only moderately maladaptive, and often rated these memories as more adaptive than maladaptive. Moreover, outside of these highly negative memories, we found little evidence of these maladaptive functions. For example, in our first set of experiments, subjects rarely rated their positive memories as serving any maladaptive functions. And in our third set of experiments, subjects tended to rate both their childhood memories and their retracted memories low on maladaptive functions. Clearly, a broader sample of memories would be needed to evaluate the relative frequency of adaptive and maladaptive functions. That said, our data are consistent with theoretical accounts suggesting autobiographical memories tend to be more adaptive than they are maladaptive.

The mix of adaptive and maladaptive functions served by people's negative memories also highlights the complexity of autobiographical memory functions, and raises the possibility that the functions of a memory might change across contexts or across time. For example, the memory of failing an important exam might serve an adaptive directive function in the lead-up to a subsequent exam by prompting the rememberer to study hard. But come the night before the exam, the same memory might make the rememberer so anxious about the next day that he is unable to sleep—a directive function that likely would have maladaptive outcomes. Such a

possibility fits with the evolutionary literature, which emphasizes that the adaptiveness of any trait depends on the context in which it is expressed (Darwin, 1859). This possibility has also been raised previously in the autobiographical memory literature (Alea & Bluck, 2003). Just how autobiographical memory functions change across time and across contexts is a question I hope future research can answer. One way to do so would be to ask subjects to recall various occasions or contexts in which they had previously brought the memory to mind, and then to report what functions the memory served on each of those occasions. But given the complexity of such a task and the recall biases it might introduce, a stronger test of this possibility would be to conduct a longitudinal study that measures the functions of a specific memory at several time-points.

Another of our key findings was that subjects consistently reported that their memories serve maladaptive social functions less than they serve maladaptive self or directive functions. There are at least two possible explanations for this finding. The first is that the maladaptive social function is less prevalent than the other two maladaptive functions. It is plausible, for example, that people are better able to prevent their memories from serving maladaptive social functions than from serving maladaptive self or directive functions. After all, people can choose how they share a memory with others—people tune their retellings of events based on their audience, and sometimes even embellish or lie about what happened in order to impress others (Marsh & Tversky, 2004; McCann & Higgins, 1992). Moreover, if people were to share a memory in a way that ends up causing them harm, they could simply choose to stop sharing that memory, or adjust the way they share it in future. By contrast, it might be difficult for people to stop memories from serving maladaptive self or directive functions. For example, it is well-established that negative self-evaluations can be difficult to overcome (Beck & Alford, 2009).

Likewise, maladaptive thoughts, such as rumination and anxiety, and maladaptive behaviors, such as substance use, violence, and over-eating, are often difficult to correct (Adams et al., 2019; Babcock et al., 2004; Barlow, 2002; Watkins & Roberts, 2020; Witkiewitz et al., 2019). Therefore, to the extent that autobiographical memories serve maladaptive self or directive functions by contributing to these kinds of thoughts and behaviors, it might not be easy for people to prevent these maladaptive effects.

Measuring adaptive and maladaptive functions

Our findings also have implications for the way researchers measure the functions of autobiographical memory. If any given memory can serve a mix of adaptive and maladaptive functions, we need to take a nuanced approach to measuring functions that does not conflate adaptive and maladaptive usage. To the extent we conflate adaptive and maladaptive usage., it becomes difficult to interpret any findings. To see why, let us consider some recent work showing that negative and positive memories tend to serve directive functions to a similar extent (Rasmussen, Burton-Wood, Burnell, & Garry, 2021). The function measures used in this work did not separate adaptive and maladaptive functions—subjects rated only the extent to which the memory "guides my thinking and behavior." How are we to interpret the finding that positive and negative memories were rated as similarly directive? One possibility is that negative and positive memories are equally useful for guiding people's behavior in ways that are adaptive. But it is also possible that positive memories tend to serve adaptive directive functions more frequently, but because negative memories also serve maladaptive directive functions, subjects rated their negative memories as similarly directive. Without separating adaptive and maladaptive functions, it is difficult to tease apart these two possible explanations. The first set

of experiments in this thesis, which did separate adaptive and maladaptive functions, fit with the second possibility: we found that negative memories serve adaptive directive functions to a lesser extent than positive memories, but serve maladaptive directive functions far more. As this example demonstrates, if we want to fully understand the ways in which people's memories affect their thinking and behavior, it is vital to use measures that separate adaptive and maladaptive functions.

But in order to separate adaptive and maladaptive functions, we need measures that are sensitive to maladaptive functions. Here, we made an initial attempt to create a broad, eight-item measure of the extent to which a memory serves functions in adaptive and maladaptive ways. Across the experiments reported here, we found that this measure had good reliability. But this measure includes only a single, broad item for each function—for example, the maladaptive directive function is measured using the item "this memory guides my thinking and behavior in ways that hurt me". For this reason, this measure cannot provide insight into the precise ways in which people's memories serve maladaptive functions. For instance, memories might serve maladaptive directive functions by leading people to make poor decisions. But they might also serve maladaptive directive functions by causing people to ruminate excessively about their experiences. If we want to fully understand how often—and in what ways—people's autobiographical memories can be maladaptive, we need measures that can capture maladaptive functions in a more fine-grained way.

It also remains unclear how well the three-function model describes maladaptive functions. There is no clear theoretical reason to expect maladaptive functions to fit neatly into the same three broad categories (directive, self, and social) as adaptive functions. After all, even

if maladaptive functions are simply "side effects" of the systems that allow people's memories to serve adaptive functions, there is no guarantee that these side effects are the negative parallel of the benefits. In fact, the side effects of drugs, behavioral interventions, and even laws and regulations are often completely unrelated to the intended effects (Clemens et al., 2020; Devine & Barnhill, 2018; Ferguson, 2001). It is true that the data reported here provide some evidence that memories can be adaptive and maladaptive in ways that parallel each other on directive, self, and social functions. But it is still possible that autobiographical memories have other maladaptive effects we did not measure.

How, then, might we develop appropriate, fine-grained measures of maladaptive functions? Although we could adapt an established measure of functions such as the TALE by creating "maladaptive" items that parallel the adaptive ones, this approach relies on the dubious assumption that the three-function model captures maladaptive functions well. For this reason, it might be better to start with a bottom-up approach. One reasonable starting point would be to ask people to list all the ways a given memory is harmful to them, and then collate common responses to guide scale development. This kind of bottom-up approach has been used before in the autobiographical memory literature. For instance, the Reminiscence Functions Scale—a fine-grained measure of memory functions—was developed by asking people to write, in their own words, the various reasons why they reminisce (Webster, 1993). Subjects' responses were then collated, and common reasons were used to craft a set of scale items. The Reminiscence Function Scale does not measure maladaptive usage because it was created using prompts that would probably have encouraged people to consider adaptive usage ("what purpose does reminiscence fulfill, or, what goal does retrieving certain memories help you accomplish?"). But

a similar approach could be used to develop a measure of maladaptive functions if subjects were explicitly asked to think of the ways in which their memories cause them harm.

Factors that drive memories to serve functions

Belief

Finally, our findings have implications for our understanding of the factors that drive memories to serve functions. In our third set of experiments, we found that retracted memories—that is, memories people no longer believe—continue to serve directive, self, and social functions, much like memories people still believe. These findings suggest that it might not be important for people to believe a memory in order for that memory to serve functions.

In the case of the directive function, it makes sense that belief would not always be critical for this function. After all, one does not need to have personally experienced an event to learn lessons from that event. People regularly imagine events that might happen in the future and use these imagined events to guide their decisions, even though they may never come to pass (Sanson et al., 2018). People also glean useful lessons from other people's experiences, and even from fictional stories (Pillemer et al., 2015; Yang, 2018). Moreover, as our fourth set of experiments show, collectives use memories of historical events that happened lifetimes ago to guide the decision making of the collective. In a similar way, retracted memories might provide valuable lessons even though the events did not really happen. For example, one subject's retracted memory of a metal shard flying into his eye during renovations could impart a useful warning about the dangers of not wearing eye protection, even though the accident did not really happen. Still, there might be some situations in which people's belief in a memory is important

for the directive functions that memory serves. Take the case of Beth Rutherford discussed earlier. Having come to believe she had been raped by her father, Rutherford cut all contact with her family and anyone else who did not believe her allegations—clear examples of a directive function. But after she learned that her memory was false, Rutherford reconnected with her family and rebuilt her relationship with her father. It seems unlikely Rutherford would have taken these steps had she still believed her father had raped her, which suggests Rutherford's belief in her memory was important for the directive functions it served. Perhaps, then, belief is important for some instances of the directive function, but not others—a possibility that fine-grained measures of maladaptive functions might be able to address.

It is also plausible that memories could serve social functions without people believing the memories. After all, something does not need to be true for it to be an engaging or interesting topic of conversation. Indeed, people often talk to others about fictional stories they have read in books or seen in movies (Storey, 2010). There is also evidence that people sometimes discuss news they know to be fake on social media (Brummette et al., 2018). In some cases, then, people might continue sharing a story with others even though they no longer believe it to be true. People might also talk about the memory with others to figure out what really happened. Consistent with this idea, the most common reason people point to for retracting a memory is because a family member or friend told them their memory is wrong (Mazzoni et al., 2010). Finally, the very fact that a memory turned out to be false might make it worthy of sharing with others. For example, people might share the memory as a warning to others that memory is fallible, or simply because it makes for an interesting story. For all these reasons, people might continue to share memories with others in ways that serve social functions even after the memories are retracted.

It is less clear, however, why memories would serve self functions in the absence of belief. On the face of it, it seems counter-intuitive that people would draw on events that never really happened to inform their sense of self. But there are at least two reasons why people might think their retracted memories serve self functions. First, when people endorse self-function items like "this memory tells me something about my identity," it might not be the events portrayed in the memory per se that are shaping their identity, but rather the knowledge that they had come to believe in something that never happened. For instance, a retracted memory might lead people to think they are stupid to have made such an error, or to conclude they have an unreliable memory. Second, it is possible that retracted memories had shaped elements of people's identity while those memories were still believed, and that these elements remain even after the memory has been retracted. Take Beth Rutherford, who became strongly religious after coming to believe her father raped her. Just because she realised her memory was false does not mean she would necessarily discard such an integral part of her identity—even though the false memory contributed to that identity. One way to tease apart these possibilities would be to ask people to report, in their own words, how their retracted memory has shaped their identity, and to code these responses according to which explanation (if either) they support.

Phenomenology

Although we found no strong evidence that belief is related to the functions people's memories serve, we did find evidence in our third set of experiments that these functions are related to the phenomenology of people's memories. More specifically, the more strongly a memory was accompanied by a sense of reliving, the more it tended to serve directive and self functions. These findings support theoretical accounts that suggest episodic information is

important for memories to serve directive functions because this information provides useful memory cues and contains information that can aid problem solving and decision making (Madore & Schacter, 2014; Rasmussen & Berntsen, 2009; Sheldon et al., 2011). Theoretical accounts of the self function place less importance on episodic information, and instead emphasise the role of the self-related semantic knowledge that these memories contain (Conway, 2005). For instance, people use specific memories to build a narrative of their life story (McAdams, 2001). This life story narrative is semantic and does not necessarily include episodic information. Nonetheless, episodic information might still play a role in the self function. Being able to relive past experiences might make people feel connected to their past selves, which in turn gives people a sense of self-continuity (Sokol et al., 2017). As for the social function, it is puzzling that we found no relationship between a sense of reliving and this function. This finding conflicts with theoretical accounts of the social function, which suggest that episodic information allows people to share their experiences in ways that are engaging and easy for listeners to comprehend and empathise with (Cohen, 1998; Pillemer, 1992). It is possible that this unexpected finding is a consequence of how we measured social functions. We asked people to report the degree to which they "share this memory with other people in ways that help/hurt me." Because this measure does not explicitly ask subjects about how listeners responded to the memory, it may not be sensitive to the relationship between episodic information and listeners' comprehension and engagement.

Given we found relationships between reliving and the directive and self functions, why did we not find similar relationships between these functions and the vividness of the memory? In Experiments 3 and 4 of our third manuscript, we found no evidence that vividness is related to functions after controlling for reliving and belief. One possible explanation for this finding is that

asking people about the extent to which they experience a sense of reliving broadly captures the phenomenological experience of remembering, while asking about vividness captures only one aspect of that phenomenological experience. In other words, vividness could be thought of as a subset of what reliving captures. If this explanation is correct, it would be unsurprising that vividness explains little variance in functions over and above the variance explained by reliving. Such a possibility does not necessarily suggest vividness is unrelated to memory functions, though. Indeed, when we examined the raw correlations between vividness and functions, we found small positive correlations between vividness and both directive and self functions, $r_{directive}(594) = 0.14$ [0.06, 0.22], $r_{self}(594) = 0.15$ [0.07, 0.22]. Still, the fact that reliving was a significant predictor of functions even after controlling for vividness suggests that a sense of reliving is a better predictor of memory functions than vividness.

Limitations

A critic might argue that our measures did not truly tap into the extent to which people's memories are adaptive, because they do not measure the effects of these memories on survival. Our measures show people believe their memories are sometimes helpful and sometimes harmful in their everyday life, but that does not necessarily mean the memories have direct effects on survival. It would, of course, be difficult to measure the evolutionary adaptivity of people's autobiographical memories; we can measure only the ways in which memories affect people in the contexts of modern society. There is no guarantee that the ways in which people's autobiographical memories affect them today reflect the functions that autobiographical memories served during human evolution. Therefore, studies of memory functions might be better, as some have suggested, to frame their findings in terms of how people use their memory

in today's world, rather than attempting to draw conclusions about the functions autobiographical memories evolved to serve (Bluck & Alea, 2011). Yet autobiographical memories are, almost certainly, a product of evolution, and considering the functions these memories evolved to serve might still generate useful questions and hypotheses (Baddeley, 1988; Neisser, 1978). For instance, the hypothesis that memories might have evolved to help people imagine the future has generated a large body of work investigating the relationships between memory and imagination (Addis et al., 2007; Mullally & Maguire, 2014). For this reason, it is important that researchers do not ignore the evolutionary roots of autobiographical memory.

One limitation that cuts across the experiments presented here is that we relied on self-report measures of function. Self-report measures are common in the autobiographical memory literature, but there are issues with relying on them (Bluck & Alea, 2011; Rasmussen & Berntsen, 2009). An inherent assumption of using a self-report approach is that people's reports about the functions of their memories align relatively closely with the functions those memories actually serve. But it is unlikely this assumption always holds (Banaji & Crowder, 1989).

For one thing, self-report measures of function are almost always retrospective—that is, people are asked to report the functions their memories have served in the past, rather than the functions the memories are serving right now. Therefore, people's reports of functions are subject to the various errors and biases that plague other retrospective judgments (Kihlstrom et al., 2000). For example, recent memories tend to be more accessible than distant memories, and therefore tend to have greater sway over people's judgments (Tversky & Kahneman, 1974) . As a result, people's ratings of functions might be disproportionately influenced by recent instances of the memory serving a function.

In addition, people's judgments about their memories can be biased by their general schemas and beliefs about memory (Banaji & Crowder, 1989; Conway et al., 2004; Johnson & Sherman, 1990). If, as our second set of experiments suggests, people tend to believe that negative events will have negative consequences, they might be prone to overestimate how maladaptive their negative memories tend to be. Confirmation bias may also play into these judgments—if, for example, people believe a particular memory tends to be maladaptive, they will tend to search for evidence that supports this belief and rationalize or ignore evidence to the contrary (Mynatt et al., 1977).

There is also specific evidence to suggest people might underestimate the extent to which their memories serve functions. Studies show that people often forget instances in which they have brought a memory to mind—a phenomenon known as the forgot-it-all-along effect (Arnold & Lindsay, 2002; Schooler et al., 1997). If people struggle to remember all the occasions in which they brought a memory to mind to guide their behavior or identity, it stands to reason they would rate functions lower than they should.

Finally, there might be situations in which people have difficulty evaluating the extent to which a memory has had helpful or harmful effects. Take, for instance, someone who has a memory of being attacked by a dog in childhood and for whom the memory evokes a feeling of anxiety when she brings it to mind. This person might believe the memory is serving a maladaptive directive function because the feeling of anxiety is unpleasant. Yet this anxiety might have unrecognised benefits—motivating her to avoid potentially dangerous dogs and preparing her fight-or-flight response.

For all these reasons, self-report measures of function might not accurately capture the functions of people's autobiographical memories. But these limitations do not mean these data are uninformative. Although we cannot be sure people's negative memories are really serving functions in the way they reported in the experiments reported here, our findings generate a useful hypothesis for researchers to test: that the functions of autobiographical memory sometimes produce maladaptive outcomes. But it is vital that this hypothesis is tested using behavioral measures of function.

There are paradigms in the literature that could be used to achieve this aim. For example, some studies investigating social functions have asked pairs of subjects to engage in conversations (Klein et al., 2010). The researchers then either monitor or manipulate whether the subjects share autobiographical memories during the conversation. Finally, the researchers ask both the sharer and the listener to evaluate their conversational partner. Using this paradigm, researchers can directly measure the effects of sharing autobiographical memories on the relationship between the two subjects, which allows them to search for circumstances in which sharing a memory might harm the relationship. Similarly, researchers could investigate the directive function by asking people to recall either a specific autobiographical memory or more general semantic information, and then measuring the effects of the recalled information on people's decision making (see Sheldon et al., 2011). By requiring subjects to recall a memory that the researchers know might lead the subjects astray, this paradigm could provide more robust evidence that memories can serve maladaptive directive functions. Collecting behavioral measures of the self function is somewhat difficult because of the introspective nature of the self. But it might be fruitful to ask subjects to recall a specific memory of a past success or failure and then measure the effects of that recall by having subjects rate themselves on various personality

traits. Ultimately, a variety of methods will be needed to provide a full understanding of the functions of autobiographical memory.

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Appendix A: Supplemental Materials for Manuscript 1 (Chapter 2)

Experiment 1

Memory prompt

"For this study, we are interested in some of the memories from your life.

A memory is defined as the memory of a single event that took place within 24 hours at a specific time and place that you personally experienced.

--page break--

A human life consists of many emotional and less emotional events. Some events become highly significant to your personal life story, whereas others are forgotten. From where you are in your life right now, some events may stand out as your **most negative[positive] memories.**

Now imagine that you have to choose between these memories. What is your most **negative[positive] memory**?

Please describe your most negative memory in a few brief sentences. Please be assured that your answers are confidential. Don't give us any identifying information. And, of course, feel free to leave out details that you don't wish to share."

Erase Instructions

"Suppose that you could **permanently erase this memory**. If you erased this memory, you would **not be able to re--experience it again**. That is, you would not be able to bring to mind any aspect or aspects of what happened. You would also not be able to bring to mind what you experienced at the time of the event. In other words, the visual images, feelings, and particular associations with other experiences would be **gone**.

Now imagine you were able to use this service."

Individual Function Correlations

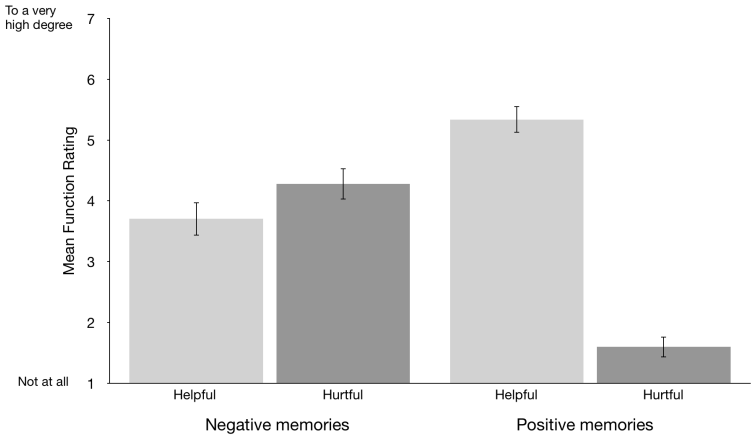
Measure	Directive Helpful	Self Helpful	Social Helpful	Social Identity Helpful	Directive Hurtful	Self Hurtful	Social Hurtful	Social Identity Hurtful
Directive Helpful	-							
Self Helpful	0.71	-						
Social Helpful	0.48	0.50	-					
Social Identity Helpful	0.48	0.49	0.62	-				
Directive Hurtful	-0.46	-0.41	-0.36	-0.46	-			
Self Hurtful	-0.32	-0.32	-0.33	-0.42	0.82	-		
Social Hurtful	-0.19	-0.21	-0.09	-0.20	0.54	0.56	-	
Social Identity Hurtful	-0.29	-0.33	-0.39	-0.58	0.67	0.66	0.45	-

Helpful function Cronbach's alpha: 0.83, 95% CI [0.8, 0.85]

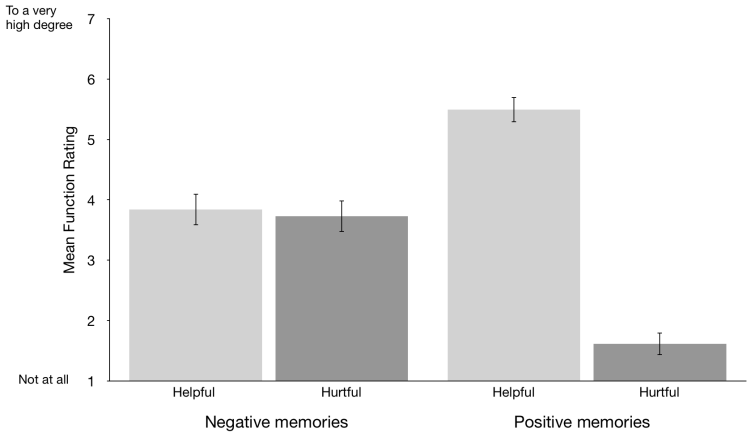
Hurtful function Cronbach's alpha: 0.86, 95% CI [0.84, 0.88]

Plots of individual functions

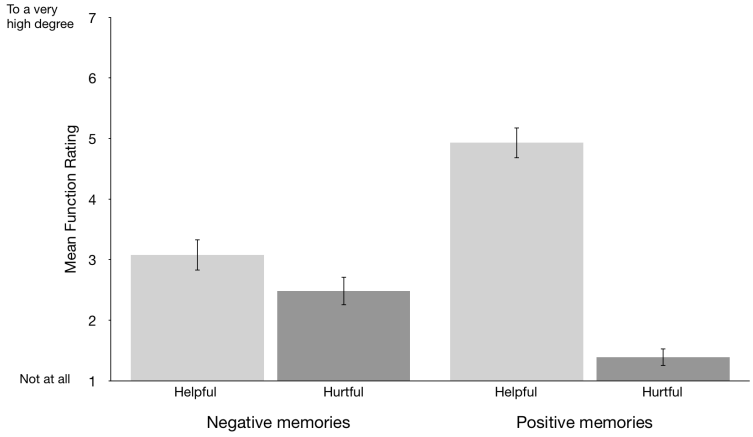
Directive Function



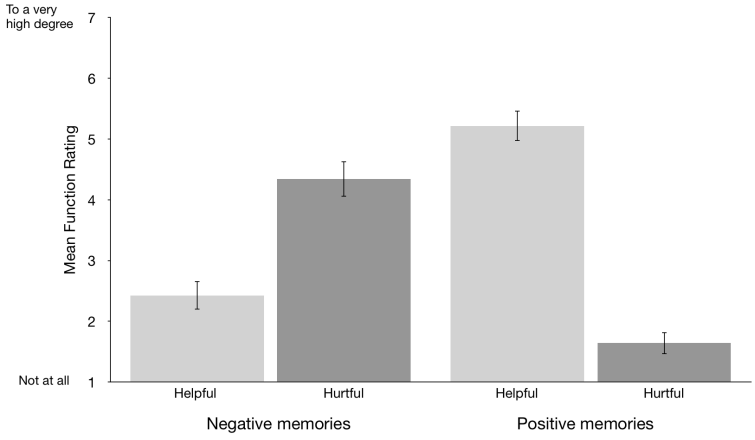
Self Function



Social Function



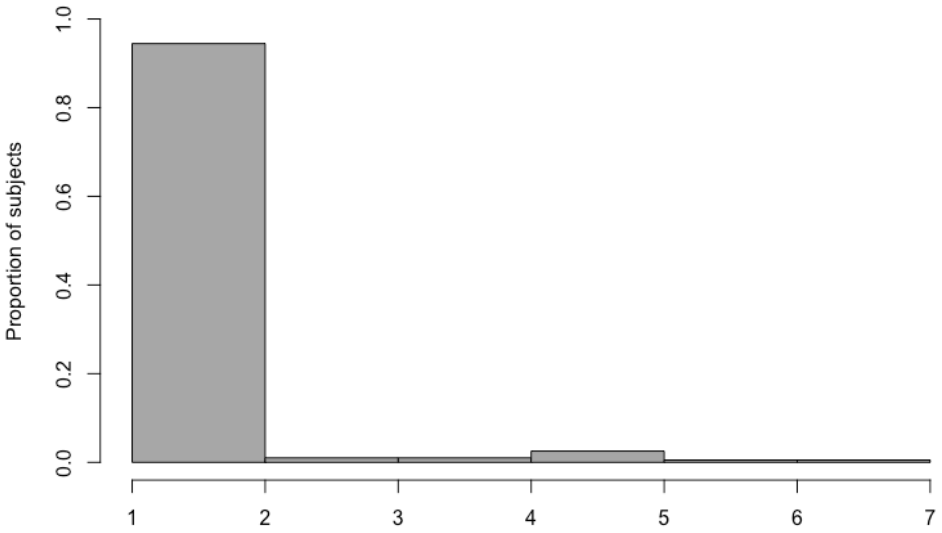
Social Identity Function



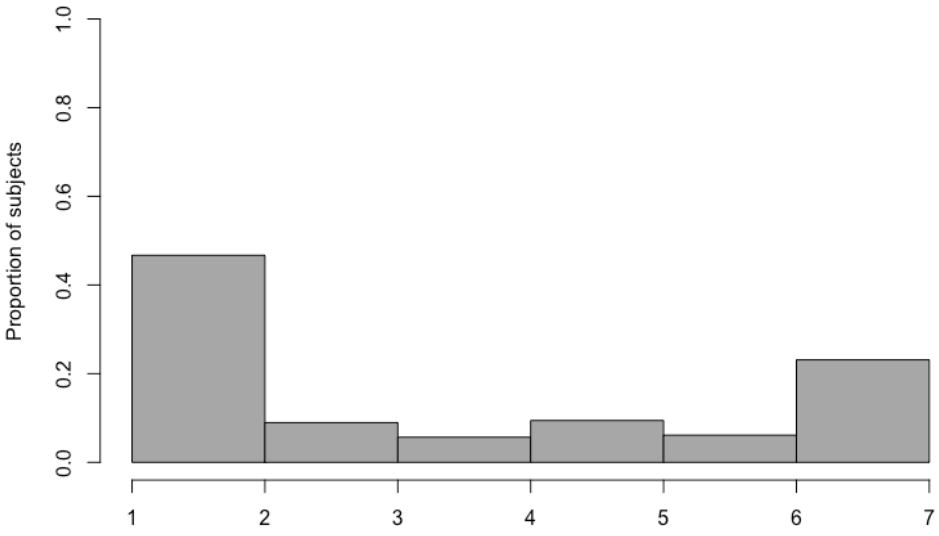
Likelihood of Erasing

If you could actually erase[save] this memory, how likely would you be to do that? (1 = Not at all likely, 7 = Extremely likely)

Negative Memories



Positive Memories



Experiment 2

Memory Prompt Instructions

" For this study, we are interested in some of the memories from your life.

A memory is defined as the memory of a single event that took place within 24 hours at a specific time and place that you personally experienced.

--page break--

A human life consists of many emotional and less emotional events. Some events become highly significant to your personal life story, whereas others are forgotten. From where you are in your life right now, some events may stand out as your **most negative[positive] memories.**

Now imagine that you have to choose between these memories. What are your **five most negative[positive] memories?**

Please describe your five memories in a few brief sentences. Please be assured that your answers are confidential. Don't give us any identifying information. And, of course, feel free to leave out details that you don't wish to share."

Erase & Save Instructions

Save Instructions

"Suppose that you could **permanently save one specific memory**. If you saved that memory you would save **whatever information you currently have about that event**, and be able to **re-experience it whenever you wanted to.** That is, you would be able to bring to mind some aspect or aspects of what happened. You would also be able to bring to mind what you experienced at the time of the event. In other words, the saved memory would enable you to bring back to mind visual images, feelings, and particular associations with other experiences even if you lost your memory for all other life experiences."

Erase Instructions

"Suppose that you could **permanently erase one specific memory**. If you erased that memory you would **not be able to re-experience it again**. That is, you would not be able to bring to mind any aspect or aspects of what happened. You would also not be able to bring to mind what you experienced at the time of the event. In other words, the visual images, feelings, and particular associations with other experiences would be **gone**."

Memory selection instructions

Now imagine you were able to use this service.

Which memory would you be **most likely** to erase[save]?

[all 5 memory descriptions fed back as a forced choice selection]

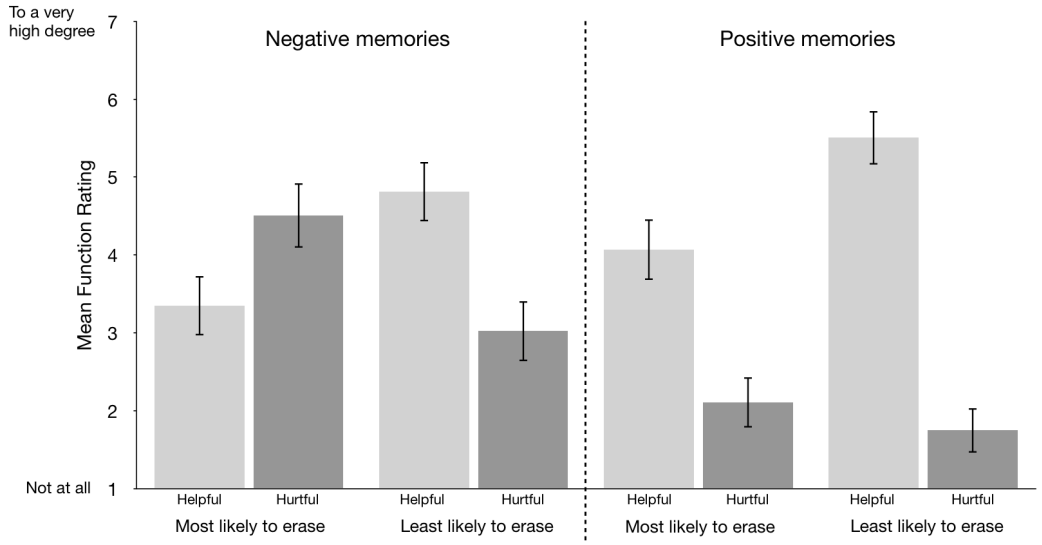
Which memory would you be **least likely** to erase[save]?

[all 5 memory descriptions fed back as a forced choice selection]

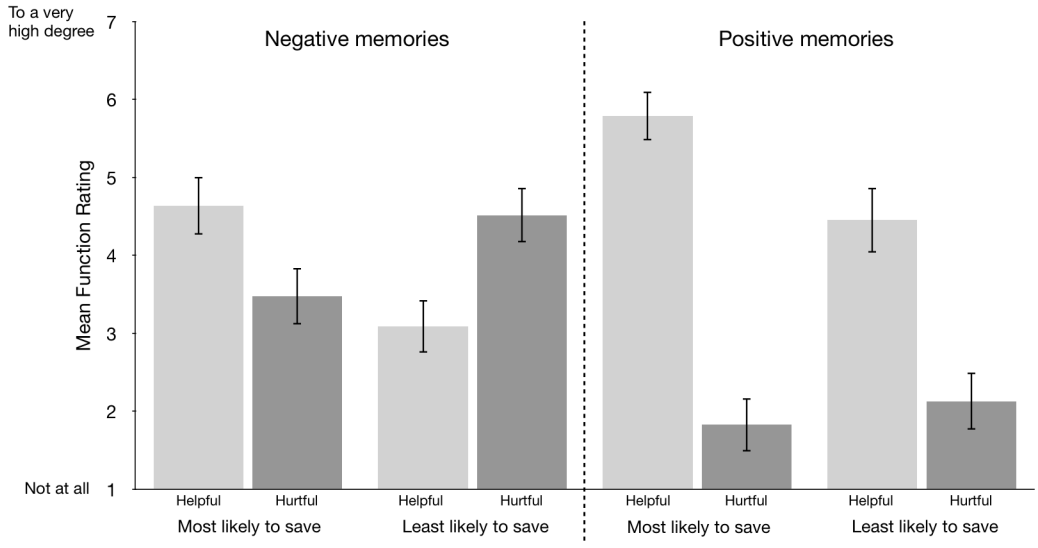
Plots of individual functions

Error bars indicate 95% CIs of the cell means.

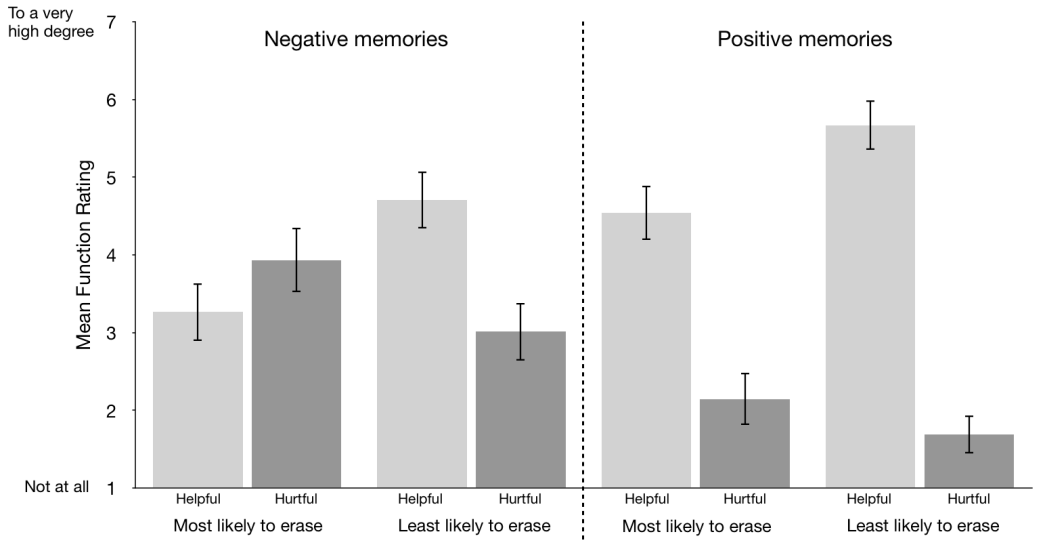
Directive Erase Plot



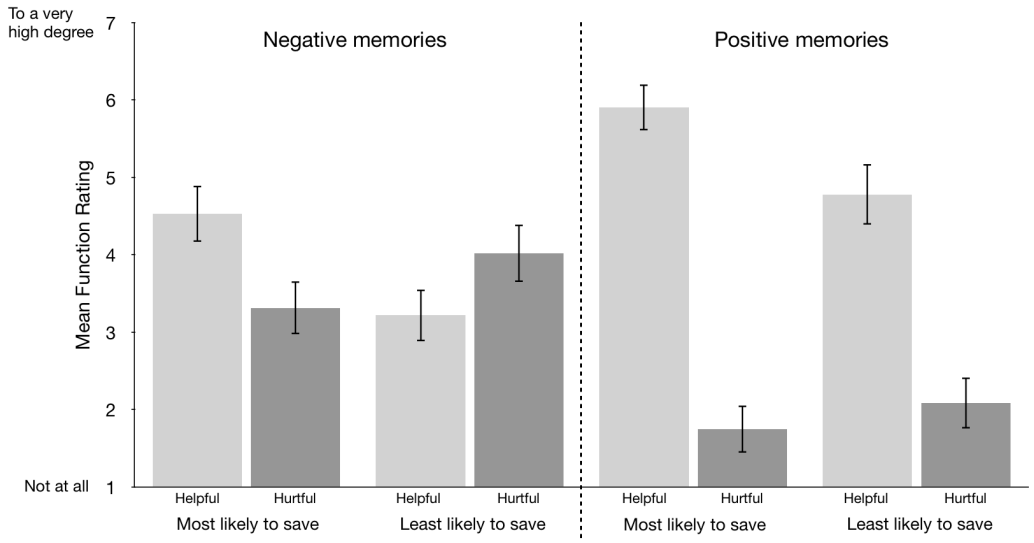
Directive Save Plot



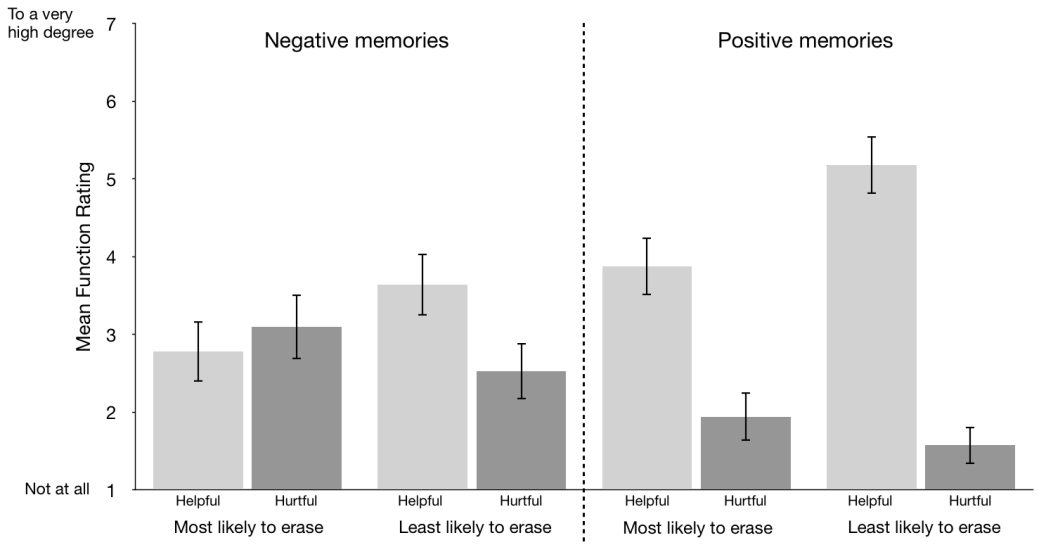
Self Erase Plot



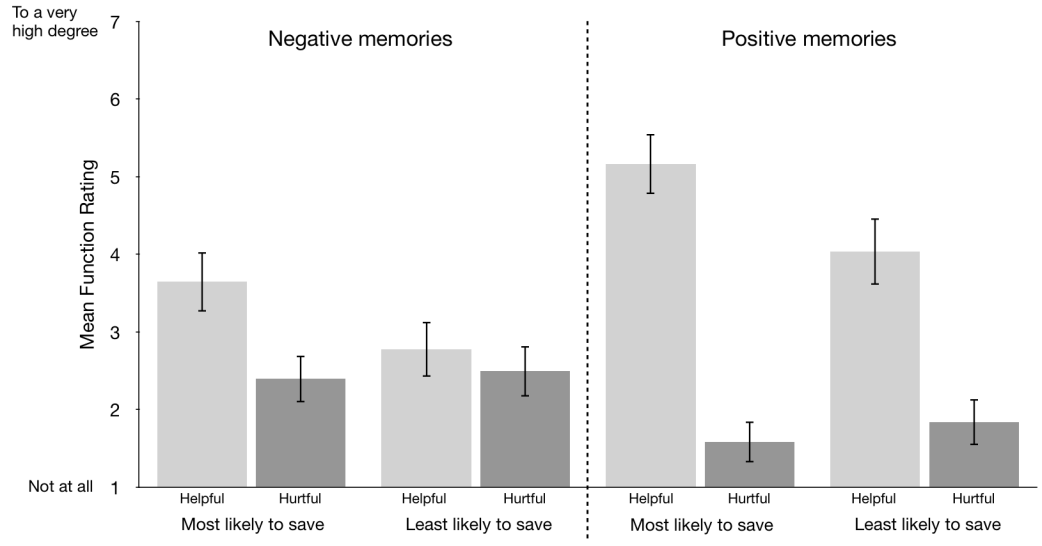
Self Save Plot



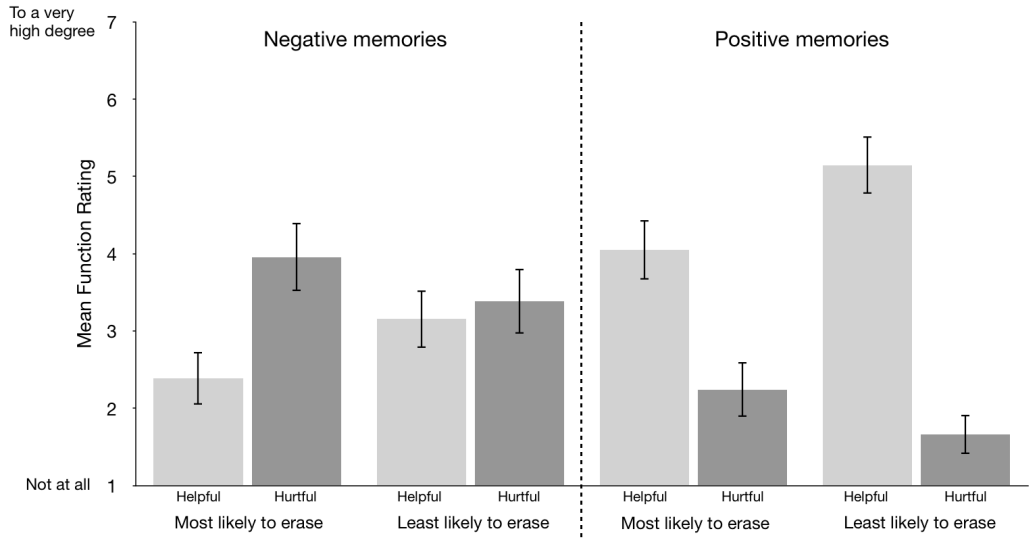
Social Erase Plot



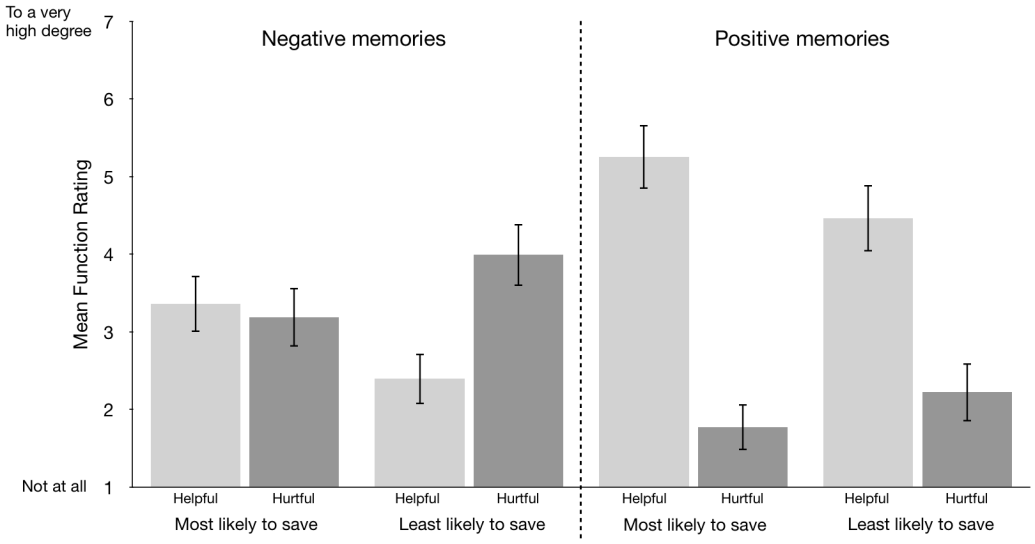
Social Save Plot



Social Identity Erase Plot



Social Identity Save Plot



Likelihood of Saving/Erasing

Valence	Condition	*M*	*SD*	95% CI
Negative	Most likely to erase	5.46	1.89	[5.07, 5.85]
	Least likely to erase	2.96	1.90	[2.57, 3.35]
	Most likely to save	4.35	2.12	[3.98, 4.73]
	Least likely to save	2.12	1.81	[1.80, 2.44]
Positive	Most likely to erase	2.58	2.00	[2.20, 2.97]
	Least likely to erase	1.45	1.26	[1.20, 1.69]
	Most likely to save	6.49	1.07	[6.26, 6.71]
	Least likely to save	4.77	1.79	[4.39, 5.15]

Appendix B: Supplemental Materials for Manuscript 2 (Chapter 3)

Memory reports

Car crash

I was driving to school early in the morning. I began nodding off on the highway. I was two or three blocks from school and I fell asleep on a long straight road. When I woke up, I had crashed through a barbed wire fence and into a telephone pole. My shirt was bloodied. I was crying. The smell of the engine fluids just permeated. I was taken to the hospital. No serious injuries, but I was rather lucky to be alive. (82 words)

Father suicide

My father has had some issues with drinking and had recently gotten into a toxic relationship with a woman. We got the call that he had a big fight with his girlfriend and said he was going to kill himself. We called the cops and tried to find him. We ended up locating him at a local fishing spot. He had gone out in the woods and was sitting on a log. When the cops got close to him, he saw them and put the gun to his head and pulled the trigger. (93 words)

Friend drowned

Some friends and I were at the river and a friend of ours decided to dive in. The water wasn't as deep as we thought and he went head first into some rocks. He didn't come up from the water, so we went and got him and he wasn't breathing. We called 911 and they came and pronounced him dead. (60 words)

Tornado (Experiment 1 only)

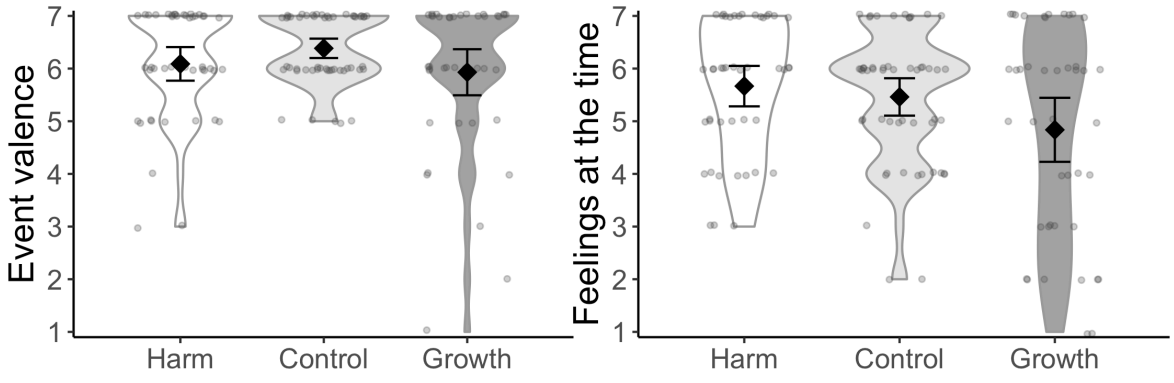
I was six years old and was staying with my grandmother at the time. I was not in school, and she was sick at the time. I remember that the hail was as big as softballs, and I remember granny said to get to the center of a room and get away from the windows. Then I heard her say “oh my, it’s coming toward us.” I just looked out the window in the kitchen and there was a big black tornado coming right toward the house. She grabbed me and put me behind a sofa, against a wall. The noise did not sound like a train at all, it was a noise that was so loud that nothing can compare to it. I felt the wall against my back give a little, and granny said “it’s going to be okay.” I was screaming so loud I could hardly hear her. And then, all at once, it was still—no noise. We got up, and it was gone. (168 words)

Results broken down by memory report

On the whole, we found similar patterns across the different events. But there were some notable differences. In Experiments 1 and 2 the effects of the growth consequence were more pronounced in the tornado and friend drowned memory reports than in the father suicide and car crash reports. In addition, subjects rated the car crash and tornado events as less negative overall than the friend drowned and father suicide events. In Experiment 3, we found an effect of the harm consequence for the car crash and friend drowned reports, but no effect of the growth consequence. By contrast, for the father suicide report we found an effect of the growth consequence but no effect of the harm consequence. But given the small number of people in each cell when analyzing the memory reports separately, we are reluctant to draw conclusions from these differences.

Experiment 1

Car Crash

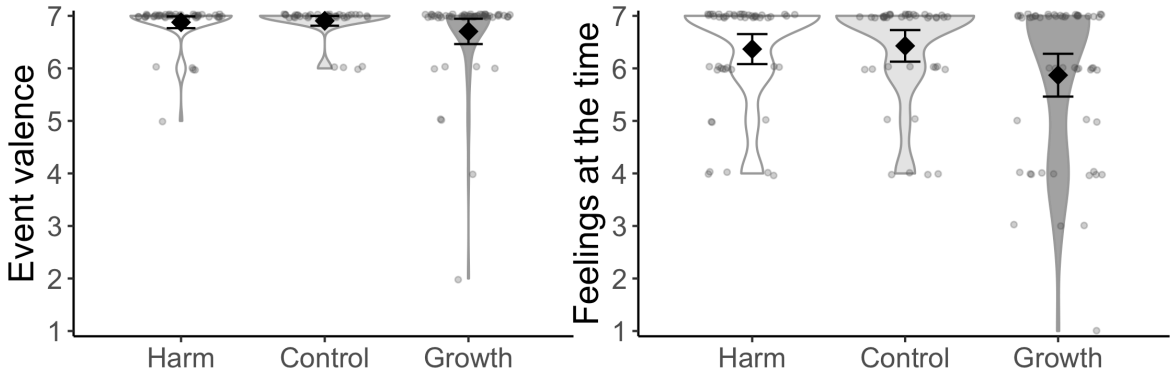


We found that subjects who read the growth consequence rated the event as less negative than subjects who read the harm consequence or who read nothing about consequences, although these differences were plausibly no different from zero, $M_{\text{diff(harm-growth)}} = 0.16$, 95% CI [-0.38,

0.70]; $M_{diff(control\text{-}growth)}$ = 0.45 [-0.07, 0.98]. Subjects who read the harm consequence rated the event as slightly less negative than subjects who read nothing about consequences, although this difference was plausibly no different from zero, $M_{diff(control\text{-}harm)}$ = 0.30 [-0.22, 0.81].

We found a similar pattern when we turned to subjects' ratings of P7's feelings at the time of the event, $M_{diff(harm\text{-}growth)}$ = 0.83, 95% CI [0.06, 1.60]; $M_{diff(control\text{-}growth)}$ = 0.62 [-0.12, 1.37]. Here, though, subjects who read the harm consequence rated P7's feelings at the time as slightly more negative than subjects who read nothing about consequences, $M_{diff(control\text{-}harm)}$ = 0.21 [-0.53, 0.94].

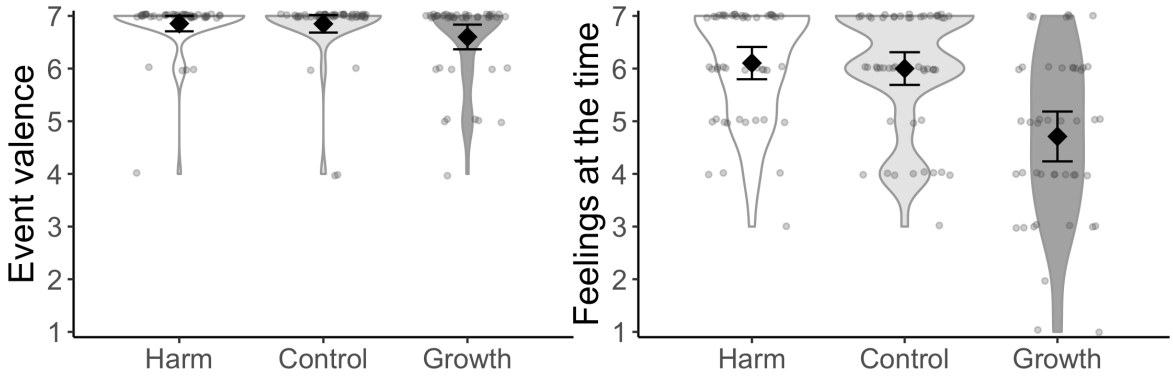
Father Suicide



We found that subjects who read the growth consequence rated the event as less negative than subjects who read the harm consequence or who read nothing about consequences, although these differences were plausibly no different from zero, $M_{diff(harm\text{-}growth)}$ = 0.17, 95% CI [-0.11, 0.46]; $M_{diff(control\text{-}growth)}$ = 0.20 [-0.09, 0.50]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(control\text{-}harm)}$ = 0.03 [-0.27, 0.33].

We found a similar pattern when we turned to subjects' ratings of P7's feelings at the time of the event, $M_{diff(harm\text{-}growth)}$ = 0.50, 95% CI [-0.06, 1.06]; $M_{diff(control\text{-}growth)}$ = 0.56 [-0.03, 1.14]; $M_{diff(control\text{-}harm)}$ = 0.06 [-0.54, 0.66].

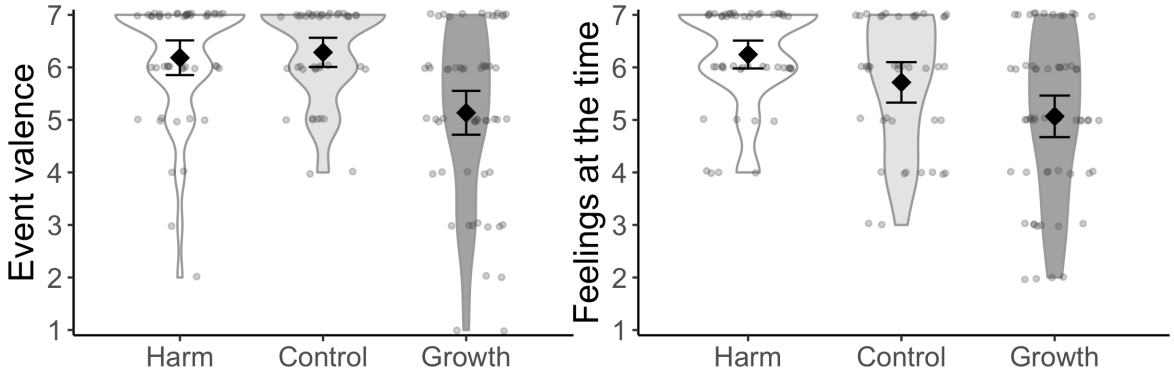
Friend Drowned



We found that subjects who read the growth consequence rated the event as less negative than subjects who read the harm consequence or who read nothing about consequences, although these differences were plausibly no different from zero, $M_{diff(harm\text{-}growth)}$ = 0.25, 95% CI [-0.06, 0.57]; $M_{diff(control\text{-}growth)}$ = 0.25 [-0.06, 0.55]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(harm\text{-}control)}$ = 0.01 [-0.29, 0.30].

Similarly, we found that subjects who read the growth consequence rated P7's feelings at the time as substantially less negative than subjects who read the harm consequence or who read nothing about consequences $M_{diff(harm\text{-}growth)}$ = 1.39, 95% CI [0.77, 2.01]; $M_{diff(control\text{-}growth)}$ = 1.29 [0.68, 1.89]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(control\text{-}harm)}$ = 0.10 [-0.49, 0.70].

Tornado

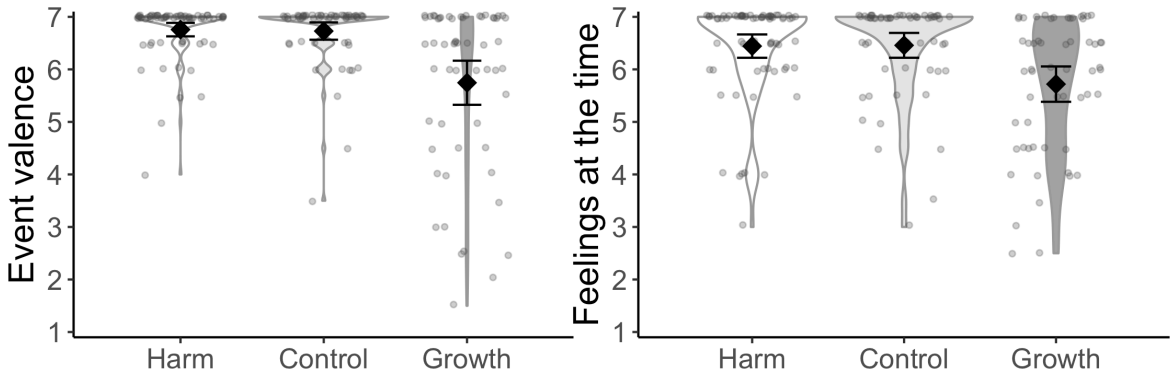


We found that subjects who read the growth consequence rated the event as less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{diff(harm-growth)}$ = 1.05, 95% CI [0.46, 1.64]; $M_{diff(control-growth)}$ = 1.15 [0.53, 1.77]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(harm-control)}$ = 0.10 [-0.54, 0.74].

Similarly, we found that subjects who read the growth consequence rated P7's feelings at the time as substantially less negative than subjects who read the harm consequence or who read nothing about consequences $M_{diff(harm-growth)}$ = 1.18, 95% CI [0.60, 1.76]; $M_{diff(control-growth)}$ = 0.65 [0.04, 1.25]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(control-harm)}$ = 0.53 [-0.10, 1.16].

Experiment 2

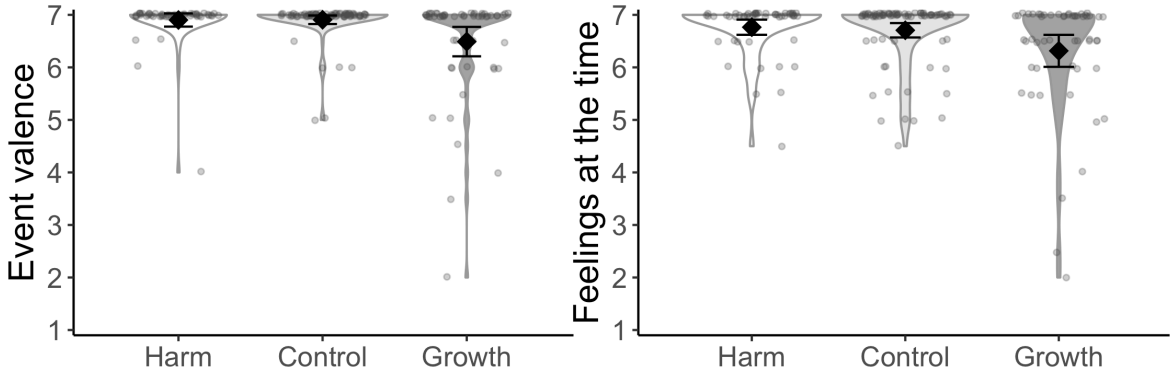
Car Crash



We found that subjects who read the growth consequence rated the event as less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{\text{diff(harm-growth)}} = 1.01$, 95% CI [0.59, 1.43]; $M_{\text{diff(control-growth)}} = 0.98$ [0.54, 1.42]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{\text{diff(control-harm)}} = 0.03$ [-0.39, 0.45].

We found a similar pattern when we turned to subjects' ratings of P7's feelings at the time of the event, $M_{\text{diff(harm-growth)}} = 0.72$, 95% CI [0.29, 1.16]; $M_{\text{diff(control-growth)}} = 0.74$ [0.28, 1.19]; $M_{\text{diff(control-harm)}} = 0.01$ [-0.42, 0.45].

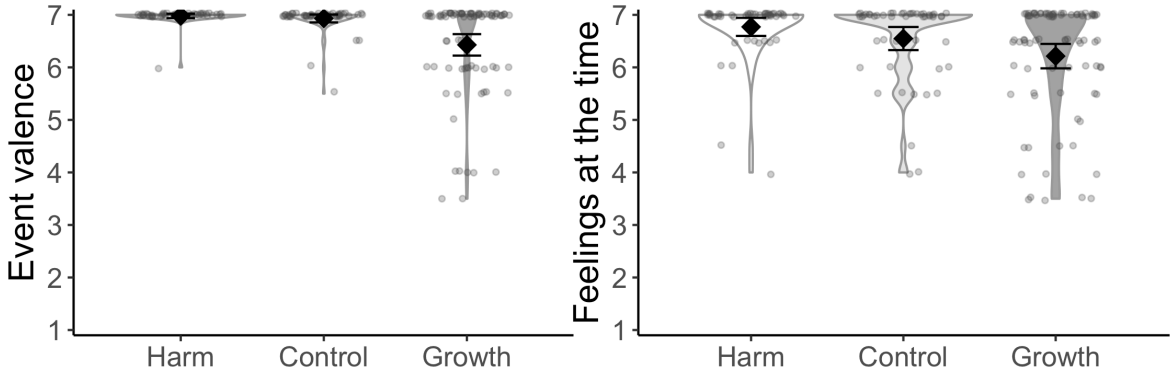
Father Suicide



We found that subjects who read the growth consequence rated the event as less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{diff(harm-growth)}$ = 0.41, 95% CI [0.11, 0.71]; $M_{diff(control-growth)}$ = 0.42 [0.15, 0.68]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(control-harm)}$ = 0.00 [-0.27, 0.28].

We found a similar pattern when we turned to subjects' ratings of P7's feelings at the time of the event, $M_{diff(harm-growth)}$ = 0.45, 95% CI [0.09, 0.81]; $M_{diff(control-growth)}$ = 0.39 [0.07, 0.71]; $M_{diff(control-harm)}$ = 0.06 [-0.27, 0.39].

Friend Drowned

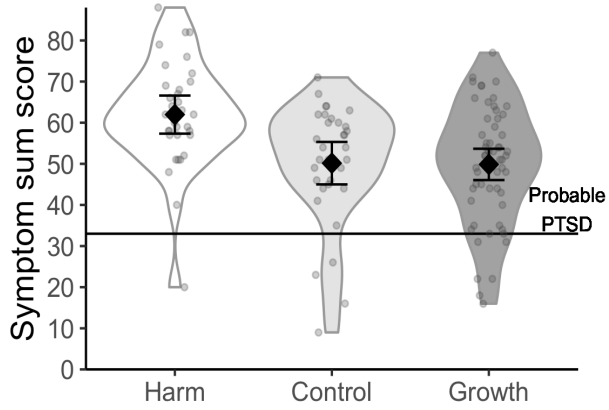


We found that subjects who read the growth consequence rated the event as less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{diff(harm-growth)}$ = 0.55, 95% CI [0.27, 0.83]; $M_{diff(control-growth)}$ = 0.50 [0.23, 0.78]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(harm-control)}$ = 0.05 [-0.27, 0.36].

We found a similar pattern when we turned to subjects' ratings of P7's feelings at the time of the event, $M_{diff(harm-growth)}$ = 0.56, 95% CI [0.18, 0.94]; $M_{diff(control-growth)}$ = 0.33 [-0.04, 0.71]; $M_{diff(control-harm)}$ = 0.22 [-0.20, 0.64].

Experiment 3

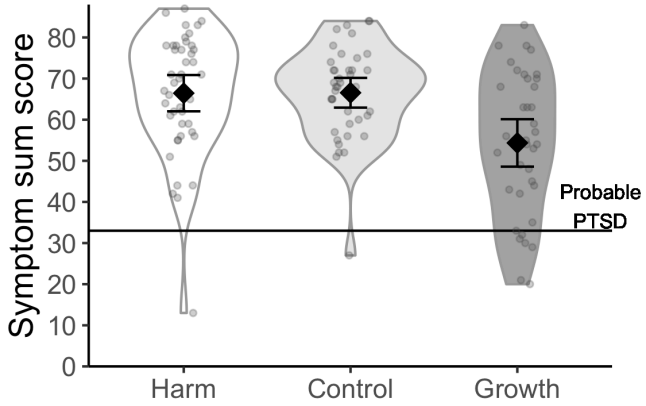
Car Crash



We found that subjects who read the harm consequence thought that P7 would have experienced more intense symptoms of distress in the months following the event than subjects who read the growth consequence or who read nothing about consequences, $M_{diff(harm-growth)}$ = 12.11, 95% CI [4.82, 19.41]; $M_{diff(harm-control)}$ = 11.82 [3.63, 20.00]. The difference between subjects who read the

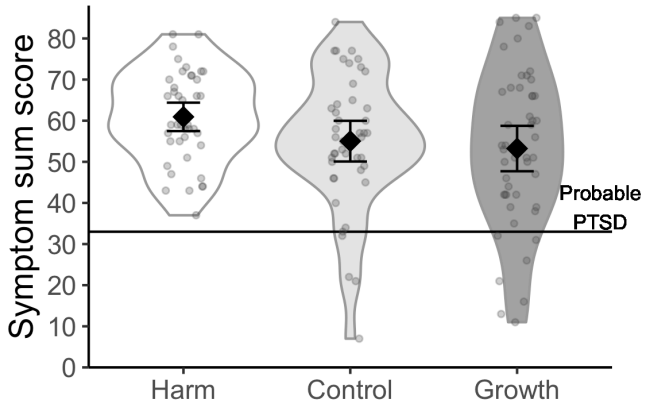
growth consequence and subjects who read nothing about consequences was trivial, $M_{diff(control-growth)}$ = 0.29 [-7.00, 7.59].

Father Suicide



We found that subjects who read the growth consequence thought that P7 would have experienced less intense symptoms of distress in the months following the event than subjects who read the harm consequence or who read nothing about consequences, $M_{diff(harm-growth)}$ = 12.09, 95% CI [4.42, 19.76]; $M_{diff(control-growth)}$ = 12.20 [4.31, 20.08]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was trivial, $M_{diff(control-harm)}$ = 0.11 [-7.41, 7.62].

Friend Drowned



We found that subjects who read the harm consequence thought that P7 would have experienced more intense symptoms of distress in the months following the event than subjects who read the growth consequence or who read nothing about consequences, although these differences were plausibly no different than zero, $M_{\text{diff(harm-growth)}} = 0.55$, 95% CI [0.27, 0.83]; $M_{\text{diff(harm-control)}} = 0.05$ [-0.27, 0.36]. The difference between subjects who read the growth consequence and subjects who read nothing about consequences was trivial, $M_{\text{diff(control-growth)}} = 0.50$ [0.23, 0.78].

Pilot study

Method

Subjects

We recruited 1983 subjects from Amazon's Mechanical Turk. From these subjects, we excluded 175 who failed the attention check, leaving us with our final sample of 1808 subjects.

Procedure

In this pilot study, we piloted two sets of consequences. The first set ultimately formed the basis for the consequences we used in Experiment 1 ("Through this experience, I discovered that I'm stronger than I thought I was." and "Through this experience, I discovered that I'm not as strong as I thought I was.) and the second set formed the basis for the consequences we used in Experiments 2 and 3 ("Because of this experience, I ultimately became a better person." and "Because of this experience, I ultimately became a worse person."). We created these consequences by adapting items from the Post-traumatic Growth Inventory (Cann et al., 2010).

Subjects read one of the four memory reports used in the main experiments. As in the main experiments, we manipulated what consequences, if any, were reported at the end of this memory report. To do so, we first divided subjects into three groups: one group who would read that P7 grew from the experience, one group who would read that P7 was harmed by the experience, and one group who would read nothing about consequences. Of the subjects who read that P7 grew, half of those subjects read the growth sentence from the first set, and half read

the growth sentence from the second set. Likewise, of the subjects who read that P7 was harmed, half of those subjects read the harm sentence from the first set, and half read the harm sentence from the second set.

Once subjects had read the memory report, they rated how plausible it is that P7 really experienced the event, how clear they found the story in P7's description, and how well they understood what happened in the event P7 described, all on a scale from 1 (Not at all) to 7 (Completely). We also included an attention check in this ratings block and excluded subjects who failed it.

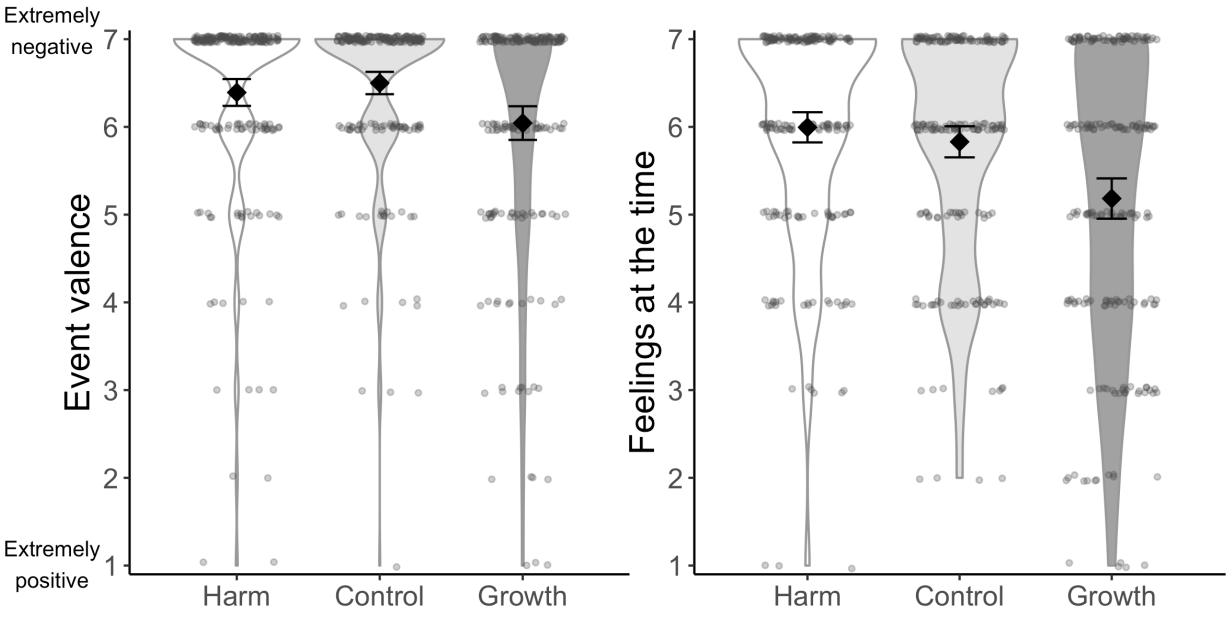
Results

Means and standard deviations (in parentheses) of subjects' ratings of plausibility, clarity, and understanding.

Ending	Plausibility	Clarity	Understanding
Not as strong as I thought	5.93 (1.29)	6.17 (1.10)	6.36 (0.97)
Stronger than I thought	5.91 (1.29)	6.08 (1.09)	6.21 (1.07)
Control	5.71 (1.39)	5.97 (1.16)	6.17 (1.08)
Became a worse person	6.09 (1.16)	6.29 (0.92)	6.42 (0.82)
Became a better person	6.05 (1.18)	6.18 (1.00)	6.26 (0.94)

Results including subjects who failed to identify the ending sentence they read

Experiment 1

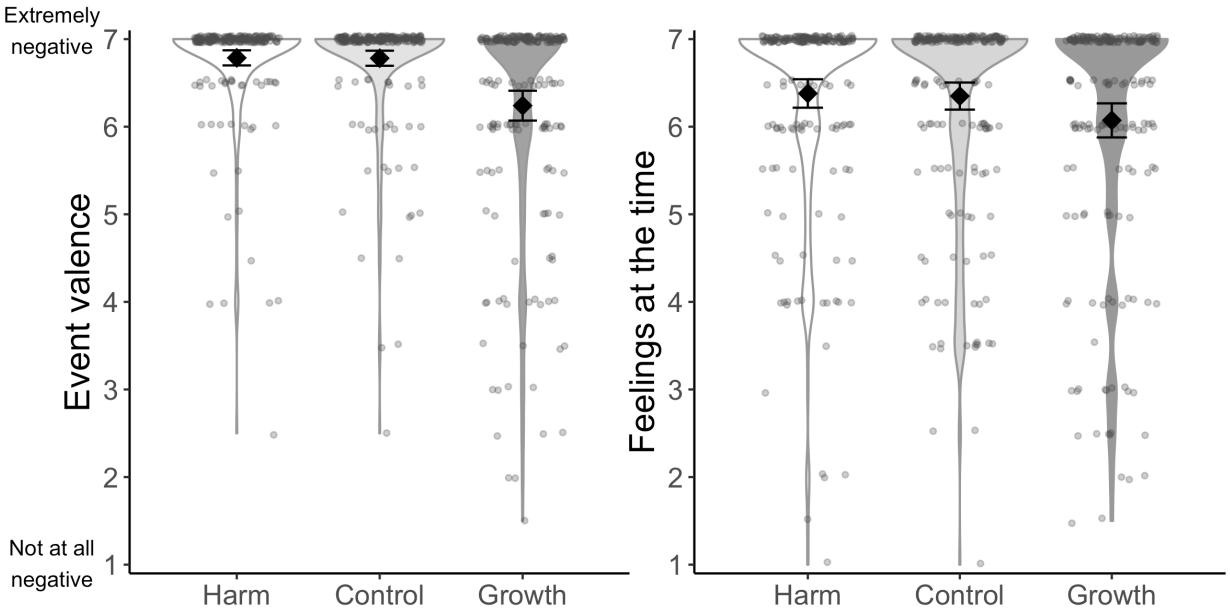


Considering subjects' ratings of the valence of the event, we found that subjects who read the growth consequence rated the event itself as less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{\text{diff(growth-harm)}} = 0.35$ [0.08 , 0.62]; $M_{\text{diff(growth-control)}} = 0.46$ [0.19, 0.73]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was plausibly no different from zero $M_{\text{diff(control-harm)}} = 0.11$ [-0.16, 0.38].

Likewise, we found that subjects who read the growth consequence rated P7's feelings at the time of the event as being less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{\text{diff(growth-harm)}} = 0.81$ [0.48 , 1.14], $M_{\text{diff(growth-control)}} = 0.65$ [0.32, 0.98]. The difference between subjects who read the harm consequence and subjects who

read nothing about consequences was plausibly no different from zero, $M_{diff(control\text{-}harm)}$ = 0.17 [-0.16, 0.49].

Experiment 2

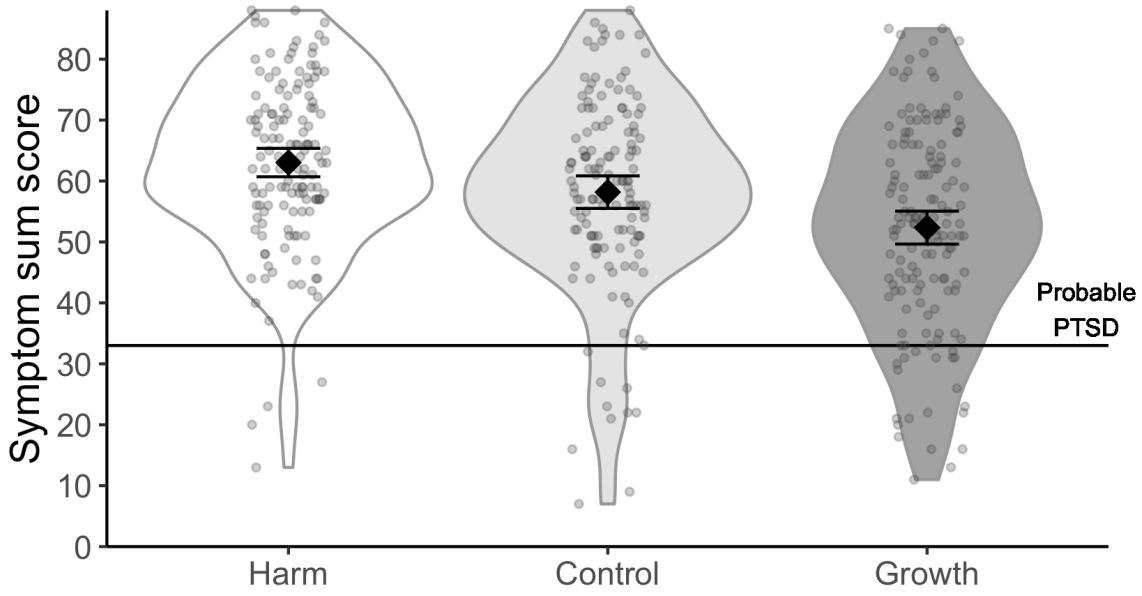


Considering subjects' ratings of the valence of the event, we found that subjects who read the growth consequence rated the event itself as less negative than subjects who read the harm consequence or who read nothing about consequences, $M_{diff(growth\text{-}harm)}$ = 0.55 [0.34 , 0.75], $M_{diff(growth\text{-}control)}$ = 0.54 [0.34, 0.74]. The difference between subjects who read the harm consequence and subjects who read nothing about consequences was plausibly no different from zero, $M_{diff(control\text{-}harm)}$ = 0.00 [-0.20, 0.21].

Likewise, we found that subjects who read the growth consequence rated P7's feelings at the time of the event as being less negative than subjects who read the harm consequence or who read nothing about consequences, although this latter difference was plausibly no different than

zero, $M_{diff(growth\text{-}harm)}$ = 0.31 [0.02 , 0.60], $M_{diff(growth\text{-}control)}$ = 0.28 [-0.01, 0.56]). The difference between subjects who read the harm consequence and subjects who read nothing about consequences was plausibly no different from zero, $M_{diff(control\text{-}harm)}$ = 0.03 [-0.26, 0.32].

Experiment 3



Subjects who read the growth consequence thought P7 would have experienced less intense symptoms of distress in the months following the event than subjects who read the harm consequence or who read nothing about consequences, $M_{diff(harm\text{-}growth)}$ = 10.68 [6.37 , 14.98]; $M_{diff(control\text{-}growth)}$ = 5.82 [1.49, 10.15]. These results suggest that subjects were using P7's report of growth to make appraisals about his or her symptoms of distress in the months following the event—consistent with the findings from the first two Experiments. Furthermore, we found that subjects who read the harm consequence thought that P7 would have experienced more intense symptoms of distress in the months following the event than subjects who read nothing about consequences, $M_{diff(harm\text{-}control)}$ = 5.82 [0.45, 9.25].

Personality rating results

Adapted Ten Item Personality Inventory (Gosling et al., 2003)

Here are a number of personality traits that may or may not apply to Participant 7. For each statement, please indicate the extent to which you agree or disagree with that statement.

You should rate the extent to which the pair of traits applies to Participant 7, even if one characteristic applies more strongly than the other.

I see Participant 7 as extraverted, enthusiastic
I see Participant 7 as critical, quarrelsome
I see Participant 7 as dependable, self-disciplined
I see Participant 7 as anxious, easily upset
I see Participant 7 as open to new experiences, complex
I see Participant 7 as reserved, quiet
I see Participant 7 as sympathetic, warm
I see Participant 7 as disorganized, careless
I see Participant 7 as calm, emotionally stable
I see Participant 7 as conventional, uncreative

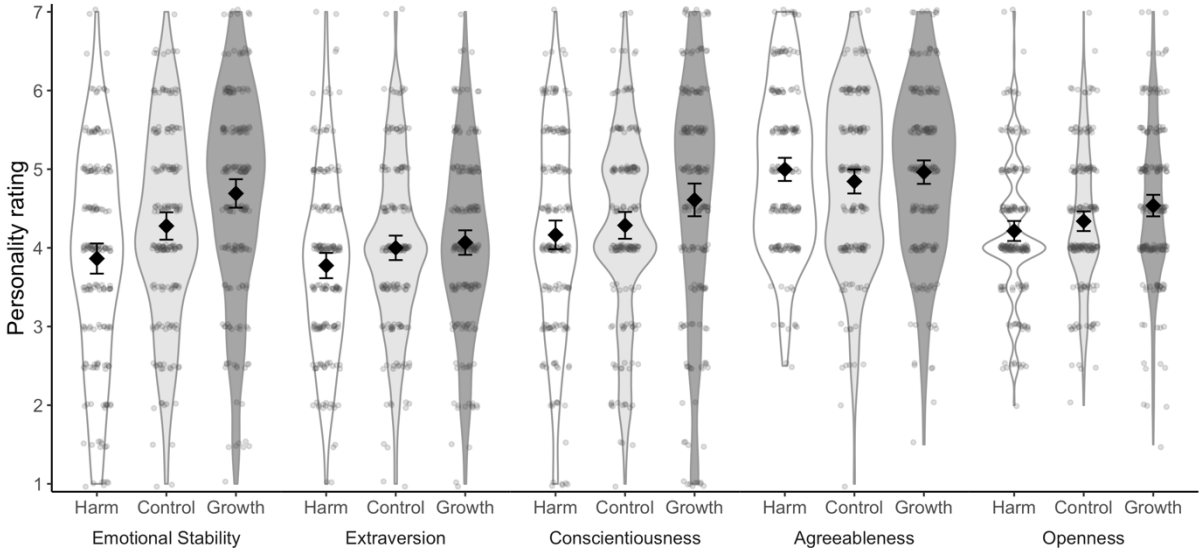
All items rated from 1 (*Strongly Disagree*) to 7 (*Strongly Agree*).

Subscales

Extraversion: 1, 6 (reversed)
Agreeableness: 2 (reversed), 7
Conscientiousness: 3, 8 (reversed)
Emotional Stability: 4 (reversed), 9
Openness: 5, 10 (reversed)

Results

Condition	Emotional Stability	Extraversion	Conscientiousness	Agreeableness	Openness
Harm	3.86 (1.34)	3.77 (1.13)	4.16 (1.28)	5.00 (1.03)	4.21 (0.89)
Control	4.28 (1.21)	4 (1.08)	4.16 (1.19)	4.84 (1.06)	4.34 (0.87)
Growth	4.69 (1.30)	4.07 (1.12)	4.61 (1.50)	4.96 (1.07)	4.54 (0.98)

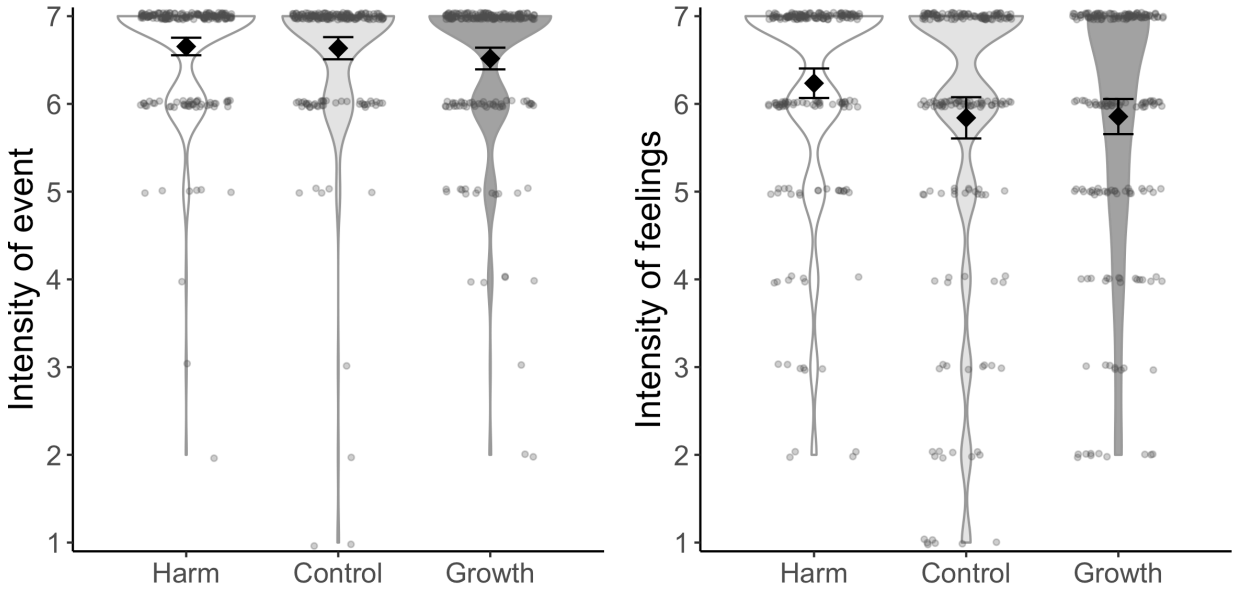


Violin plots of subjects' personality ratings split by condition. Dots represent individual data points, diamonds represent the cell means, and error bars represent the 95% CI around the cell means.

We found that, compared to subjects who read nothing about consequences, subjects who read the growth consequence rated P7 as more emotionally stable, and subjects who read the harm consequence rated P7 as less emotionally stable, $M_{\text{diff(growth-control)}} = 0.41$, 95% CI [0.11, 0.72], $M_{\text{diff(control-harm)}} = 0.41$ [0.10, 0.72]. These results suggest that when someone reports that a negative event helped them grow, others use that report as evidence of emotional stability. Conversely, when someone reports that a negative event caused them harm, the results suggest that others use that report as evidence of a lack of emotional stability.

Intensity results

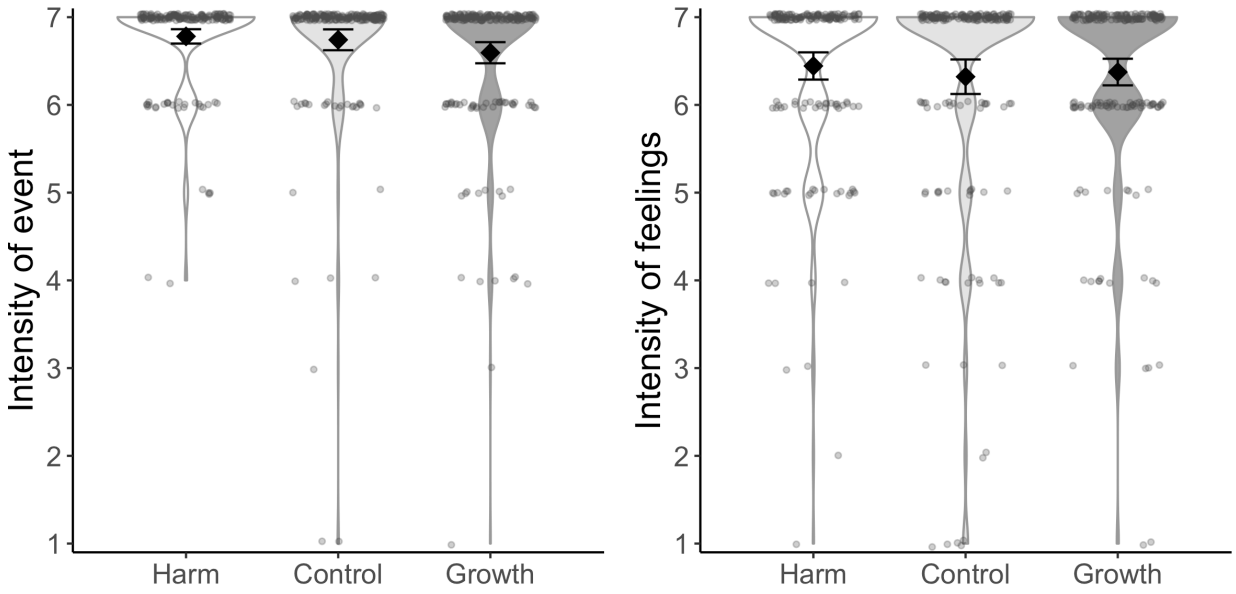
Experiment 1



Considering subjects' ratings of the intensity of the event itself, the effects of the consequences on subjects' ratings of the intensity of the event were plausibly no different than zero ($M_{diff(harm-growth)}$ = 0.14 [-0.06 , 0.33]; ($M_{diff(harm-control)}$ = 0.02 [-0.18, 0.22]; $M_{diff(control-growth)}$ = 0.12 [-0.08, 0.31]).

Considering subjects' ratings of the intensity of P7's feelings at the time, we found that subjects who read the harm consequence rated P7's feelings at the time of the event as being more intense than when P7 reported harm or reported nothing about consequences ($M_{diff(harm-growth)}$ = 0.38 [0.04 , 0.72]; $M_{diff(harm-control)}$ = 0.39 [0.05, 0.74]). The difference between when P7 reported growth and when P7 reported nothing about consequences was plausibly no different from zero ($M_{diff(growth-control)}$ = 0.01 [-0.33, 0.36]).

Experiment 2



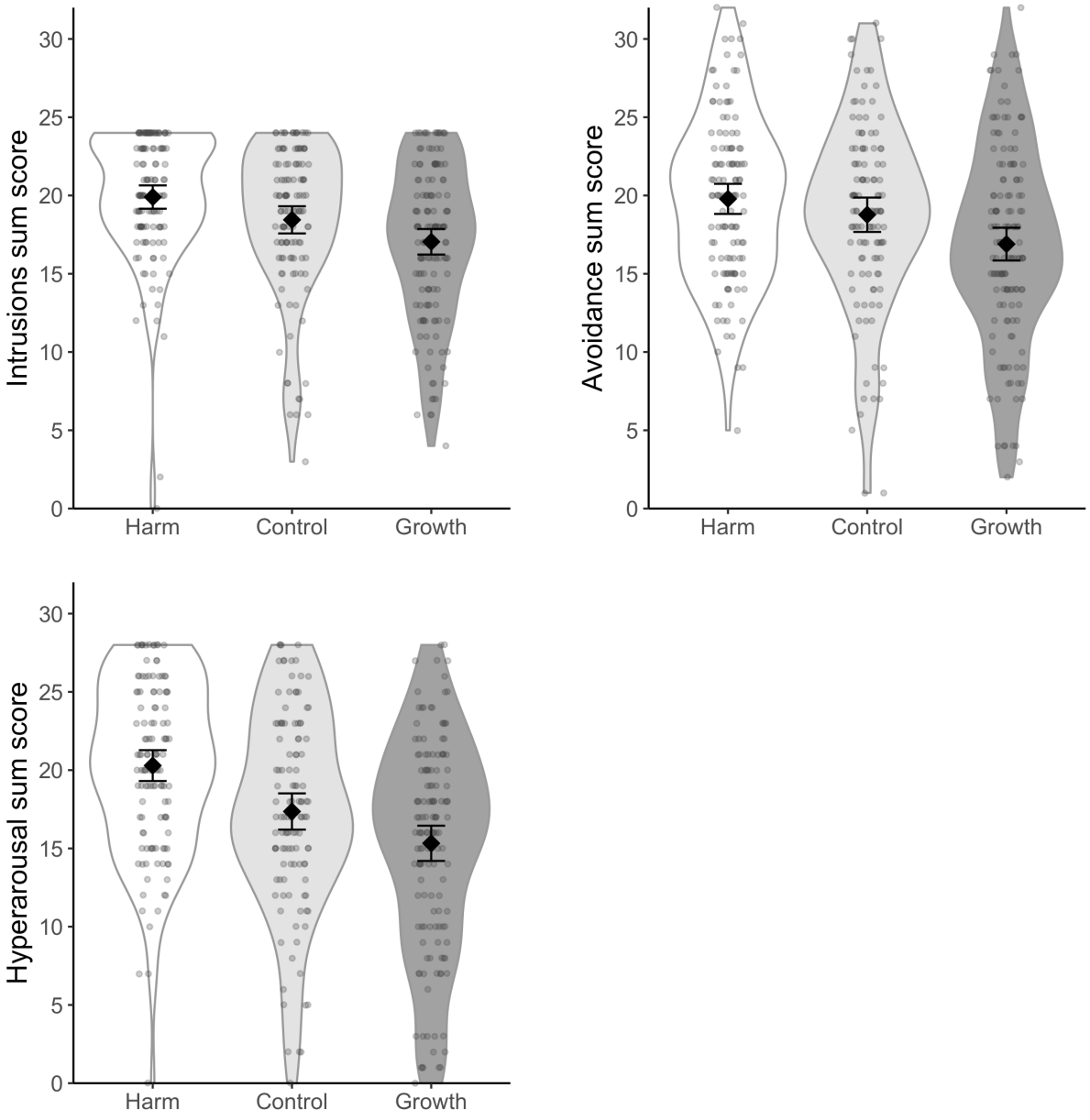
Considering subjects' ratings of the intensity of the event itself, the effects of the consequences on subjects' ratings of the intensity of the event were plausibly no different than zero ($M_{\text{diff(harm-growth)}}$ = 0.19 [-0.00 , 0.37]; ($M_{\text{diff(harm-control)}}$ = 0.04 [-0.15, 0.23]; $M_{\text{diff(control-growth)}}$ = 0.15 [-0.04, 0.33]).

Likewise, considering subjects' ratings of the intensity of P7's feelings at the time, the effects of the consequences on subjects' ratings of the intensity of the event were plausibly no different than zero ($M_{\text{diff(harm-growth)}}$ = 0.07 [-0.22 , 0.36]; $M_{\text{diff(harm-control)}}$ = 0.12 [-0.17, 0.41]; ($M_{\text{diff(growth-control)}}$ = 0.05 [-0.23, 0.33]).

Adapted Impact of Events Scale - Revised (Weiss, 2007)

Item	Subscale
Any reminder brought back feelings about it	Intrusion
I had trouble staying asleep	Intrusion
Other things kept making me think about it	Intrusion
I felt irritable and angry	Hyperarousal
I avoided letting myself get upset when I thought about it or was reminded of it	Avoidance
I thought about it when I didn't mean to	Intrusion
I felt as if it hadn't happened or wasn't real	Avoidance
I stayed away from reminders about it	Avoidance
Pictures about it popped into my mind	Intrusion
I was jumpy and easily startled	Hyperarousal
I tried not to think about it	Avoidance
I was aware that I still had a lot of feelings about it, but I didn't deal with them	Avoidance
My feelings about it were kind of numb	Avoidance
I found myself acting or feeling like I was back at that time	Hyperarousal
I had trouble falling asleep	Hyperarousal
I had waves of strong feelings about it	Intrusion
I tried to remove it from my memory	Avoidance
I had trouble concentrating	Hyperarousal
Reminders of it caused me to have physical reactions, such as sweating, trouble breathing, nausea, or a pounding heart	Hyperarousal
I had dreams about it	Intrusion
I felt watchful and on guard	Hyperarousal
I tried not to talk about it	Avoidance

Symptom subscale results



Violin plots of symptom subscale scores. The maximum intrusions score was 24, the maximum avoidance score was 32, and the maximum hyperarousal score was 28.

Appendix C: Supplemental Materials for Manuscript 3 (Chapter 4)

Reasons for retracting

In Experiments 1, 2, and 3, we asked people about their primary reason for retracting their retracted memory using one multiple choice question:

What was the primary reason you stopped believing the event happened?

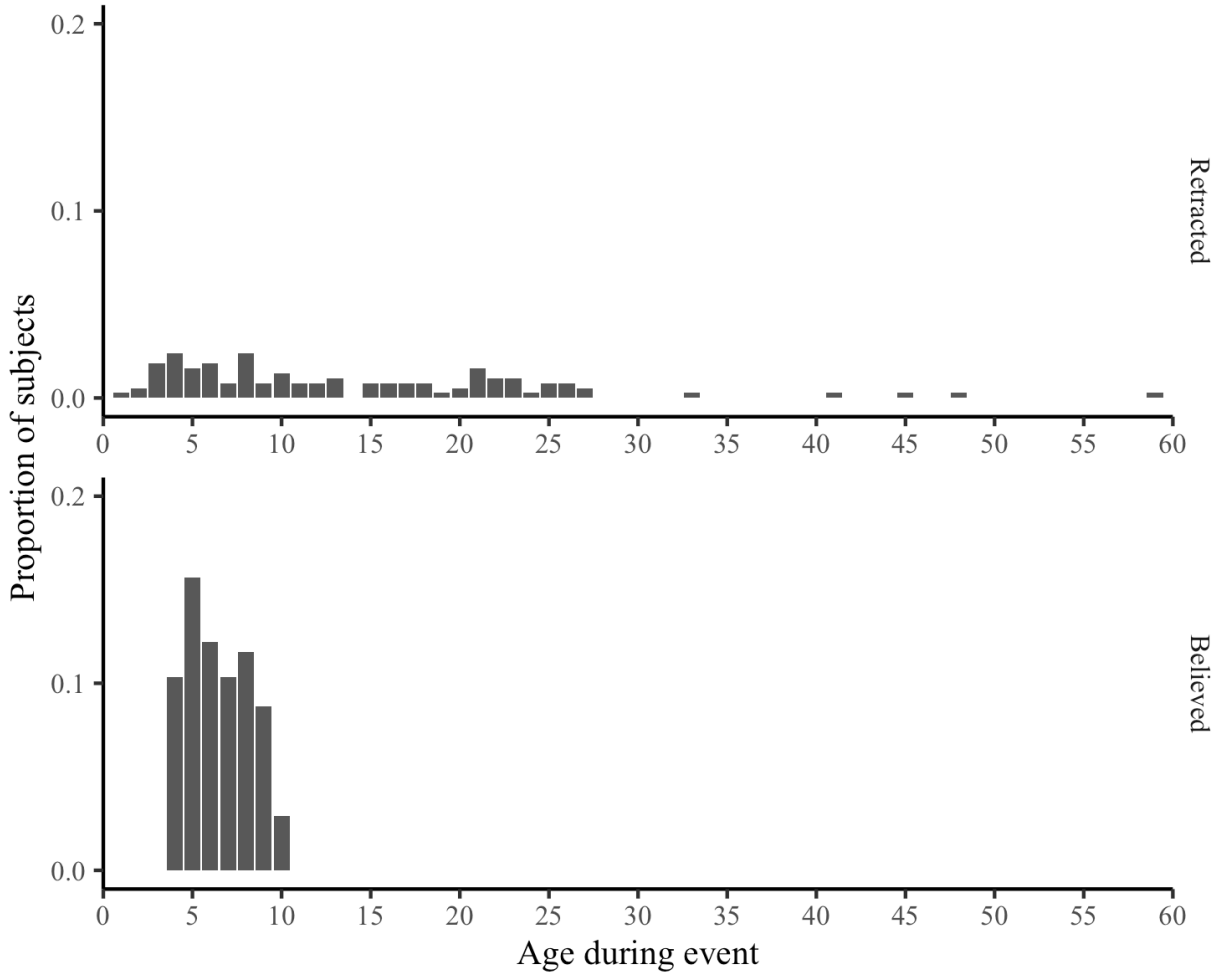
- I was told the event never happened
- I was told the event happened to someone else
- I was told the event happened differently to how I remember it
- The event was unrealistic or impossible
- There was evidence to suggest the event never happened (Experiments 1 and 2 only)
- There was other evidence to suggest the event never happened (Experiment 3 only)
- There was no evidence to suggest the event happened
- Other (please describe)

Results

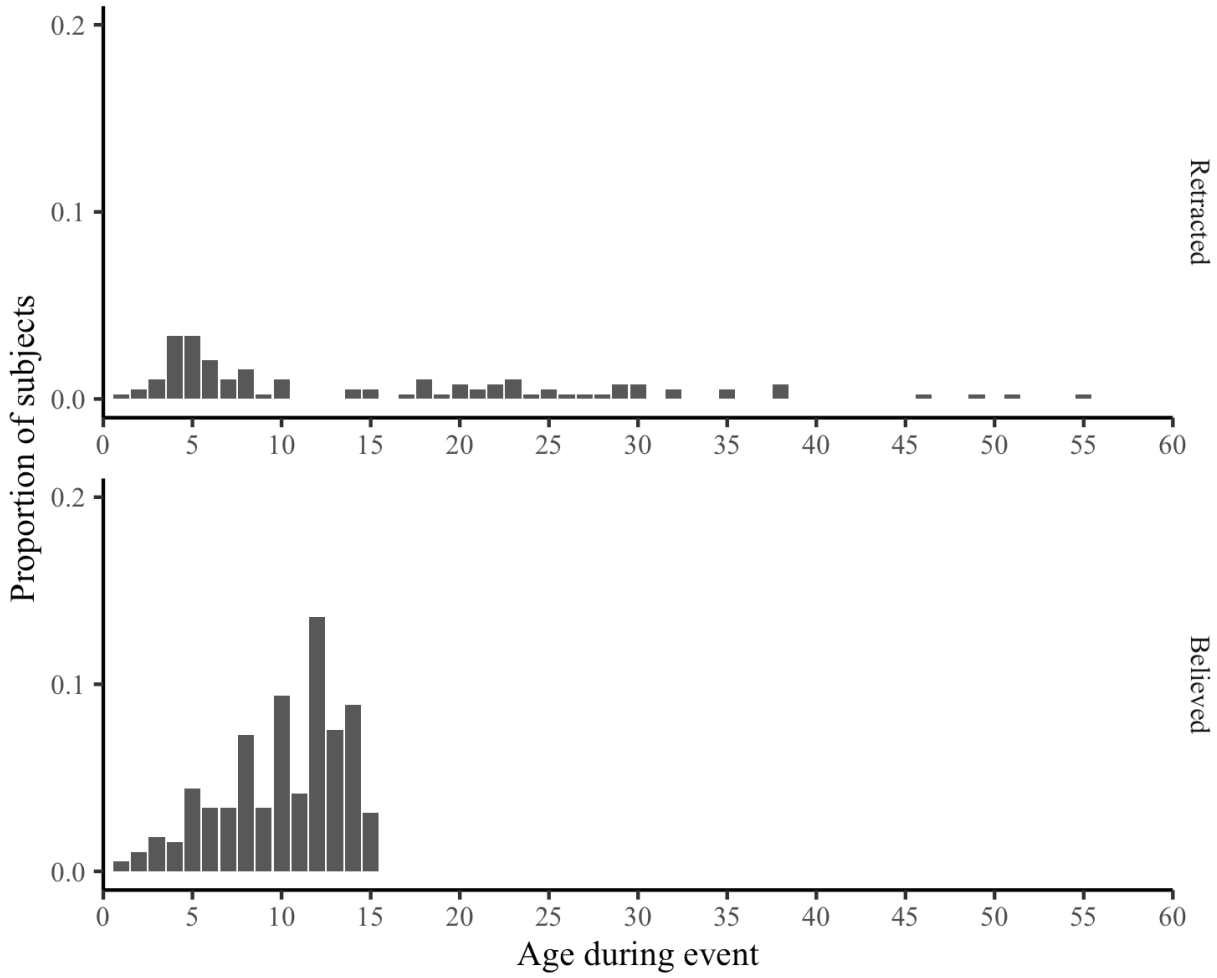
	Experiment 1		Experiment 2		Experiment 3	
Reason	n	%	n	%	n	%
I was told the event never happened	13	12.26	44	43.56	113	35.20
The event was unrealistic or impossible	26	24.53	19	18.81	64	19.94
There was evidence to suggest the event never happened	9	8.49	18	17.82	52	16.20
There was no evidence to suggest the event happened	22	20.75	12	11.88	50	15.58
I was told the event happened differently to how I remember it	18	16.98	3	2.97	26	8.10
Other	18	16.98	5	4.95	16	4.98

Age distributions from Experiments 1 and 2

Experiment 1



Experiment 2

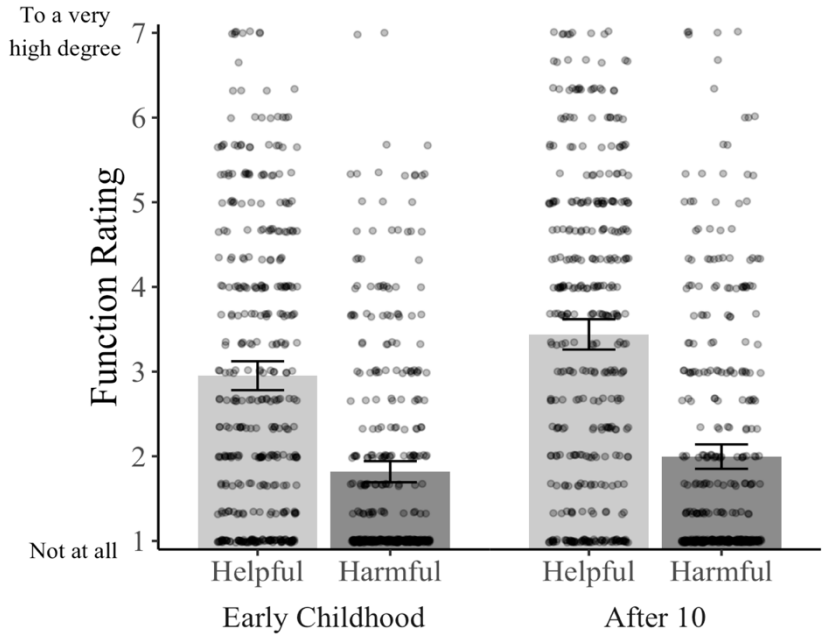


Results from Experiment 3 for people who did not have any retracted memories

Participants who reported they did not have any retracted memories were asked to describe and rate two believed memories: one from their early childhood, and one from after age 10.

Subjects reported strong belief in both their memories from early childhood (M = 6.04, SD = 1.36) and their memories from after age 10 (M = 6.33, SD = 1.28).

As the distributions in the figure below show, people reported that their believed memories from after age 10 serve helpful functions more than their believed memories from early childhood, $M_{\text{early childhood}}$ = 3.44; $M_{\text{after 10}}$ = 2.95; M_{diff} = 0.49 [0.30, 0.67]. Likewise, people's memories from after age 10 were slightly more harmful, $M_{\text{early childhood}}$ = 2.00; $M_{\text{after 10}}$ = 1.82; M_{diff} = 0.18 [0.04, 0.32]).



Phenomenology results

Measures

This memory is significant for my life because it imparts an important message for me or represents a critical juncture or turning point.

The feelings I experience as I recall the event are positive

The feelings I experience as I recall the event are negative

The feelings I experience as I recall the event are intense

above items rated from 1 (Not at all) to 7 (To a very high degree)

As I remember the event, I feel as though I am reliving it

As I remember the event, I can see it in my mind

As I remember the event, I can hear it in my mind

As I remember the event, I can hear myself or other people talking

As I remember the event, I know its spatial layout

As I remember the event, I can recall the setting where it occurred

above items rated from 1 (Not at all) to 7 (As if it was happening right now)

As I remember the event, I feel that I travel back to the time it happened

How vivid and clear is your memory for this event?

If another witness to the event (who you generally trusted) existed and told you a very different account of the event, to what extent could you be persuaded that your memory was wrong?

above items rated from 1 (Not at all) to 7 (Completely)

Since it happened, I have talked about the event

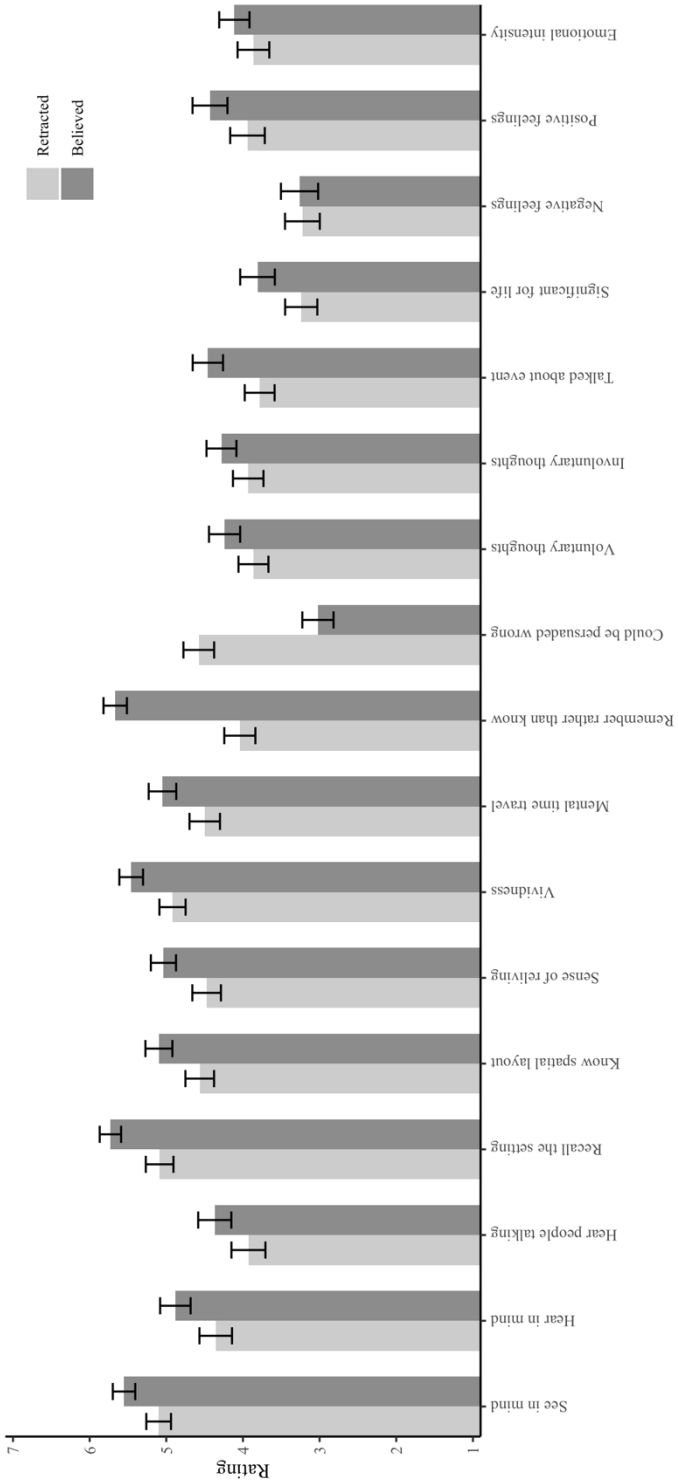
Since it happened, I have deliberately thought about the event

Since it happened, the event has come to me out of the blue, without my trying to think about it

above items rated from 1 (Not at all) to 7 (As often as any event in my life)

Sometimes people know an event happened to them without being able to actually remember it. As I think about the event, I can actually remember it rather than just knowing that it happened. (*1 = Not at all, 7 = As clearly as if it was happening right now*)

Results


Retracted
Believed
Rating
1
2
3
4
5
6
7
See in mind
Hear in mind
Hear people talking
Recall the setting
Know spatial layout
Sense of reliving
Vividness
Mental time travel
Remember rather than know
Could be persuaded wrong
Voluntary thoughts
Involuntary thoughts
Talked about event
Significant for life
Negative feelings
Positive feelings
Emotional intensity

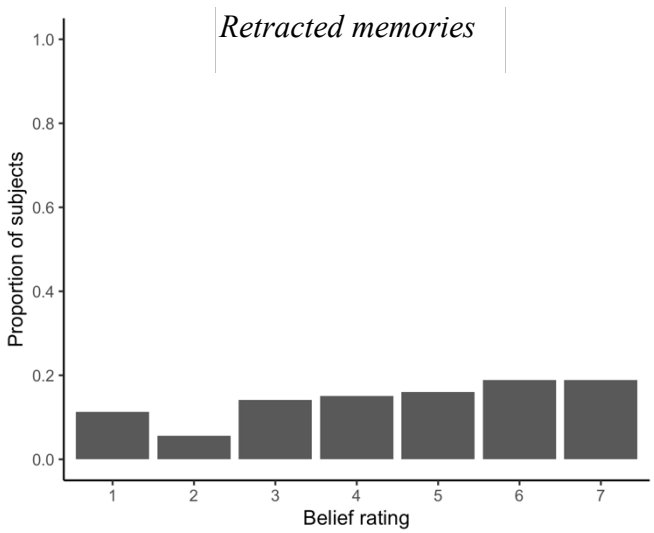
Experiment 3 regression with negative feelings as a predictor

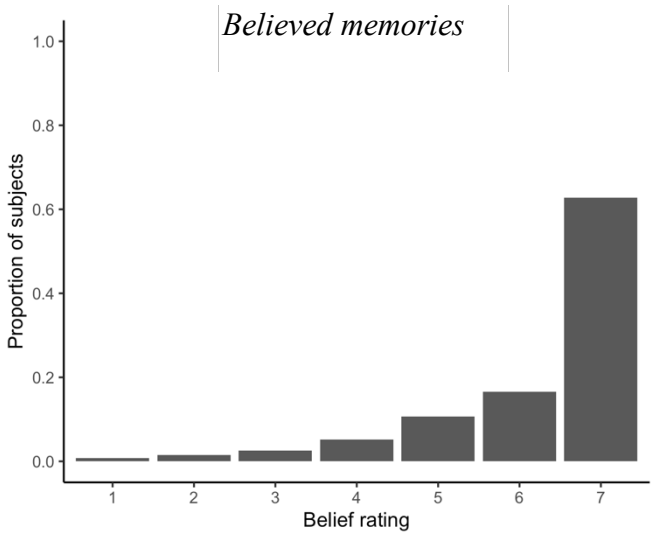
Standardised Beta estimates from the two regressions predicting helpful functions and harmful functions respectively, with reliving, vividness, belief, and negative feelings as predictors.

	Helpful function		Harmful function	
Predictor	*β* [95% CI]	*p*	*β* [95% CI]	*p*
Reliving	-0.21 [0.10, 0.33]	<.001*	-0.03 [-.13, 0.08]	.668
Vividness	0.09 [-0.04, 0.21]	.154	0.01 [-0.10, 0.12]	.901
Belief	0.27 [0.19, 0.36]	<.001*	0.12 [0.04, 0.20]	.029*
Negative feelings	-0.03 [-0.11, 0.51	.587	0.42[0.35, 0.49]	<.001*

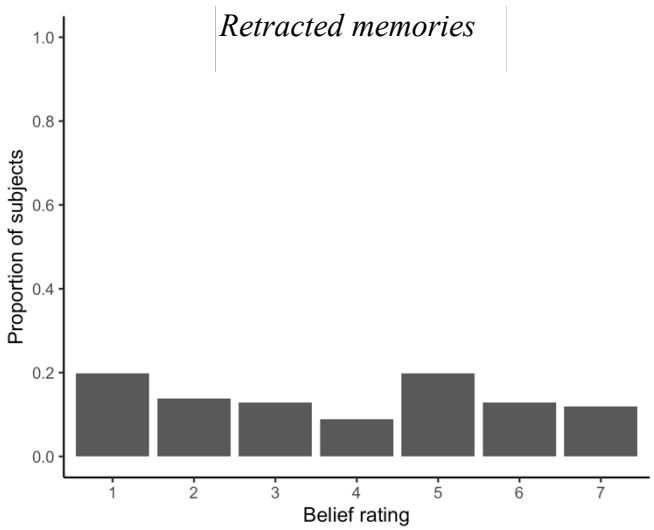
Distributions of belief ratings

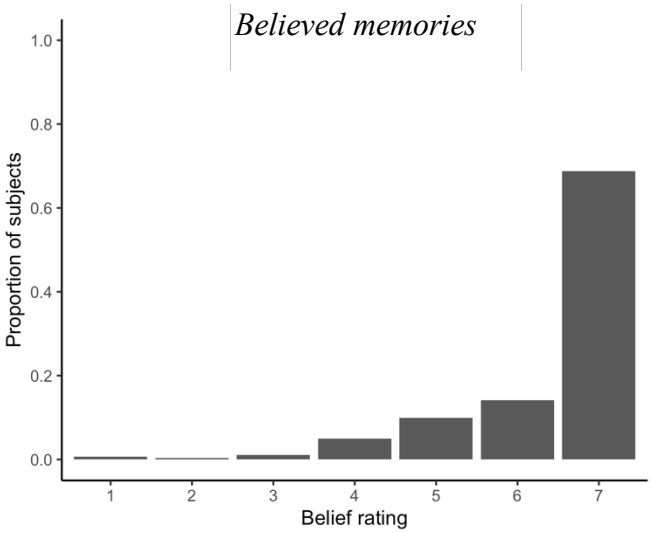
Experiment 1



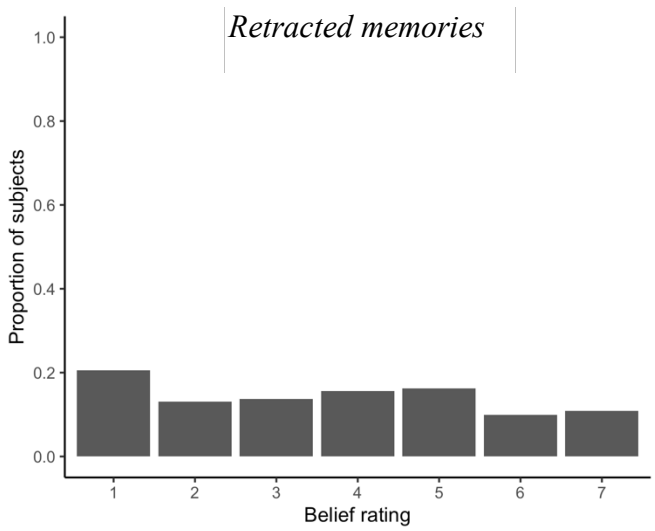


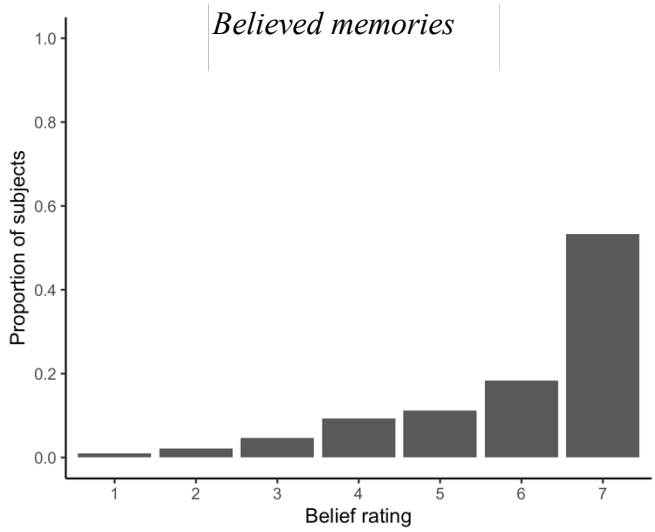
Experiment 2



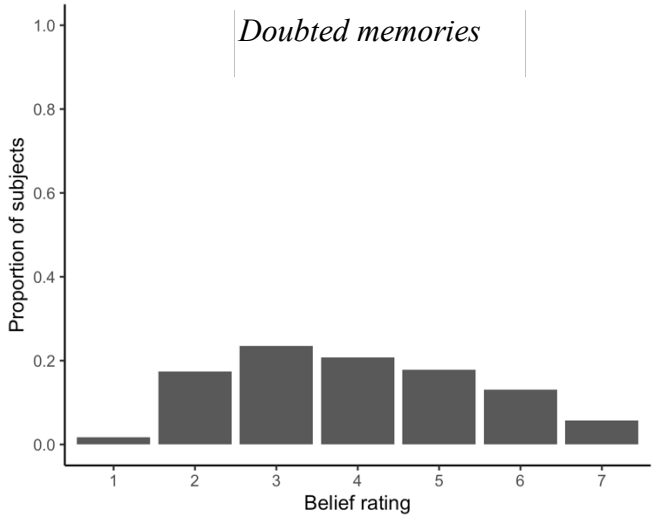


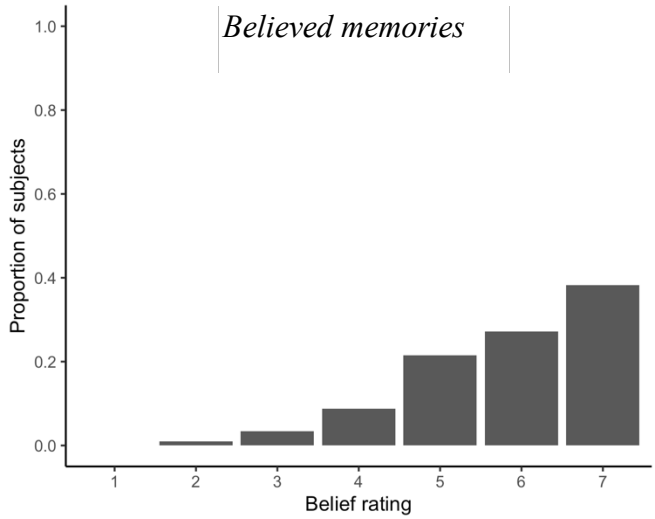
Experiment 3





Experiment 4





Pilot study with Doubted Memories Prompt

Method

Subjects

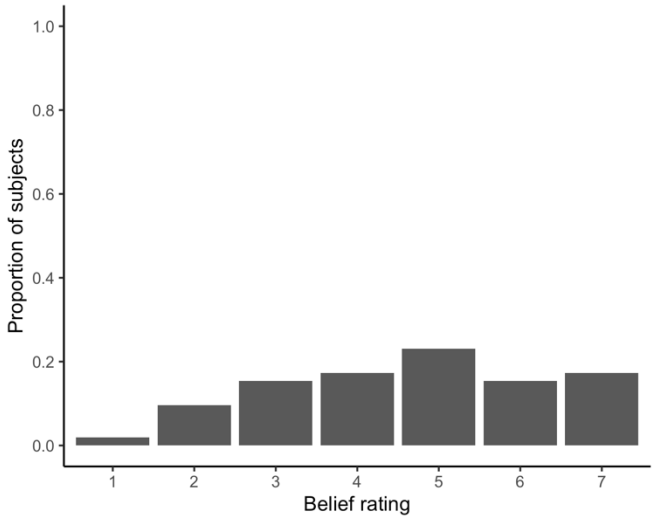
We recruited workers from the United States and Canada on Amazon's Mechanical Turk platform through TurkPrime (Litman et al., 2017). Subjects participated in exchange for Amazon credit. We aimed to collect data until 50 subjects had completed the survey. Because of the way Mechanical Turk interacts with Qualtrics, 52 subjects completed the survey.

Procedure

First, we provided subjects with a description of a doubted memory: "Sometimes people have doubts about particular memories of their past experiences—that is, they doubt whether the events they remember really happened at all." Then, we asked subjects to describe the memory they have the most doubts about. Next, subjects rated their belief in the memory on the three items from Rubin et al. (2019). The first of these items was the belief item from Experiments 1-3. The second was "My memory of the event is an accurate reflection of the event as a neutral observer would report it and is not distorted by my beliefs, motives, and expectations" (1 = 100% distorted, 7 = 100% accurate). The third was "Would you be confident enough in your memory of the event to testify in a court of law?" (1 = Not at all, 7 = As much as any memory).

Results

As the figure below shows, our instructions elicited a wide range of memories that are believed to various degrees ($M = 4.64$, $SD = 1.62$).



TALE adapted version

[memory description fed back to subjects]

Please keep the above memory in mind while answering the questions below. We are interested in the extent to which you think back over or talk about the above event in different situations.

For each situation below, your task is to indicate how often, when you think or talk about this event, you do so for the reasons given. Do not hesitate to use any of the points on the scale. If you never think or talk about the event for this reason, circle "Almost never." Please answer every question. I think back over or talk about this event…

when I want to feel that I am the same person that I was before.

when I want to remember something that someone else said or did that might help me now.

when I hope to find out what another person is like.

when I am concerned about whether I am still the same type of person that I was earlier.

when I believe that thinking about the past can help guide my future.

when I am concerned about whether my values have changed over time.

when I want to try to learn from my past mistakes.

when I want to develop more intimacy in a relationship.

when I need to make a life choice and I am uncertain which path to take.

when I want to remember a lesson I learned in the past.

when I want to develop a closer relationship with someone.

when I want to maintain a friendship by sharing memories with friends.

when I am concerned about whether my beliefs have changed over time.

when I hope to learn more about another person's life.

when I want to understand how I have changed from who I was before.

All items rated on the following scale: Almost never, Seldom, Occasionally, Often, Very frequently

Self items: 1,4,6,13,15 Social items: 3,8,11,12,14 Directive items: 2,5,7,9,10

Correlations between age during event, length believed, and functions

Experiment 1

We found no significant relationship between how long people believed a retracted memory and how helpful that memory was, $r(104) = -0.18$, 95% CI [-0.36, 0.01]. Likewise, we found no relationship between how long people believed a retracted memory and how harmful that memory was, $r(104) = -0.18$, 95% CI [-0.36, 0.01].

We also found no significant relationship between long ago a memory was retracted and how helpful that memory was, $r(104) = -0.14$, 95% CI [-0.32, 0.05]. Likewise, we found no relationship between how long people believed a retracted memory and how harmful that memory was, $r(104) = -0.12$, 95% CI [-0.31, 0.07].

We did, however, find that the older people were when the retracted event "occurred," the more that memory tended to serve helpful and harmful functions, $r_{helpful}(104) = 0.31$, 95% CI [0.13, 0.47]; $r_{harmful}(104) = 0.29$, 95% CI [0.11, 0.46].

Experiment 2

We found no significant relationship between how long people believed a retracted memory and how helpful that memory was, $r(99) = -0.03$, 95% CI [-0.22, 0.17]. Likewise, we found no relationship between how long people believed a retracted memory and how harmful that memory was, $r(99) = 0.01$, 95% CI [-0.19, 0.20].

We also found no significant relationship between long ago a memory was retracted and how helpful that memory was, $r(99) = -0.16$, 95% CI [-0.35, 0.03]. Likewise, we found no

relationship between how long people believed a retracted memory and how harmful that memory was, $r(99) = -0.13$, 95% CI [-0.32, 0.07].

In contrast to Experiment 1, we found no significant relationship between the age at which a retracted event "occurred" and how helpful or harmful that memory was, $r_{helpful}(99) = 0.06$, 95% CI [-0.13, 0.26]; $r_{harmful}(99) = 0.12$, 95% CI [-0.08, 0.30].

Experiment 3

We found that the longer people had believed a retracted memory, the less helpful that memory tended to be, $r(319) = -0.19$, 95% CI [-0.30, -0.09].]. Likewise, the longer people had believed a retracted memory, the less harmful that memory tended to be, $r(319) = -0.21$, 95% CI [-0.31, -0.10]. One possible explanation for these findings is that memories that were believed for long periods also tended to be memories that occurred at very young ages—perhaps, then, these memories tend to be less relevant to people's current thinking and behavior than retracted memories that "occurred" more recently.

We found that the more time had passed since a memory was retracted, the less helpful that memory tended to be, $r(319) = -0.13$, 95% CI [-0.24, -0.02]. Likewise, the more time had passed since someone retracted a memory, the less harmful that memory tended to be, $r(319) = -0.14$, 95% CI [-0.25, -0.03].

Consistent with Experiment 1, we found that the older people were when the retracted event "occurred," the more that memory tended to serve helpful and harmful functions, $r_{helpful}(319) = -0.19$, 95% CI [0.09, 0.30]; $r_{harmful}(319) = 0.11$, 95% CI [0.01, 0.22].

Appendix D: Supplemental Materials for Manuscript 4 (Chapter 5)

Collective TALE (general version from Experiment 1)

Sometimes the people of a country think back over, or talk to others about, their country's history—about things that happened quite a long time ago, or more recently. We are not interested in a particular event, but more generally in how you think your country brings together and connects the different events and periods of its history. Please circle a response to answer these two questions:

In general, how often do people from your country think back over your country's history?

[Almost never, Seldom, Occasionally, Often, Very Frequently]

In general, how often do people from your country talk to others about your country's history?

[Almost never, Seldom, Occasionally, Often, Very Frequently]

Next we present a variety of situations. Please circle one response on each scale to indicate how often, when people from your country think back over or talk about your country's history, they do it for the reasons given. There are no right or wrong answers. Do not hesitate to use any of the points on the scale. If people from your country never think back over or talk about your country's history for this reason, circle "Almost never." Please answer every question.

People of my country tend to think back over or talk about certain periods of our history…

when we want to feel that our country is the same as it was before.

when we want to remember something that another country said or did that might help us now.

when we hope to find out what another country is like.

when we are concerned about whether our country is still the same kind of place that it was earlier.

when we believe that thinking about our country's past can help guide our future.

when we are concerned about whether our values have changed over time.

when we want to try to learn from our past mistakes.

when we want to develop a new relationship with another country

when we need to make an important choice and we are uncertain which path to take.

when we want to remember a lesson we learned in the past.

when we want to develop a closer relationship with another country.

when we want to maintain friendships with other countries by sharing memories with them.

when we are concerned about whether our beliefs have changed over time.

when we hope to learn more about another country's history.

when we want to understand how we have changed from who we were before.

Items rated on the following scale: [Almost never, Seldom, Occasionally, Often, Very Frequently]

Self items: 1, 4, 6, 13, 15

Social items: 3, 8, 11, 12, 14

Directive items: 2, 5, 7, 9, 10

Collective TALE (specific event version from Experiment 2)

Below is a description of [*event name*], an event from American history:
[event description]

In general, how often do the people of your country think about this event?
[Almost never, Seldom, Occasionally, Often, Very Frequently]
In general, how often do the people of your country talk about this event?
[Almost never, Seldom, Occasionally, Often, Very Frequently]

We are interested in the extent to which people of your country think back over or talk about this event in different situations.

For each situation below, your task is to indicate how often, when people from your country think or talk about [*event name*], they do so for the reasons given. Do not hesitate to use any of the points on the scale. If people from your country never think or talk about the event for this reason, circle "Almost never." Please answer every question.

People from my country tend to think back over or talk about [*event name*]

when we as a country want to feel that our country is the same as it was before.

when we as a country want to remember something that another country did that might help us now.

when we as a country hope to find out what another country is like.

when we as a country are concerned about whether our country is still the same kind of place that it was earlier.

when we as a country believe that thinking about our country's past can help guide our future.

when we as a country are concerned about whether our values have changed over time.

when we as a country want to try to learn from our past mistakes.

when we as a country want to develop a new relationship with another country.

when we as a country need to make an important choice and we are uncertain which path to take.

when we as a country want to remember a lesson we learned in the past.

when we as a country want to develop a closer relationship with another country.

when we as a country want to maintain friendships with other countries by sharing memories with them.

when we as a country are concerned about whether our beliefs have changed over time.

when we as a country hope to learn more about another country's history.

when we as a country want to understand how we have changed from who we were before.

Items rated on the following scale: [Almost never, Seldom, Occasionally, Often, Very Frequently]

Self items: 1, 4, 6, 13, 15

Social items: 3, 8, 11, 12, 14

Directive items: 2, 5, 7, 9, 10

Original TALE (Specific event version from Experiment 2)

We'd like you to bring to mind an important event from any point in your life that has helped shape your identity.

Please describe your memory for that event, in a few sentences.

[essay text box]

In general, how often do you think about this event?

[Almost never, Seldom, Occasionally, Often, Very Frequently]

In general, how often do you talk about this event?

[Almost never, Seldom, Occasionally, Often, Very Frequently]

Now we are interested in the extent to which you think back over or talk about the event you just described in different situations.

For each situation below, your task is to indicate how often, when you think or talk about this event, you do so for the reasons given. Do not hesitate to use any of the points on the scale. If you never think or talk about the event for this reason, circle ‘‘Almost never.’’ Please answer every question.

I think back over or talk about this event...

when I want to feel that I am the same person that I was before.

when I want to remember something that someone else said or did that might help me now.

when I hope to also find out what another person is like.

when I am concerned about whether I am still the same type of person that I was earlier.

when I believe that thinking about the past can help guide my future.

when I am concerned about whether my values have changed over time.

when I want to try to learn from my past mistakes.

when I want to develop more intimacy in a relationship.

when I need to make a life choice and I am uncertain which path to take.

when I want to remember a lesson I learned in the past.

when I want to develop a closer relationship with someone.

when I want to maintain a friendship by sharing memories with friends.

when I am concerned about whether my beliefs have changed over time.
when I hope to also learn more about another person's life.
when I want to understand how I have changed from who I was before.

Items rated on the following scale: [Almost never, Seldom, Occasionally, Often, Very Frequently]

Self items: 1, 4, 6, 13, 15

Social items: 3, 8, 11, 12, 14

Directive items: 2, 5, 7, 9, 10

Collective TALE Factor Analysis Results

Experiment 1

Factor Loadings

Item	Factor1: Social	Factor2: Self	Factor3: Directive
Same as before	0.04	0.51	-0.06
Same kind of place	-0.01	0.79	-0.09
Values changed	-0.02	0.96	-0.13
Beliefs changed	-0.02	0.69	0.09
Changed from before	-0.08	0.42	0.36
Find out about another	0.71	0.05	-0.03
Develop relationship	0.91	-0.06	-0.05
Closer relationship	0.85	-0.01	-0.01
Maintain friendship	0.81	-0.02	-0.05
Learn about another	0.66	0.00	0.05
Remember what other did	0.62	0.02	0.05
Guide future	0.02	0.16	0.62
Learn from mistakes	-0.05	-0.08	0.91
Uncertain path	0.22	0.06	0.45
Lesson learned	-0.02	-0.09	0.92

	Factor 1: Social	Factor 2: Self	Factor 3: Directive
SS Loadings	3.577	2.505	2.442
Proportion Variance explained	0.238	0.167	0.163
Cumulative Variance	0.238	0.405	0.568

Factor Correlations

	Factor1: Social	Factor2: Self	Factor3: Directive
Factor1: Social	1.000	0.429	-0.603
Factor2: Self		1.000	-0.704
Factor3: Directive			1.000

Hypothesis Test

Test of the hypothesis that 3 factors are sufficient.

The chi square statistic is 177.05 on 63 degrees of freedom.

The p-value is 8.96e-13

Experiment 2

Factor Loadings

Item	Factor1: Social	Factor2: Self	Factor3: Directive
Same as before	0.13	0.40	0.19
Same kind of place	-0.04	0.69	0.11
Values changed	-0.03	0.89	-0.01
Beliefs changed	0.05	1.02	-0.23
Changed from before	-0.12	0.53	0.39
Find out about another	0.88	0.06	-0.17
Develop relationship	0.86	-0.01	-0.02
Closer relationship	0.86	-0.02	-0.03
Maintain friendship	0.80	0.01	-0.06
Learn about another	0.65	-0.10	0.16
Remember what other did	0.63	-0.04	0.19
Guide future	-0.02	0.18	0.68
Learn from mistakes	0.04	-0.06	0.77
Uncertain path	0.27	0.29	0.27
Lesson learned	-0.08	0.06	0.83

	Factor 1: Social	Factor 2: Self	Factor 3: Directive
SS Loadings	3.83	2.90	2.17
Proportion Variance explained	0.26	0.19	0.14
Cumulative Variance	0.26	0.45	0.59

Factor Correlations

	Factor1: Social	Factor2: Self	Factor3: Directive
Factor1: Social	1.000	-0.45	-0.76
Factor2: Self		1.000	0.63
Factor3: Directive			1.000

Hypothesis Test

Test of the hypothesis that 3 factors are sufficient.

The chi square statistic is 144.17 on 63 degrees of freedom.

The p-value is 2.65e-08

Event Descriptions

World War 2

World War 2 (also known as the Second World War) was a global war fought on several fronts that was sparked by the Nazi invasion of Poland that lasted from 1939 to 1945. The war was fought between the Axis powers (including Nazi Germany, Italy, and Japan) and the Allies (including France, Great Britain, the United States, and the Soviet Union).[61 words]

The Civil War

The American Civil War was a civil war fought in the United States from 1861 to 1865, between the North (the Union) and the South (the Confederacy). The Civil War began primarily as a result of the long-standing controversy over the enslavement of black people. [45 words]

The September 11 Attacks

The September 11 attacks (also referred to as 9/11) were a series of coordinated terrorist attacks by the Islamic terrorist group al-Qaeda against the United States on the morning of Tuesday, September 11, 2001. Two hijacked planes crashed into the North and South towers of the World Trade Center in New York City, and a third plane crashed into the Pentagon. [61 words]

The Declaration of Independence

The United States Declaration of Independence is a statement adopted in Philadelphia, Pennsylvania, in 1776 by the thirteen American colonies at war with the Kingdom of Great

Britain. The Declaration announced that the Colonies would regard themselves as thirteen States, no longer under British rule. [45 words]

The Revolutionary War

The American Revolutionary War (also known as the American War of Independence), was a war that lasted from 1775 to 1783. The war was fought between Great Britain and its Thirteen American Colonies, which declared independence in 1776 as the United States of America. [44 words]