AMERICAN PSYCHOLOGICAL ASSOCIATION

Journal of Experimental Psychology: General

ISSN: 0096-3445

2024, Vol. 153, No. 2, 352–371
https://doi.org/10.1037/xge0001500

Remembering Our Darkest Moments: Reminiscence Bumps for Highly Negative Life Events

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Prior research has shown that the lifetime age distribution of adults' personal memories peaks in late adolescence and early adulthood, and that this reminiscence bump is apparent primarily for positive rather than negative events. Inspired by sociological research on the crime–age curve, four new studies tested the idea that adults' negative memories of moral transgressions and behavioral missteps also would show a reminiscence bump. A secondary goal was to determine if the ages and content of actual memories recounted by older adults aligned closely with people's expectations for memories provided by an imaginary "typical" older adult. In Study 1, college students were asked to estimate the ages at which people are most likely to have committed crimes and minor moral transgressions; estimated ages peaked sharply during adolescence and early adulthood. Participants also listed emotions that they thought would accompany these misdeeds. In Study 2, college students were asked to describe memories that they expected a typical older adult to recall in response to distinctive emotion cues, including the negative emotions identified in Study 1. Study 3 was a replication of Study 2 using middle-aged participants. In Study 4, older adults provided their own personal memories in response to the emotion cues used in Study 2 and Study 3. The studies identified, for the first time, prominent reminiscence bumps for both expected and actual memories cued by negative emotions. Implications for new research on autobiographical memory functions and age-related memory declines are discussed.

Public Significance Statement
This research demonstrates, for the first time, that older adults' memories of highly negative personal events, including minor crimes and moral transgressions, are overrepresented in adolescence and early adulthood. These memories are often accompanied by feelings of shame and embarrassment. The memories reflect culturally shared themes of adolescent turmoil and may provide directives for future behavior.

Keywords: autobiographical memory, emotion, reminiscence bump, cultural life scripts, age–crime curve

Reflecting back over several decades of systematic research examining autobiographical memory across the lifespan, perhaps the most robust and frequently replicated finding is the reminiscence bump. When older adults are asked to provide personal memories in response to direct probes or word cues, the age distribution of remembered events shows a marked overrepresentation in late adolescence and early adulthood (e.g., Berntsen & Rubin, 2002; Dickson et al., 2011; Glück & Bluck, 2007; Koppel & Berntsen, 2015; for reviews, see Koppel & Rubin, 2016; Munawar et al., 2018). Discovery of the bump has provided the impetus for researchers to develop several distinct theoretical explanations (Berntsen & Rubin, 2002; Koppel & Berntsen, 2015) and also has informed practical issues, such as memory decline accompanying Alzheimer's disease (Berntsen et al., 2022).

Reminiscence Bumps for Positive Life Events

One research finding has been especially valuable as a stimulus for theoretical development and evaluation: The reminiscence bump for personal memories given in response to emotion cues is

This article was published Online First November 30, 2023.
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The authors would like to thank sociologist Cesar J. Rebellon for initially pointing out the resemblance between the reminiscence bump and the crime bump. We have no conflicts of interest to disclose. To protect participant confidentiality, the raw data used to produce the findings in Studies 1 through 4 of this article are not publicly available. These studies were not preregistered. Select data from this manuscript were part of a presentation by D.B. Pillemer at the Conference on Autobiographical Memory in Ageing and Dementia in Aarhus, Denmark, September 2022.

Çağlayan Özdemir served as lead for data curation and investigation. Michelle Leichtman contributed equally to supervision. Çağlayan Özdemir, David B. Pillemer, and Michelle D. Leichtman contributed equally to conceptualization, methodology, visualization, writing–original draft, and formal analysis. Çağlayan Özdemir and David B. Pillemer contributed equally to project administration.

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apparent primarily for positive but not negative events (e.g., Berntsen & Rubin, 2002; Dickson et al., 2011; Glück & Bluck, 2007; Rubin & Berntsen, 2003). Content analyses have identified several categories of frequently remembered positive events, including marriage and becoming a parent, that contribute strongly to the overrepresentation of memories in early adulthood (Dickson et al., 2011; Glück & Bluck, 2007; Özdemir et al., 2021; Scherman, 2013). In contrast, frequently remembered negative events are not tied as closely to particular age periods.

Rubin and Berntsen (2003; Berntsen & Rubin, 2004) theorized that the bump is the result of pervasive cultural life scripts for positive events—important positive events are expected to occur in late adolescence and early adulthood, so that a positive emotion prompt directs the memory search to this age period. In support of the cultural life script hypothesis, when research participants are asked to report events commonly experienced by a typical person within their culture, reminiscence bumps are apparent primarily for positive life events (Berntsen & Rubin, 2004; Dickson et al., 2011; Erdoğan et al., 2008; Rubin & Berntsen, 2003; Rubin et al., 2009).

In contrast, finding a reminiscence bump for positive but not negative memories is difficult to explain using alternative theories (reviewed by Berntsen & Rubin, 2004; Koppel & Berntsen, 2015; Koppel & Rubin, 2016). It is unclear why cognitive accounts, such as optimal event encoding during the bump period (e.g., Janssen & Murre, 2008) or recollection boosted by event novelty or distinctiveness (e.g., Pillemer, 2001), would lead to memory enhancement for positive episodes only. Similarly, the theory that memories of transitional events during late adolescence and early adulthood persist because they are central to adult identity formation and a continuing sense of self (e.g., Conway & Pleydell-Pearce, 2000) does not provide a ready explanation for the absence of a negative reminiscence bump. In an effort to integrate some components of previous accounts, Glück and Bluck (2007; also see Demiray et al., 2009) developed a life story account, in which the bump for positive but not negative memories is explained by the central contribution that positive developmental achievements make to the life story: "Early events in which one positively dealt with developmental tasks that required taking control of one's future life path are linked to one's current self" (Glück & Bluck, 2007, p. 1930).

Nevertheless, it is not clear why failures to successfully make the transition to young adulthood are necessarily less memorable than successful transitions.

Reminiscence Bumps for Negative Life Events?

Although prior research has identified reminiscence bumps primarily for memories of positive life events, systematic and theoretically motivated studies focusing specifically on lifetime distributions of negative memories are lacking. The present article addresses this issue in several ways: (a) designing new research inspired by sociological studies of age distributions of criminality; (b) employing a more expansive range of negative memory cues than in previous studies; (c) describing the potential adaptive value of persistent memories of troublesome events occurring during the bump years; (d) revisiting theoretical explanations of the reminiscence bump in light of new findings that target memories associated with negative emotions; and (e) suggesting how new research and theory may deepen our understanding of negative personal memories and their lifelong impact.

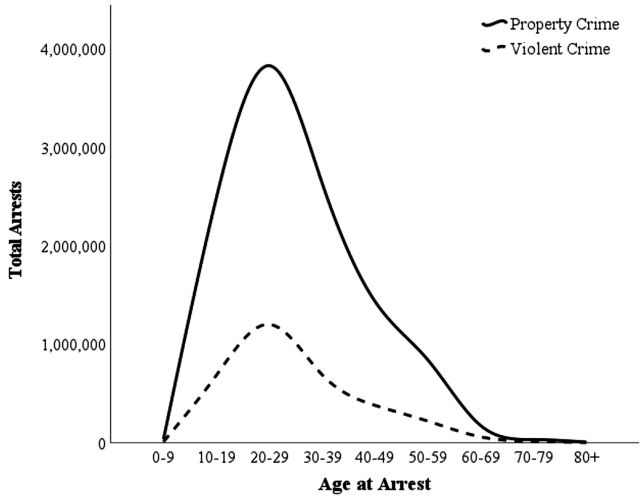
Age Distributions of Criminal Behaviors Show a Bump

The blueprint for the current series of studies was inspired by the observation that the reminiscence bump looks strikingly similar to the well-established age distribution of crime. Sociologists have long noted that documented offenses are consistently overrepresented in late adolescence and early adulthood across disparate historical periods—including England and Wales in the 1840's, England in 1908, and the United States in 1977 (Hirschi & Gottfredson, 1983). Similarly, modern age distributions of violent and property crimes in the United States show a prominent crime bump that is strikingly similar to the reminiscence bump (Figure 1). A variety of factors have been suggested to explain the age–crime curve in the sociology and political science literatures (for reviews, see Shulman et al., 2017; Steinberg, 2008; Sweeten, 2012), yet the shape and location of this curve has been invariably robust and consistently replicated for decades (Bekbolatkyzy et al., 2019; cf., Steffensmeier et al., 2020).

The crime bump is so pervasive that it may be part of general societal expectations, even though criminal convictions are experienced by only a small proportion of the population. In addition, for every documented crime there must be dozens of unreported criminal activities. Consequently, people may share the expectation that crimes are most likely to be committed in late adolescence and early adulthood. Because these serious transgressions are most likely to occur during the reminiscence bump years, it seems reasonable to posit that people's expectations for age of occurrence of relatively minor violations of moral standards or societal expectations—such as petty theft, cheating, lying, harassing, or bullying—could show similar temporal distributions. Speculatively, new research could also reveal that people have shared expectations for specific types of emotions that are likely to accompany minor and major moral transgressions. In studies of older adults' personal memories, these

Figure 1

Total Arrests Made in the United States Between 2009 and 2019 by Arrestees' Age



Note. Total arrests are shown per crime instead of per person. Adapted from *Crime Data Explorer* by Federal Bureau of Investigation, 2020 (https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/explorer/crime/crime-trend). In the public domain.

emotion cues could prompt recollections of events that cluster in the reminiscence bump years.

Expanding the Range of Negative Emotion Cues

Research evidence and informal observations identify adolescence and early adulthood as fertile periods for certain negative emotions. A recent title of a Psychology Today blog post labeled adolescence as the "age of painful embarrassment" (Pickhardt, 2022). This sentiment will feel familiar to many adults residing in the United States who have their own recollections of experiencing or witnessing painful teasing and bullying in middle school and high school, or who have heard about such encounters from their children. When research participants were asked to recall episodes of embarrassment, shame, guilt, and pride in the last 5 years, young adults (ages 18–23) were more likely than middle-aged or older adults to report episodes of embarrassment and shame (Henry et al., 2018). More generally, adolescence was described as a period of "storm and stress" more than a century ago (e.g., Hall, 1904), with frequent occurrences of risk-taking behaviors, increased conflict with peers and parents, and recurrent mood disruptions (Arnett, 1999). Reports from parents and teachers (Buchanan et al., 1990) and college students (Holmbeck & Hill, 1988), and the frequent onset of psychiatric disorders (Kessler et al., 2005) also characterize adolescence as an age of emotional turmoil.

In summary, research evidence and cultural expectations point to adolescence and early adulthood as lifetime periods associated with criminal behaviors, relatively minor moral transgressions, heightened emotional reactivity, and psychological discomfort. Accordingly, a negative reminiscence bump may become evident when memories are prompted with targeted emotion cues that are associated with these misdeeds, mishaps, indiscretions, and insensitivities. Negative event cues used in prior reminiscence bump studies include saddest or most traumatic (Berntsen & Rubin, 2002); highly negative (Dickson et al., 2011); and most afraid, angry, or jealous (Rubin & Berntsen, 2003). Only the cue "jealous" produced a robust bump, which the authors attributed to its link to romantic activities that are prevalent during adolescence and early adulthood. The negative emotion cue "regret" produced a bump for general but not specific events (Davison & Feeney, 2008). These negative cues may not fully capture the intense feelings of disquiet that are triggered by the missteps, transgressions, and acts of social sabotage marking the bump years. Questioning strategies that specifically target troublesome events associated with discomforting or painful emotions may be necessary to more accurately reveal the contents and lifetime distributions of negative memories. In the present research, emotions associated with "dark moments" occurring in late adolescence and early adulthood were identified initially (Study 1) and then used as memory cues in subsequent studies (Studies 2 through 4).

Theoretical Implications of Finding Reminiscence Bumps for Negative Memories

Would the discovery of reminiscence bumps for negative personal memories refute existing theoretical accounts? Not necessarily. With respect to the cultural life script account (e.g., Rubin & Berntsen, 2003), memory bumps for negative events could be consistent with its basic premise: that the bump owes its existence to memory search strategies reflecting widely shared expectations for the timing of events that are typically associated with particular emotions. In order for a negative bump to be consistent with life script theory, people's age estimates for negative events experienced by typical older adults in their culture should match the temporal distribution of negative memories from adults' own lives. In addition, the content of bump memories would need to show thematic regularities that imply the existence of a negative life script. Note that finding a negative memory bump falling outside the age range of late adolescence and early adulthood would not by itself invalidate the theory; a bump occurring at a different life period could nevertheless fit the timing and content expected of memorable events experienced by a typical person growing up in the culture.

Finding a negative reminiscence bump would be more difficult to assimilate into the life story account as it is currently articulated. The theory posits that "events in the reminiscence bump are characterized not only by positive valence, but also by high perceived control and high perceived influence on later development" (Glück & Bluck, 2007, p. 1928). However, this theory could potentially be modified to include memories of negative events. Negative memories are durable, vivid, and oftentimes rapidly accessed (Williams et al., 2022); as such, certain negative recollections could have "high perceived influence" on the life course and be a prominent part of the private life story. With respect to high perceived control, memories elicited by different negative emotion cues are likely to differ on this dimension. For example, especially sad memories often focus on events that are for the most part out of one's control, such as death, illness, or accidents. In contrast, memories given in response to cues such as "guilt" or "shame" are more likely to target events in which the person played an active (even if unintended) role: "Both shame and guilt are associated with high self-responsibility/control, whereas the other unpleasant emotions are associated with other responsibility/control" (Smith & Ellsworth, 1985, p. 829). When responding to shame and guilt emotion cues, "subjects always described situations in which they had done something that they regretted such as stealing something, lying, spreading gossip about a friend, or failing to meet an obligation" (Smith & Ellsworth, 1985, p. 833). A modified version of the life story account could accommodate a bump for negative memories of events exhibiting high perceived influence and control.

With respect to cognitive processing accounts (e.g., Pillemer, 2001), the distinctiveness of especially troubling experiences during the bump years would enhance their memorability. Even if memories of exceptionally disturbing events are unlikely to be frequently shared in informal conversations, these painful episodes may be rehearsed covertly when encountering similar circumstances both during adolescence and in future years. Nevertheless, if the range of bump memories is expanded to include not only highly positive cultural landmark events, but also a diverse array of more idiosyncratic and private negative events, definitions of which events qualify as truly "distinctive" become increasingly fuzzy and the theory's explanatory and predictive power would suffer.

Overview of Studies

Four studies were designed to test the central idea that adults' memories of misdeeds and moral transgressions would be overrepresented in late adolescence and early adulthood, identifying for the first time prominent and consistent reminiscence bumps for

events cued by distinctly negative emotions. A secondary goal was to determine if the ages and content of actual memories recounted by older adults aligned closely with people's expectations for memories provided by hypothetical typical older adults. In Study 1, college students were asked to estimate the ages at which people are most likely to have committed crimes or moral transgressions, and they were asked to list the emotions that would be likely to accompany these actions. In Study 2, college students were asked to imagine a typical older adult and to provide estimates of the age of occurrence and content of remembered events cued by particular emotions, including the negative emotions identified in Study 1. Study 3 replicated Study 2 but with middle-aged adults as participants. In Study 4, older adults provided their own personal memories in response to the emotion cues used in Studies 2 and 3, and memory ages were examined for the existence of negative emotion reminiscence bumps. Because the studies were conducted sequentially, with each study building and expanding upon previous findings, we offer specific hypotheses when introducing each study individually. Following the presentation of age distributions of memories in response to different emotion cues in Studies 2 through 4, the thematic contents of remembered events from the bump years are compared across studies.

Study 1

Study 1 was designed to determine if participants expected a hypothetical 80-year-old to commit crimes and moral transgressions at particular ages in the lifespan, and to identify emotions that the 80-year-old would have experienced both during these activities and in retrospect. We hypothesized that participants' age estimates of criminal behaviors and lesser transgressions should fall within the reminiscence bump years, as suggested by developmental and criminology research reviewed earlier in this article, and that participants would show general agreement on the timing of such behaviors, as reflected by confidence ratings and standard deviations of their age estimates. Participants' expectations for which emotional reactions would be associated with these activities were also analyzed for exploratory purposes, to be used as memory cues in subsequent studies.

Method

Transparency and Openness

For Studies 1–4, we explain how sample size was determined, report any data exclusions, and describe all manipulations, measures, and coding. The data were analyzed using SPSS Version 28.0.1.0. We did not preregister the design or analysis of the studies. The data contained some potentially sensitive information about negative experiences, and we did not have permission from all participants to make responses public. To protect participant confidentiality, the raw data used to produce the findings are not publicly available.

Participants

The sample included 206 undergraduate students (145 female, 57 male, four nonbinary/other) from diverse majors who completed the study for psychology course credit. Sample sizes and age ranges for Studies 1 through 4 are comparable to samples in prior studies that identified prominent reminiscence bumps (Dickson et al., 2011; Erdoğan et al., 2008; Rubin & Berntsen, 2003). Participants' M_{age} was 19.33 years ($SD = 1.35$; range = 18–26); 84% identified as European/White, 5.8% as Asian, 5.3% as Hispanic/Latino, 2.4% as African American/Black, and 2.4% as other. Seven additional participants who began the study were excluded because they either failed to follow instructions (four) or completed fewer than 50% of the items (three).

Measures

We designed a novel questionnaire to investigate age expectations for committing crimes and moral transgressions. Drawing on the psychology and criminology research literatures (e.g., Ashar et al., 2016; Hirschi & Gottfredson, 1983), we prepared a list of hypothetical misdeeds, including criminal and deviant behaviors. In addition, several prosocial behaviors were included for comparison purposes (see Appendix).

Criminal Behavior Items. Three items—engaging in a major crime, engaging in a minor crime, and getting into trouble with the law—targeted behaviors punishable by law as infractions, misdemeanors, and felonies in the U.S. criminal justice system (Green, 1999). Participants were presented with these terms without further definition. Three additional items—stealing something, physically assaulting, and harassing—were specific examples of typical criminal behaviors (e.g., Bekbolatkyzy et al., 2019; Rebellon et al., 2014; Theobald et al., 2014).

Moral Transgression Items. Six items—cheating, bullying, telling a serious lie, betraying someone's trust, getting into trouble with close others, and hurting someone psychologically—represented deviant behaviors identified in the developmental and delinquency literatures (e.g., Arnett, 1999; McCabe et al., 2001; Norona et al., 2015; Wang et al., 2012).

Prosocial Behavior Items. Four prosocial items—comforting someone in distress, donating to a charity, helping someone in need, and volunteering in a food pantry—were included for comparison purposes. Behaviors were selected from studies on prosocial behaviors (e.g., Ashar et al., 2016; Gentile et al., 2009; Schonert-Reichl et al., 2012).

Rating Items. Each hypothetical behavior was presented first with a question asking for a single-age estimate of when the hypothetical person engaged in it. Participants then responded to two open-ended questions about the emotions the hypothetical person likely associated with the behavior, both at the time it occurred and while remembering it "now" as an older person. After the age and emotion estimates, items similar in style to those used in prior reminiscence bump studies (e.g., Berntsen & Rubin, 2004; Dickson et al., 2011; Erdoğan et al., 2008; Rubin & Berntsen, 2003) were presented with 7-point Likert-type ratings (all running from less to more) in the following order: (a) confidence that the age estimate is in the right decade of life, (b) positivity of emotions, (c) negativity of emotions, (d) importance of the event for the person, (e) self-relevance of the behavior, (f) frequency of thinking about the memory, and (g) frequency of sharing the memory with others. Four additional items assessing prevalence and acceptability are not reported here (see Appendix for detailed item descriptions).

Procedure

The procedures followed in Study 1, and all subsequent studies reported in this manuscript, were approved by the Institutional Review Board of the authors' institution.

All items were tested for comprehensibility in a pilot study, in which participants were recruited through a university participant pool and received course credit. The questionnaire took approximately 35 min to complete.

Participation was online using Qualtrics software. After participants consented, they were presented with the questionnaire, which instructed them to imagine an ordinary 80-year-old person of their own gender and society. The target behaviors were shown in random order. Each behavior was presented alongside instructions to assume that the hypothetical person had engaged in the behavior at some point in their lives. Presentation of each behavior was followed by the age and emotion estimate questions, and then the rating questions in the order described above. The full instructions read:

> Your task is to imagine a hypothetical 80-year-old person of your own gender and from your culture. This person should not be someone you already know, but a typical person from the society you live in. In the following sections, you will see a series of behaviors this hypothetical person has done throughout his or her whole life. Try to think about the first example scenario that comes to your mind for each behavior. We will ask you to estimate at what age this hypothetical person is most likely to have been engaged in these behaviors. If you think these kinds of behaviors could be engaged in at multiple times in a life course, please try to think about the most typical time this person might be expected to have done these things. You will also be asked to answer some additional questions/ratings about these behaviors. There are no right or wrong answers. We are simply interested in your intuition about when each of these behaviors is most likely to occur for this hypothetical person.

Demographic items were included at the end of the questionnaire. Participants were asked to report their age with an open-ended question, and their gender and ethnicity with multiple-choice questions that provided open-ended options for self-description. See Appendix for the wording of all demographic questions; these questions were identical in Studies 1–4.

Results

Table 1 presents estimated frequencies of each behavior across eight decades of life, mean confidence ratings, and mean age estimates. When behaviors were examined individually, all had their peak points in the second decade of life, with three exceptions. For major crime and helping, the peak point was in the third decade, whereas for donating it was in the fifth decade. Employing a definition of the reminiscence bump as the age range between 11 and 30 years (see Koppel & Berntsen, 2015), participants estimated that 86.7% of all criminal behaviors and 88.2% of all moral transgressions would typically occur during the bump period. Temporal distributions for males and females separately were highly similar, with no notable differences. The expected age distribution for crimes and moral transgressions combined is presented in Figure 2.

Emotional valence ratings provided support for the validity of our novel hypothetical behavior list; all misdeeds were rated more negatively than positively, and all prosocial behaviors were rated more positively than negatively (all $ps < .001$). Participants' mean confidence ratings for estimated ages of all misdeeds (i.e., crimes and moral transgressions combined, $M = 4.23$, $SD = 1.04$) and prosocial behaviors were similar ($M = 4.15$, $SD = 1.22$), $t(205) = 1.29$, $p = .20$ (see Table 1). This finding contrasts with results of prior studies of cultural life scripts, where participants have typically reported being more confident about their age estimates for positive events, or events prompted by positive emotion cues, than about their estimates for negative events (e.g., Berntsen & Rubin, 2004; Rubin & Berntsen, 2003). In addition, variation in age estimates as reflected by standard deviations were uniformly smaller for misdeeds than for prosocial behaviors (Table 1). For each participant, mean importance and self-relevance ratings were computed for misdeeds and prosocial behaviors. Prosocial behaviors were rated as more important ($M = 4.49$, $SD = 0.96$) than misdeeds ($M = 4.09$, $SD = 0.81$), $t(205) = 5.90$, $p < .001$, and prosocial behaviors were rated as more self-relevant ($M = 4.53$, $SD = 1.04$) than misdeeds ($M = 3.90$, $SD = 0.96$), $t(205) = 9.19$, $p < .001$.

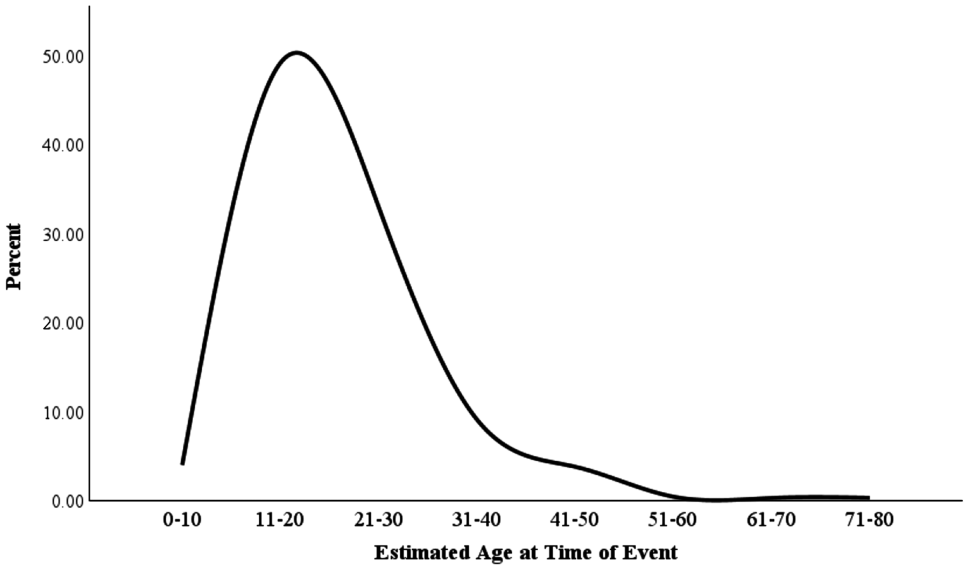
Table 1

Study 1: Hypothetical Behavior Mean Confidence Ratings, Mean Age Estimates, and Behavior Frequencies by Decade of Life

	Confidence rating	Age estimate		Decade of life							
Behaviors	*M*	*M*	*SD*	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
Major crime	3.71	28.87	7.06	0	15	141	36	10	2	0	0
Minor crime	4.57	19.58	4.39	0	152	48	6	0	0	0	0
Trouble with law	4.43	21.60	5.83	0	125	70	9	1	1	0	0
Stealing	4.25	17.35	8.23	23	151	28	1	1	0	0	2
Physical hurt	4.20	17.59	9.61	58	81	55	8	3	0	0	1
Harassment	3.86	22.17	10.37	3	121	63	7	7	1	2	2
Cheating	4.51	21.58	8.80	6	124	53	15	6	1	0	1
Lying	3.93	21.37	7.96	5	131	48	14	7	0	0	0
Bullying	5.02	13.24	2.79	37	168	1	0	0	0	0	0
Trouble with others	4.31	19.37	8.33	20	126	42	13	4	1	0	0
Psychological hurt	3.91	23.47	8.79	0	106	71	22	3	2	0	1
Betraying trust	4.01	20.85	7.33	4	136	48	11	7	0	0	0
Negative (all)	4.23	20.58	8.53	156	1,436	668	142	49	8	2	7
Volunteering	3.99	29.26	13.60	1	90	45	24	23	11	11	1
Helping	3.99	29.49	13.70	11	50	78	33	22	7	1	3
Donating	4.43	42.17	15.66	2	21	42	38	50	31	20	2
Comforting	3.99	29.32	13.60	7	68	58	38	24	7	2	2
Positive (all)	4.15	32.65	15.64	21	229	223	133	119	56	34	8
Total	4.20	23.60	11.96	177	1,665	891	268	161	72	38	15

Figure 2

Study 1: Distribution of Participants' Combined Age Estimations of Criminal Behaviors and Moral Transgressions



Participants' expectations of the hypothetical person's emotional reactions, both when engaging in the behaviors and when remembering them, are presented in Table 2. The top five most frequently cited emotion terms for all misdeeds combined at the time of engagement were angry, guilty, afraid, sad, and excited, while the top five emotions at the time of retrieval were regretful, guilty, ashamed, sad, and embarrassed. The top five most frequently cited emotion words for the prosocial behaviors were the same for both the time of engagement and the time of retrieval: happy, proud, helpful, joyful, and good.

Discussion

Prior research reviewed earlier has documented that remembered events in the reminiscence bump tend to be predominantly positive, with no discernable bump for negative events. In contrast, Study 1 participants expected particular types of negative events—misdeeds that may or may not include criminal behaviors—to occur most frequently during the bump years. They also identified emotions that a typical person would associate with these negative behaviors; these emotions were included as memory cues in Studies 2–4.

Study 2

Participants in Study 1 expected misdeeds, including crimes and other more minor moral transgressions, to occur most frequently in late adolescence and early adulthood. In addition, they indicated which negative emotions are likely to be associated with these misdeeds. Study 2 replicated and expanded on previous studies of cultural life scripts (e.g., Berntsen & Rubin, 2004, Study 2; Rubin & Berntsen, 2003). College students were asked to imagine the memories that a typical 80-year-old would recall in response to a variety of emotion cues, including the novel negative emotion terms generated by participants in Study 1. We hypothesized that memories participants expected to be recalled in response to positive emotion cues would generate reminiscence bumps, consistent with prior research (e.g., Koppel & Berntsen, 2015), and that expectations for memories prompted by negative emotion cues that have been examined previously (e.g., sad, afraid) would replicate prior findings, with no distinctive bumps (e.g., Berntsen & Rubin, 2004). In addition, we tested the key exploratory hypothesis that reminiscence bumps would be apparent for memories that participants would expect a typical older adult to recall when cued by the negative emotion terms associated with misdeeds in Study 1 (e.g., shame, guilt, embarrassment).

Table 2

Study 1: Frequencies of a Hypothetical 80-Year-Olds' Anticipated Emotions While Engaging in ("Then") and Subsequently Remembering ("Now") Criminal Behaviors, Moral Transgressions, and Prosocial Behaviors

Criminal-then	Criminal-now	Transgression-then	Transgression-now	Prosocial-then	Prosocial-now
Angry ($n = 351$)	Regretful ($n = 395$)	Angry ($n = 266$)	Regretful ($n = 371$)	Happy ($n = 278$)	Happy ($n = 316$)
Afraid ($n = 218$)	Guilty ($n = 228$)	Guilty ($n = 194$)	Guilty ($n = 291$)	Helpful ($n = 202$)	Proud ($n = 197$)
Guilty ($n = 100$)	Ashamed ($n = 142$)	Sad ($n = 119$)	Ashamed ($n = 132$)	Proud ($n = 98$)	Helpful ($n = 77$)
Excited ($n = 78$)	Embarrassed ($n = 91$)	Powerful ($n = 78$)	Sad ($n = 170$)	Good ($n = 66$)	Joyful ($n = 61$)
Sad ($n = 57$)	Sad ($n = 89$)	Excited ($n = 38$)	Embarrassed ($n = 82$)	Joyful ($n = 66$)	Good ($n = 55$)
Other ($n = 284$)	Other ($n = 351$)	Other ($n = 445$)	Other ($n = 303$)	Other ($n = 352$)	Other ($n = 224$)
Total = 1,088	Total = 1,296	Total = 1,140	Total = 1,349	Total = 1,062	Total = 930

Method

Participants

The sample included 200 undergraduate students (145 female, 55 male) residing in the United States who completed the survey on the Prolific Researcher platform for $5 monetary compensation. Students could be from any undergraduate major. Participants ranged in age from 18 to 26 years ($M = 21.13$, $SD = 1.86$); 58.5% self-identified as Caucasian/White, 20% as Asian, 8% as Hispanic/Latinx, 7% as African American/Black, and 6.5% as other. Two additional participants were removed from the data set because they failed to follow instructions.

Measures

We adapted materials and instructions from Rubin and Berntsen (2003) and Berntsen and Rubin (2004). Emotion words associated with negative behaviors in Study 1 served as cues in Study 2. These included afraid, angry, sad, ashamed, embarrassed, guilty, regretful, and excited. Two positive emotion cues, happy and proud, were included for comparison purposes. All emotion cue words were preceded by the modifier extremely.

Participants were informed that the study involved imagining a typical 80-year-old person of their own gender and from their own society. In response to a series of emotion cues, they were asked to imagine and describe events this typical person might have experienced at some point in their life, and to estimate the person's age at the time of each event. For example, the prompt for the cue word happy was "Imagine at some point in his life, this 80-year-old person has experienced an extremely happy event, that he recalls with much happiness. How old do you think he is in this memory?" Participants were further instructed: "Please briefly describe the example scenario that came to your mind in two to three sentences (e.g., What was the event?)." For each event, participants were queried with 7-point Likert-type rating scales (always running from less to more) in the following order: (a) confidence in age estimate, (b) positivity, (c) negativity, (d) importance, (f) recall/revisit frequency, and (g) sharing frequency. (These are the same items shown in Appendix.) Demographic information was collected at the end of the questionnaire.

Procedure

The questionnaire was administered online in Qualtrics survey software, advertised on the Prolific platform only to members registered as college students. The emotion cues were presented to participants in random order. Participants were compensated through Prolific's system upon successful completion.

Results

To examine the life span distributions of predicted event ages, we created eight age bins, corresponding to eight decades of life, for events prompted by each emotion cue (Table 3). We identified the modal decade(s) for each distribution, indicating where—if present—a "bump" appeared for each. Distributions of predicted ages in response to the positive emotion cues happy and proud peaked sharply in the third decade of life. Although Study 1 participants had identified most excited as an emotion that could accompany committing a crime, Study 2 participants' positivity ratings (Table 4) indicated that they viewed this cue as highly positive, with a pronounced peak in the third decade. The age distribution for most afraid events demonstrated a flatter peak spanning the second and third decades of life, whereas most angry events were prevalent across the second, third, and fourth decades. The age distribution of saddest events showed a predictable increasing prevalence with age.

Of particular importance for the current study, distributions of participants' age estimates in response to several negative emotion cues linked directly to misdeeds produced clear reminiscence bumps. Events cued by ashamed, guilty, and embarrassed peaked sharply in the second decade of life, whereas a flatter peak for regretful events spanned the second and third decades. Age curves are displayed in Figure 3. Table 3 also presents confidence ratings for age estimates of events associated with emotion cues. Mean confidence scores for positive and negative emotions were computed for each participant; participants had higher confidence in their age estimates of events cued by positive ($M = 4.55$, $SD = 1.34$) as opposed to negative ($M = 3.95$, $SD = 1.22$) emotions, $t(199) = 10.40$, $p < .001$.

Table 4 displays mean ratings of emotional intensity, frequency of recall, and frequency of memory sharing. Events cued by positive emotions (including excitement) received higher positive than negative ratings and events cued by negative emotions received higher negative than positive ratings (all $ps < .001$). Mean ratings of importance,

Table 3
Study 2: Mean Confidence Ratings, Standard Deviations of Age Estimates, and Age Distributions of Hypothetical Events by Emotion Cue

			Estimated decade of life							
Emotion cue	Confidence rating	*SD* age	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
Happy	4.60	14.04	10	23	**122**	17	9	9	6	4
Excited	4.57	13.85	25	56	**88**	13	6	2	7	3
Proud	4.49	13.57	2	21	**98**	28	28	16	7	0
Sad	4.26	21.05	3	23	20	19	32	33	27	**43**
Afraid	3.97	18.92	34	**55**	**55**	21	10	9	5	11
Angry	3.87	13.80	5	52	**58**	47	27	4	4	3
Ashamed	3.83	14.82	14	**85**	43	28	16	8	3	3
Guilty	3.72	13.55	12	**82**	42	37	15	6	2	2
Regretful	3.90	16.63	1	55	**58**	32	26	15	5	8
Embarrassed	4.11	13.96	18	**123**	32	11	4	4	3	4

Note. Modal categories in bold.

Table 4
Study 2: Mean Ratings of Hypothetical Event Positivity, Negativity, Importance, Recall Frequency, and Sharing Frequency by Emotion Cue

Emotion cues	Positivity	Negativity	Importance	Recall	Share
Happy	6.71	1.38	6.20	5.68	5.43
Proud	6.59	1.40	5.89	5.07	4.92
Excited	6.54	1.52	5.69	5.11	5.02
Sad	1.33	6.57	6.10	5.55	4.26
Afraid	1.46	6.22	4.71	4.38	3.66
Angry	1.41	6.32	4.36	3.95	3.40
Ashamed	1.54	5.96	4.04	3.89	2.59
Guilty	1.73	5.87	4.21	3.96	2.58
Regretful	1.64	5.85	4.77	4.59	3.01
Embarrassed	1.71	5.57	3.26	3.43	2.95

Note. The sample size (N) = 200.

frequency of recall, and frequency of sharing for positive and negative events were computed for each participant. Events cued by positive emotions were rated as more important ($M = 5.93$, $SD = 0.85$) than those cued by negative emotions ($M = 4.49$, $SD = 0.82$), $t(199) = 20.28$, $p < .001$. Similarly, they were rated as more frequently recalled ($M = 5.29$, $SD = 0.99$) than events cued by negative emotions ($M = 4.25$, $SD = 0.8$), $t(199) = 15.77$, $p < .001$, and more frequently shared ($M = 5.13$, $SD = 1.07$) than such events ($M = 3.20$, $SD = 0.81$), $t(199) = 24.21$, $p < .001$.

Temporal distributions and mean ratings for males and females were highly similar, with no notable discrepancies.

Discussion

Study 2 replicated and expanded upon previous studies of temporal distributions of memories given in response to emotion cues (e.g., Berntsen & Rubin, 2004; Rubin & Berntsen, 2003). We asked college students to imagine a typical older adult and to generate events cued by the emotion words identified in Study 1, and to provide estimates of the age at which the events occurred in that person's life. Participants' age estimates produced several robust reminiscence bumps, not only in response to the positive cues happy, proud, and excited, but also to the negative cues ashamed, guilty, and embarrassed. The negative cues afraid and regretful also produced visible but flatter age bumps.

Study 3

Study 3 replicated Study 2 with a middle-aged sample, to address the possibility that college students' expectations for memories recalled by a typical older adult might have been biased toward their own current ages, thereby producing exaggerated reminiscence bumps for both positive and negative emotion cues. The design and procedure were virtually identical to those of Study 2. We expected Study 3 results to replicate those of Study 2, with the possible exception that reminiscence bumps might be less pronounced for emotion cues when using an older sample.

Method

Participants

A total of 201 middle-aged adults (130 female, 71 male) residing in the United States completed the survey through Prolific Researcher for $5 monetary compensation. Participants ranged in age from 49 to 55 years ($M = 52.33$, $SD = 1.72$); 86% identified as Caucasian/White, 5% as African American/Black, 3% as Hispanic/Latinx, 2% as Asian, and 4% as other. Regarding highest educational status achieved, 79% held a bachelor's degree or higher, 2% had some college, 17% had a high-school degree, and 2% had not completed high school.

Measures and Procedure

The questionnaire and procedure were identical to those of Study 2, except for an additional multiple-choice item asking about participants' educational status.

Results

Age estimates, standard deviations of the age estimates, and mean confidence ratings for each emotion cue are presented in Table 5.

In comparison with Study 2 results, age distributions were slightly biased toward participants' own ages. Age distributions associated with positive emotion cues revealed classic reminiscence bumps: Happy and excited events peaked sharply in the third decade of life. Proud events not only showed a peak in the third decade, but also a modest second peak in the fifth decade. For negative emotions, embarrassed events peaked sharply in the second decade of life. Ashamed events showed a clearly discernible but flatter peak in the second and third decades. Age distributions for angry, afraid, regretful, and guilty did not show classic reminiscence bumps in the second or third decade of life. The age distribution of sad events showed a predictable increase with age. Table 5 also shows confidence ratings for age estimates of events associated with each emotion cue. Replicating Study 2 results, the participants' mean confidence ratings for age estimates of events cued by positive emotions ($M = 5.30$, $SD = 1.22$) was significantly higher than for events cued by negative emotions ($M = 4.66$, $SD = 1.27$), $t(200) = 11.95$, $p < .001$.

Table 6 presents mean ratings for the events participants generated in response to each emotion cue. As expected, events cued by positive emotions received higher positive than negative ratings and events cued by negative emotions received higher negative than positive ratings (all $ps < .001$). Participants' mean ratings for events generated in response to positive and negative emotion cues replicated the results from Study 2. Events cued by positive emotions were rated as more important ($M = 6.40$, $SD = 0.59$) than events cued by negative emotions ($M = 5.23$, $SD = 0.81$), $t(200) = 20.73$, $p < .001$. Events cued by positive emotions were also rated as more frequently recalled ($M = 5.57$, $SD = 0.98$) than events cued by negative emotions ($M = 4.62$, $SD = 0.91$), $t(200) = 12.88$, $p < .001$, and more frequently shared ($M = 5.27$, $SD = 1.06$) than negatively cued events ($M = 3.34$, $SD = 0.83$), $t(200) = 24.72$, $p < .001$.

Temporal distributions and mean ratings for males and females were highly similar, with no notable discrepancies.

Discussion

There was an apparent modest age bias in participants' age estimates for events that a hypothetical typical older adult was likely

Figure 3

Study 2 (Young Adults Ages 18–26) and Study 3 (Middle Aged Adults Ages 49–55): Age Distributions of Hypothetical Events by Emotion Cue

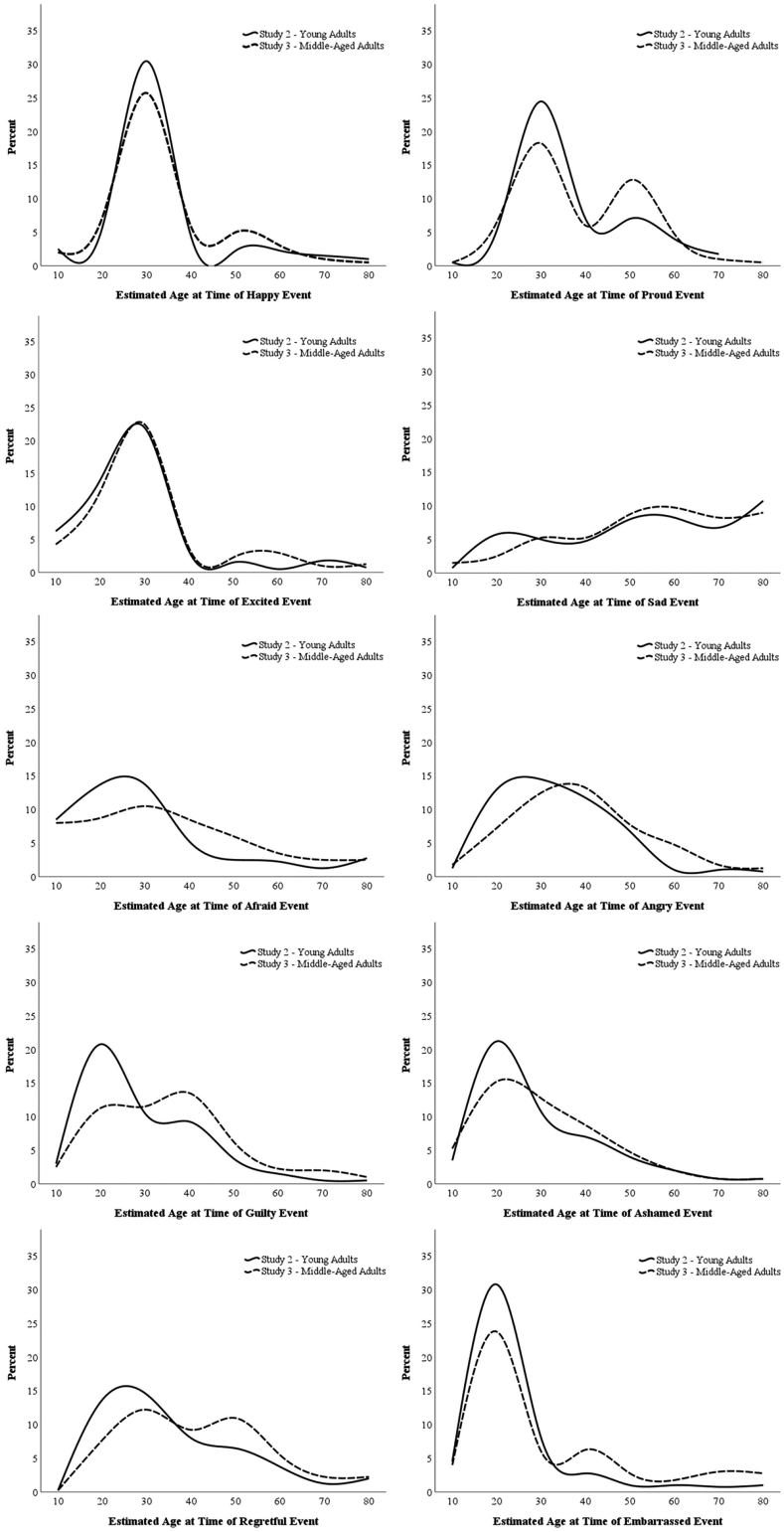


Table 5
Study 3: Mean Confidence Ratings, Standard Deviations of Age Estimates, and Age Distributions of Hypothetical Events

			Estimated decade of life							
Emotion cue	Confidence rating	*SD* age	0–10	11–20	21–30	31–40	41–50	51–60	61–70	71–80
Happy	5.29	13.58	8	29	**103**	23	20	12	4	2
Excited	5.25	15.51	17	49	**90**	15	9	12	4	5
Proud	5.35	14.44	2	26	**73**	24	51	19	4	2
Sad	4.96	18.99	6	10	21	21	35	**39**	33	36
Afraid	4.65	19.95	32	35	**42**	34	24	14	10	10
Angry	4.55	15.59	7	29	50	**53**	31	19	7	5
Ashamed	4.57	15.34	21	**61**	51	35	19	8	3	3
Guilty	4.49	15.78	10	45	46	**54**	25	9	8	4
Regretful	4.76	16.58	0	31	**49**	37	44	22	9	9
Embarrassed	4.62	20.00	16	**95**	24	25	11	7	12	11

Note. Modal categories in bold.

to remember in response to emotion cues, such that college students tended to provide earlier age estimates than middle-aged adults. Nevertheless, classic reminiscence bumps occurring in the second or third decades of life were evident in both studies not only for the positive cues happy, excited, and proud, but also for the negative cues embarrassed and ashamed. In contrast to Study 1, reminiscence bumps in the second or third decade of life were not clearly evident for angry, afraid, guilty, and regretful. Furthermore, in response to the proud cue, there also was a discernable later bump that was not apparent in Study 2. Across studies, sad events showed a consistent and steady increase with age.

Study 4

In Study 4, older adults provided their own personal memories in response to the same emotion cues used in Studies 2 and 3. Consistent with the results of the three preceding studies, we hypothesized that ages associated with personal memories would produce reminiscence bumps not only for positive emotion cues (happy, excited, proud) but also for certain negative emotion cues closely associated with misdeeds, especially embarrassed and ashamed. Study 2 and Study 3 memory age distributions for the negative cues guilty, regretful, and afraid were inconsistent, with classic reminiscence bumps apparent primarily for the college age sample. As such, from the perspective of cultural life script theory (e.g., Berntsen & Rubin, 2004), our hypotheses that classic reminiscence bumps would be evident for personal memories cued by these emotions were more tenuous.

Table 6
Study 3: Mean Ratings of Hypothetical Event Positivity, Negativity, Importance, Recall Frequency, and Sharing Frequency by Emotion Cue

Emotion cues	Positivity	Negativity	Importance	Recall	Share
Happy	6.74	1.31	6.59	5.96	5.57
Proud	6.69	1.29	6.35	5.33	5.21
Excited	6.56	1.27	6.24	5.41	5.01
Sad	1.31	6.43	6.36	5.85	4.62
Afraid	1.49	6.37	5.67	4.68	4.01
Angry	1.36	6.49	5.27	4.57	3.70
Ashamed	1.56	6.17	4.91	4.12	2.30
Guilty	1.86	5.79	4.97	4.43	2.56
Regretful	1.76	5.76	5.26	4.81	3.27
Embarrassed	1.72	5.83	4.19	3.87	2.89

Note. The sample size (N) = 201.

Method

Participants

Two hundred middle-aged and older adults (128 female, 72 male) residing in the United States were recruited from Prolific Researcher for $8 monetary compensation. Participants ranged in age from 56 to 71 years ($M = 62.06$, $SD = 4.51$), older than participants in Study 3 and well beyond the reminiscence bump years, but still within an age range where potential participants were relatively plentiful; 87% identified as Caucasian/White, 5.5% African American/Black, 3% Hispanic/Latino, 2.5% Asian, and 2% other. In terms of highest educational level achieved, 88% of participants held a bachelor's degree or higher, 3% had some college education, 6% had a high school degree, and 3% had not completed high school. One additional participant was removed because they failed to complete more than 50% of the items.

Measures and Procedure

The questionnaire we utilized was similar to those in Studies 2 and 3, with instructions modified to ask for participants' own personal memories associated with each of the emotion cues, rather than the memories of a typical person. For example, for the cue happy, participants saw the following instructions:

> At some point in their life, many people have experienced an event in which they were extremely happy and which they recall with much happiness. If you have at least one such memory from your life, how old are you in this memory?

Participants were then asked to briefly describe the memory in two to three sentences.

Rating items from Studies 2 and 3 were modified to reflect participants' own perceptions of the events they recounted. These were 5-point Likert-type rating items (always running from less to more), presented in the following order: (a) importance, (b) positivity, (c) negativity, (d) recall frequency, and (e) sharing frequency. As in the earlier studies, emotion cues were presented in random order

Table 7
Study 4: Standard Deviations and Distributions of Participants' Ages at Time of Remembered Events

		Decade of life						
Emotion cue	*SD* age	0–10	11–20	21–30	31–40	41–50	51–60	61+
Happy	14.86	7	31	**58**	38	29	29	7
Excited	15.93	9	41	**55**	28	25	33	9
Proud	15.26	8	26	30	**46**	44	35	10
Sad	16.60	10	19	23	25	42	**63**	18
Afraid	17.52	22	39	**40**	21	34	31	7
Angry	16.66	3	27	35	29	31	**51**	21
Ashamed	16.08	20	**59**	42	22	20	19	5
Guilty	16.94	16	40	**41**	29	26	31	10
Regretful	14.98	3	33	**58**	29	42	25	9
Embarrassed	14.76	21	**63**	45	31	19	13	3

Note. Modal categories in bold.

across participants. Demographic information was collected at the end of the questionnaire.

Results

In Studies 2 and 3, age estimates for events reported in response to emotion cues were assigned to bins corresponding to the eight decades of life of a typical 80-year-old. In Study 4, participants were between 56 and 71 years of age, and remembered events were assigned to age bins for the first six decades of life, with an additional bin containing all memories that were dated age 61 or older. Although the number of participants who could potentially report memories of events occurring relatively late in life (i.e., those occurring after age 56) is lower than for younger ages, this has no bearing on our hypotheses focusing on the reminiscence bump; all participants could freely report memories of events that occurred during their first five decades of life, including years prior to and following the predicted bump ages.

Memory age estimates for each emotion cue are presented in Table 7 and age curves are presented in Figure 4. Consistent with Study 2 and Study 3 results, robust reminiscence bumps were evident for participants' happy, excited, ashamed and embarrassed memories; the modal category for memory ages was 21–30 years for happy and excited events, and 11–20 years for ashamed and embarrassed events. Reminiscence bumps for other emotion cues were less prominent, less consistent, or nonexistent. Notably, proud memories did not show the predicted clustering in the bump years.

Table 8 presents mean ratings for the events participants remembered in response to each emotion cue. As expected, events cued by positive emotions were rated more positively than negatively and events cued by negative emotions were rated more negatively than positively (all $ps < .001$). Participants' mean ratings for events cued by positive emotions ($M = 4.45$, $SD = 0.64$) were more important than those cued by negative emotions ($M = 3.72$, $SD = 0.71$), $t(173) = 13.32$, $p < .001$. Similarly, participants indicated that they recalled events cued by positive emotions more frequently ($M = 3.78$, $SD = 0.77$) than events cued by negative emotions ($M = 3.21$, $SD = 0.71$), $t(173) = 9.24$, $p < .001$, and that they shared these events more frequently ($M = 3.21$, $SD = 0.93$) than those cued by negative emotions ($M = 2.34$, $SD = 0.66$), $t(173) = 13.50$, $p < .001$.

Temporal distributions and mean ratings for males and females were highly similar, with no notable discrepancies.

Discussion

In Study 4, older adults provided personal memories from their own lives, in response to the same cues that Study 2 and 3 participants used to generate memories for a hypothetical older person. Study 4 confirmed that the robust reminiscence bumps identified in Studies 2 and 3 were clearly evident in age distributions of personal memories recounted by older adults for several emotion cues: happy, excited, ashamed, and embarrassed. Reminiscence bumps for the emotion cues guilty, regretful, and afraid were more modest and inconsistent, and participants' proud, angry, and sad events frequently occurred in the decades following the reminiscence bump years.

Memory Themes in Hypothetical and Personal Memories

Studies 2, 3, and 4 demonstrated prominent and consistent reminiscence bumps for hypothetical and actual memories given in response to four emotion cues: happy, excited, ashamed, and embarrassed. Notably, the modal memory ages for happy and excited (ages 21–30), and ashamed and embarrassed (11–20), were identical for expectations people have for a typical older person (Studies 2 and 3) and personal memories reported by older adults (Study 4). The close agreement between expected and actual memory age distributions is consistent with the life script account of the reminiscence bump, which posits that life scripts direct the memory search to ages where events associated with a particular emotion are expected to occur most frequently (e.g., Rubin & Berntsen, 2003). A second source of support for life script theory would involve identifying consistent memory themes in expected and actual memories from the reminiscence bump years. These themes should represent events that by their nature are especially prevalent in late adolescence and early adulthood.

To examine themes represented in hypothetical and personal memories, we coded memory content using methods adapted from previous research (Dickson et al., 2011; Özdemir et al., 2021). The first author first read the memory narratives for all emotion cues and then identified content categories that embodied recurring themes. Broad categories were refined by searching for subthemes that represented more than 4% of participants' total responses, in which case they became independent categories. Content categories first identified for Study 2 captured all major themes of memories in Study 3 and Study 4, so that the same coding scheme was used throughout. The final coding scheme included 45 thematic categories. For Studies 2 and 3, another researcher blind to the study

Figure 4

Study 4: Age Distributions of Remembered Events by Emotion Cue

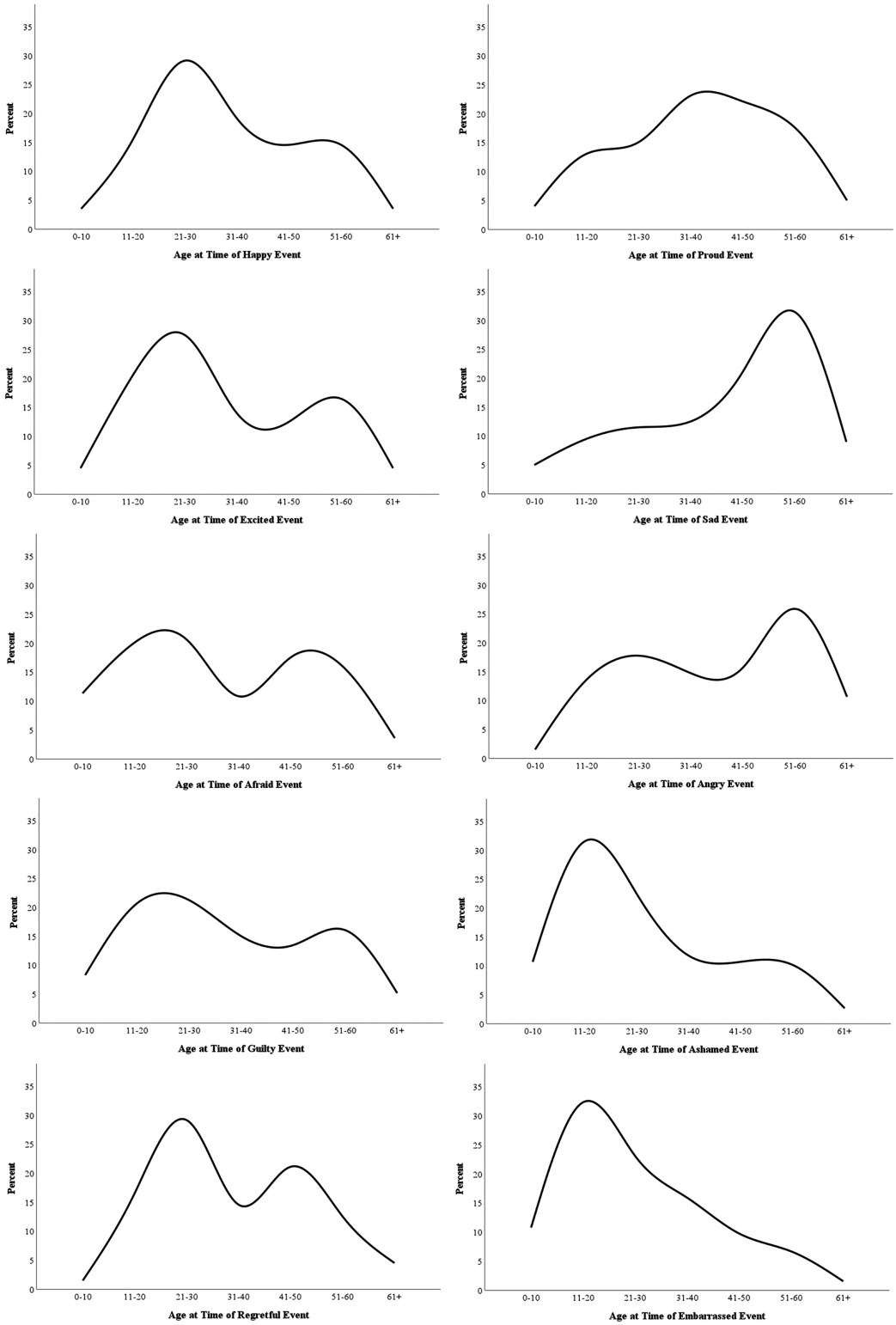


Table 8
Study 4: Mean Ratings of Memory Positivity, Negativity, Importance, Recall Frequency, and Sharing Frequency by Emotion Cue

Emotion cues	Positivity	Negativity	Importance	Recall	Share
Happy	4.91	1.16	4.67	4.06	3.37
Proud	4.87	1.12	4.43	3.55	2.97
Excited	4.83	1.14	4.24	3.63	3.20
Sad	1.20	4.72	4.63	4.01	2.90
Afraid	1.25	4.57	3.76	3.15	2.62
Angry	1.13	4.76	3.74	3.28	2.56
Ashamed	1.27	4.44	3.40	2.81	1.83
Guilty	1.39	4.39	3.64	3.21	2.05
Regretful	1.56	4.21	4.19	3.51	2.35
Embarrassed	1.49	4.02	2.66	2.56	1.98

Note. The sample size (N) = 200.

hypotheses was trained and coded a randomly selected 25% of the hypothetical memory reports ($n = 931$); intercoder agreement was 83.5% ($K = .83$). Similarly, for Study 4 a third researcher blind to the study hypotheses was trained and coded a randomly selected 25% of personal memories ($n = 493$); intercoder agreement was 87% ($K = .86$).

To directly evaluate support for the life script account of the reminiscence bump, we focused primarily on memories given in response to emotion cues for which bumps were both prominent and consistent across all three studies: happy, excited, embarrassed, and ashamed. These analyses included memories falling in the modal age category for the happy and excited cues (ages 21–30) and for the embarrassed and ashamed cues (ages 11–20).

Table 9 presents the five most frequently identified themes in modal age bump memories for Studies 2, 3, and 4. For the positive cue happy, the majority of bump memories in all studies focused on two events—marriage and childbirth. For the cue excited, marriage, childbirth, and graduation were consistently among the most frequent memory themes. The prevalence of positive age-linked cultural milestone events within the bump years is in close agreement with prior studies (see Özdemir et al., 2021). Content analyses also suggested a partial explanation for the failure of the positive cue proud to produce consistent reminiscence bumps across studies: Common themes included not only personal events (such as one's own college graduation), but also events happening to one's offspring (such as a child's college graduation).

For the negative cue ashamed, consistent memory themes across studies included family conflict, education-related memories (other than starting school or graduation, which constituted separate thematic categories) and, in agreement with sociological analyses of crime described in the introduction, theft. For the cue embarrassed, memories frequently focused on education, minor mishaps, and puberty. Education and puberty typically occur within the reminiscence bump years, whereas family conflicts and minor mishaps can occur at any age. Nevertheless, intensive family conflicts, extreme sensitivity to others' reactions to relatively inconsequential mishaps, and low-level criminal behaviors could be especially common in the teenage and early adult years. As such, they may comprise an "adolescence" life script; this issue will be explored more fully in the general discussion. In addition, the consistent age-related increases in sad events were especially prominent in the personal memories of older participants in Study 4. Across studies, expected and personal sad memories overwhelmingly focused on deaths of parents, partners, or other people. These findings raise the possibility (to be discussed later) that age distributions for sad memories reflect in part cultural life scripts for events likely to occur in the later decades of life.

Memory contents for males and females were highly similar, with one notable exception: For the memory cue embarrassed, events that focused on puberty were more common for females ($N = 11$) than for males ($N = 1$).

General Discussion

The present research provides the first systematic evidence for reminiscence bumps corresponding to negative as well as positive emotion cues. These findings stand in contrast to prior research demonstrating prominent bumps for positive events but finding scant evidence for negative bumps (e.g., Berntsen & Rubin, 2002; Glück & Bluck, 2007). Negative memory prompts used in prior studies—such as sad, traumatic, afraid, angry—apparently did not fully capture the negative feelings and psychological turmoil characteristic of late adolescence and early adulthood. Inspired by sociological research on the age distribution of crime (Hirschi & Gottfredson, 1983), which has consistently shown a peak in late adolescence and early adulthood, the present studies focused specifically on misdeeds and their accompanying emotions. Participants in Study 1 were asked to estimate when in the lifespan a typical 80-year-old would have engaged in a series of criminal behaviors and moral transgressions; they expected misdeeds large and small to be especially likely to occur during the bump years. When asked to describe emotions that the typical person would likely associate with each behavior, they identified a collection of associated feelings, including shame, embarrassment, guilt, regret, and anger.

When young adults in Study 2 and middle-aged adults in Study 3 were asked to imagine memories that a typical older adult would recount in response to specific emotion prompts, memory ages for the cues happy, excited, ashamed, and embarrassed showed pronounced and consistent reminiscence bumps across samples. In Study 4, older adults' own personal memories also produced prominent reminiscence bumps for these same emotion cues; memory ages were centered in the same decade across studies. The discussion is organized around issues raised by the discovery of reminiscence bumps for negative emotions.

Reminiscence Bumps Are Associated With Positive and Particular Negative Emotions

Positive memories from the bump years often focus on culturally shared landmark events that are prevalent in late adolescence and early adulthood, such as getting married, having children, and graduating from college (e.g., Özdemir et al., 2021). The negative cues used in prior studies, such as sad, angry, and afraid (e.g., Berntsen & Rubin, 2002; Rubin & Berntsen, 2003) failed to produce reminiscence bumps at least in part because they are not linked to particular categories of activities that are especially prevalent in the bump years. For example, memories prompted by the cue word "sad" prominently described deaths and serious illnesses, which are relatively rare in the bump years but common later in life. In contrast, negative events occurring frequently in the bump years are marked by embarrassment, shame and, to a lesser extent, related emotions (also see Henry et al., 2018). Negative bumps may not have been

Table 9
Studies 2, 3, and 4: Top Five Content Categories by Emotion Cue Within the Modal Decades

Study 2	Study 3	Study 4
	Happy	
Marriage (52.5%)	Childbirth (51.5%)	Childbirth (36.2%)
Childbirth (39.0%)	Marriage (35.9%)	Marriage (25.9%)
Graduation (6.6%)	Romantic meetings/dates (4.9%)	Achievement other (6.9%)
Career achievement (1.6%)	Graduation (2.9%)	Residential moves (6.9%)
Romantic dates/meetings (1.6%)	Career achievement (1.0%)	Employment start job (5.2%)
	Excited	
Marriage (38.6%)	Marriage (37.8%)	Childbirth (27.3%)
Childbirth (20.5%)	Childbirth (25.6%)	Graduation (12.7%)
Graduation (8.0%)	Residential moves (6.7%)	Traveling/outing (12.7%)
Traveling/outing (8.0%)	Employment start job (5.6%)	Marriage (10.9%)
Celebrations (4.5%)	Graduation (5.6%)	Social events (10.9%)
	Ashamed	
Education other (15.3%)	Theft (18.0%)	Family conflict (11.9%)
Interpersonal conflict (14.1%)	Interpersonal conflict (11.5%)	Bullying (10.2%)
Family conflict (10.6%)	Family conflict (9.8%)	Education other (10.2%)
Theft (10.6%)	Bullying (8.2%)	Substance use (10.2%)
Substance abuse (8.2%)	Education other (8.2%)	Theft (10.2%)
	Embarrassed	
Education other (24.4%)	Puberty (21.1%)	Education other (25.4%)
Minor mishaps (19.5%)	Minor mishaps (15.8%)	Minor mishaps (25.4%)
Puberty (15.4%)	Romantic conflict (13.7%)	Puberty (17.5%)
Romantic conflict (12.2%)	Bullying (12.6%)	Family conflict (4.8%)
Bullying (6.5%)	Education other (11.6%)	Illness/medical issues (4.8%)

Note. Consistent modal decades of event ages across Studies 2–4 were 21–30 for happy and excited emotion cues, and 11–20 for ashamed and embarrassed emotion cues.

discovered previously because these dark moments are part of the "private" life story. Participants' memory ratings show that, with the exception of the cue sad, negative memories were rated as less important, less likely to be recalled, and less likely to be shared than positive memories. As such, they are shared with others only selectively and reluctantly—in the present studies, in response to a targeted memory prompt. Nevertheless, these negative memories could serve important adaptive functions for the individual, to be described later in the discussion.

Our results also revealed that different positive cues do not always produce similar memory age curves. Memories reported in response to the cues happy and excited were clearly overrepresented in early adulthood, whereas proud memories were not. Content analyses identified not only one's own achievements (such as college graduation) but also one's offspring's achievements as frequent sources of pride.

Research in other domains has uncovered lifetime changes in the way that happiness and excitement are experienced and expressed, which could be reflected in both our expected and observed memory distributions. Analyses of thousands of blog posts revealed two forms of happiness: excited happiness and peaceful happiness (Mogilner et al., 2011, Study 1). Excited happiness was more common than peaceful happiness in the teens and 20s, and peaceful happiness was more common than excited happiness in the 40s and 50s. A follow-up survey (Mogilner et al., 2011, Study 2) showed that for people in their teens and 20s, happiness was positively correlated with feeling excited and negatively correlated with feeling peaceful. This relationship was reversed for people in their 40s, 50s, 60s, and 70s, when happiness was positively correlated with feeling peaceful and negatively correlated with feeling excited. These results suggest that, unlike the positive cue excited, the cue "peaceful" would fail to produce a classic reminiscence bump and instead show a heightened incidence of memories later in life.

In summary, broad contrasts between lifetime distributions of positive and negative memories (e.g., Glück & Bluck, 2007; Rubin & Berntsen, 2003) are not sensitive to differences in distinctive emotional qualities within these overarching categories. Our research shows that expected and actual age distributions will vary systematically as a function of the particular type of positive or negative emotion cues used to elicit memories. Distributions of memory ages associated with cultural scripts appear to mirror variations in real-world lifetime distributions of emotion-laden events: happy and exciting memories of marriage, births, and graduations peak in the 21–30 year age range; sad memories of deaths and illnesses predominate in older adulthood when deaths are frequent and expected; and shame and embarrassment memories cluster in adolescence, where these emotions are most likely to occur with high salience and intensity.

Adaptive Value of Negative Reminiscence Bump Memories

Like positive memories of personal landmark events occurring in late adolescence and early adulthood, our results show that negative memories from the reminiscence bump years focusing on moral failures, interpersonal discord, and embarrassing mishaps also persist for decades. What may explain the stubborn persistence of recollections such as these? Memories of events marked by shame, embarrassment, guilt, and regret can be adaptive and instructive by discouraging similar future behaviors, thereby avoiding the accompanying punitive emotional reactions. For example, Sznycer et al. (2016) portrayed shame as "an adaptation designed to counter the

threat of being socially devalued" (p. 2628). Consistent with this perspective, content analyses of older adults' personal memories cued by shame revealed a frequent focus on problematic social interactions or disappointments. Memories cued by embarrassment frequently involved educational experiences, puberty, or minor mishaps that led to real or perceived social disapproval or ridicule.

Autobiographical memory theory posits that remembering dark moments such as these may serve directive functions by bringing to mind painful, disappointing, risky, and socially inappropriate situations to be avoided in the future (e.g., Bluck et al., 2005; Pillemer, 1992, 1998, 2003; Rasmussen & Berntsen, 2009). For example, participants' personal memories given in response to the emotion cue "shame" illustrate their perceived long-lasting influence on feelings, thoughts, and behaviors:

> I once told a lie to my dad, not thinking that it would have any real importance. But he trusted my word and acted on what I had said. Then he found out it wasn't true and I had to admit that. I respected him and I was so ashamed when I had to apologize for what I said. It never happened again (memory age: 15).

> On the way to a weekend bluegrass festival, I stole a few items from a roadside tourist stand. We just stopped to stretch our legs and I ended up stealing a pint whisky flask and a small leather pouch. I've never forgotten the shame associated with that and it's been 40 + years (memory age: 17).

> I treated some close friends of my parents in an extremely rude and calloused manner. I don't know what got into me, but they were ashamed, and I'm ashamed thinking about it (memory age: 19).

Memories given in response to the cue embarrassed frequently focused on relatively minor indignities or mishaps rather than serious moral shortcomings, but the negative feelings endured for decades nevertheless, as in these examples:

> I was eating at the cafeteria of the university where I was a student and as I was trying to cut my steak the whole thing flew off the plate and on the floor in the corridor where students move around. Everyone around me saw this and they started laughing. I was very shy at that age and it affected me very badly (memory age: 20).

> I know this sounds dumb but I was in a jazz choir and the director would point at one of us during a number and we were supposed to sing "scat," an improvised way of singing to nonsense words. When he pointed at me I froze and then did an absolutely horrible job. I was beyond embarrassed. This memory haunts me more than most much more important events (memory age: 22).

> I started my period at school and blood was on my pants. I went to the girls bathroom, took off my pants and tried to wash it out in the sink. Then my pants were all wet. I got my shirt wet too, tied my jacket around my waist and kept telling people I fell in a puddle. But, I lived in somewhere sunny and warm where it didn't rain much, so no one believed me (memory age: 13).

Theories of autobiographical memory functions have identified feelings of self-continuity as a core benefit of remembering past events (e.g., Bluck et al., 2005; Bluck & Liao, 2013). In contrast, negative memories such as the examples associated with shame and embarrassment appear to serve a self-discontinuity function: Feelings of self-worth are preserved in part by assigning our darkest moments to a distant and regrettable view of a past self, and attempting to modify one's present and future behaviors accordingly. The clustering of these negative memories relatively early in life may be attributable in part to purposeful later efforts to avoid parallel situations or activities that are likely to reproduce similarly self-punitive feelings and painful social repercussions.

Implications for Theories of the Reminiscence Bump

Existing theoretical explanations for the reminiscence bump were developed to account for the key finding that the bump holds primarily for memories of positive rather than negative events (e.g., Berntsen & Rubin, 2002; Demiray et al., 2009; Koppel & Berntsen, 2014; Rubin & Berntsen, 2003). In contrast to prior work, the current studies show convincingly that people's expectations for the expected ages of occurrence for negative events recalled by a typical person, and the ages associated with people's own negative personal memories, reveal reminiscence bumps that are as pronounced as bumps for memories cued by positive emotions. As such, existing theories will have to be reformulated or expanded to incorporate the new findings. We focus here on the two most comprehensive theories—the life script account and the life story account—for which differing age patterns linked to positive and negative memories are key components.

The Life Script Account

Life script theorists posit that the search for memories in response to an emotion cue is driven by broad cultural expectations for when in the lifespan the particular emotion is especially likely to be experienced (Rubin & Berntsen, 2003). This account could be expanded to include negative memory reminiscence bumps under certain conditions: The remembered events must be associated with emotional reactions that are broadly believed to be characteristic of particular ages in the lifespan. In Studies 2 and 3, we employed the research strategy developed by Berntsen and Rubin (2004) in which participants estimated the age at which a typical person would experience highly emotional events. Our results showed classic reminiscence bumps for embarrassment and shame in both younger adult and middle-aged adult samples. Importantly, age distributions of older adults' personal memories of shame and embarrassment (Study 4) closely mirrored the expected lifetime distributions for a typical person growing up in the culture (Studies 2 and 3). In support of the life script account, middle-aged adults' expectations for a typical adult produced reminiscence bumps for regret and guilt that were less well defined and uniform than for shame and embarrassment (Study 3), and reminiscence bumps for older adults' own personal memories involving regret and guilt were similarly muted (Study 4).

Our findings appear to support a revised theoretical model in which the reminiscence bumps for shame and embarrassment that we observed so clearly in our data are attributable at least in part to an active role played by life scripts in guiding the memory search. Social discord and emotional turmoil are often portrayed as characteristic of the interpersonal challenges accompanying late adolescence and early adulthood (e.g., Arnett, 1999; Holmbeck & Hill, 1988). Parents and teachers endorse this cultural stereotype: "Both cultural transmission and personal experience influence adults' beliefs about adolescents. The role of cultural transmission is strong, in that stereotyped notions of adolescent difficulty are endorsed fairly consistently by all groups" (Buchanan et al., 1990, p. 291). A comprehensive review concluded that shame is a prominent feature of the "emotional landscape of adolescence" (Reimer, 1996. p. 354), and an analysis from a psychotherapeutic perspective

drew a similar conclusion: "In adolescence shame is a ubiquitous phenomenon, as this developmental stage consists of all the parameters that can trigger feelings of shame" (Anastasopoulos, 1997, p. 103). As mentioned earlier, popular depictions also identify adolescence as the "age of painful embarrassment" (Pickhardt, 2022). Puberty was a prominent theme in our content coding of people's (especially women's) embarrassing memories, and this fits well with research findings and prevailing views: "Menarche may have a positive personal significance insofar as it is associated with greater maturity, but this positive impact is overshadowed by a negative interpersonal significance as girls become increasingly self-conscious, embarrassed, and secretive" (Koff et al., 1981, p. 148). These broadly shared views of the social and emotional challenges facing adolescents could guide the memory search to this age period.

Although life script theory was developed to account for the clustering of memory ages in late adolescence and early adulthood, there is no a priori reason why a similar logic and research strategy could not be applied to other lifetime periods. Our older adult participants frequently identified their own sad memories as occurring later in life, with a clear focus on deaths of parents or others (Study 4). Participants' expectations for the ages of sad memories reported by a typical older adult also showed age-related increases, and themes of death predominated (Studies 2 and 3). In addition, sad memories tended to be more frequently recalled and shared with others than memories cued by other negative emotions (Table 8). Although we are unaware of systematic gerontological research on the frequency with which older adults think about and talk about deaths of loved ones and acquaintances, informal observations suggest that this topic of conversation increases dramatically in the later years as one's family members and friends begin to become ill and die; this could contribute both to a cultural life script for the expected ages of sad memories and to a late adulthood age bump for sad personal memories.

The Life Story Account

The life story account (e.g., Demiray et al., 2009) attributes the reminiscence bump to the prominent place in the self-narrative held by positive memories of influential events in which the person had a high degree of perceived control (Glück & Bluck, 2007). This theory could potentially be expanded to include long-lasting negative recollections without undermining its basic tenets. There is no clear a priori reason why impactful negative bump memories would be excluded from the evolving life story. In addition, negative reminiscence bumps for personal memories were evident primarily for emotions where the person is likely to have played an active (although possibly unintended) role, including shame and embarrassment. As was discussed previously, episodes marked by shame and guilt frequently involve high levels of perceived personal responsibility or control, whereas other negative emotions (e.g., sadness) are more likely to involve situations in which others have control (Smith & Ellsworth, 1985). A coherent life story, in which one's past is causally and thematically linked to the present self, would seem to be incomplete without the inclusion of negative episodes that contributed actively to the development of self and that persisted well into adulthood.

New Directions

Our studies may inform future research directions in several ways. First, memory researchers could benefit by looking beyond the limited range of new ideas suggested by closely related and narrowly defined scholarship. Our studies were inspired by a seemingly unlikely source—sociological research on crime. Yet, the striking and consistent crime–age curve, with its peak in late adolescence and early adulthood, suggested that memories of misdeeds, and people's general expectations for when in life they are likely to occur, might for the first time reveal reminiscence bumps for negative emotions. Similarly, social psychological research on a topic seemingly unrelated to age distributions of personal memories—the "shifting meaning of happiness" from excited to peaceful (Mogilner et al., 2011)—suggests that constructing new memory cues in future research to coincide with documented age-related shifts in the quality of emotional experiences may identify parallel shifts in the location of corresponding memory age bumps. More broadly, attending to public expressions that suggest an age dependency for certain emotional reactions may further expand the range of cues that elicit memory bumps and provide additional tests of competing theoretical accounts.

Second, new research could more closely examine potential functions served by vivid memories associated with particular negative emotions. For example, although remembering especially shameful and embarrassing past episodes would on the surface appear to be painful and even dysfunctional, theorists have identified adaptive qualities of these affective reactions (e.g., Sznycer et al., 2016, 2021). By vividly portraying circumstances in which personal behaviors led to social rejection or ridicule, memories of embarrassment, shame, and similar emotions may provide directives (Pillemer, 2003) or correctives for future activities. Research could also contrast the potential adaptive value of lessons conveyed by intensely negative memories with the potential costs to psychological health and feelings of well-being.

Third, our findings of robust reminiscence bumps for negative emotions should be tested in broader samples than ours, which included predominately White, college educated participants living in the United States, and a disproportionate number of women. While gender comparisons did not reveal meaningful differences, the gender imbalance in our sample is still worthy of note.

A final question for future research targets age-related memory decline and dementia. Recent research has shown that memories from the reminiscence bump years are at least partially spared in patients with Alzheimer's disease (e.g., Berntsen et al., 2022). Are the memory savings found primarily for highly scripted positive events that populate the conventional reminiscence bump, or are the negative memories that were remembered so vividly by our older participants similarly spared? Examining this question, which juxtaposes frequently rehearsed and socially shared positive memories against infrequently talked about memories of our darkest moments, could provide new insights into the mechanisms underlying memory preservation in the face of inevitable age-related declines.

Constraints on Generality

Our findings revealed a reminiscence bump for memories associated with select negative emotions; this bump was predicted by college students and adults imagining the memories of an older person, and it was apparent in the memories of middle- to older-aged adults. Participants in all studies resided in the United States and the majority were White and either college students (Studies 1 and 2) or college educated (Studies 3 and 4). Because prior research has shown

that the reminiscence bump for positive events is similar across demographically diverse populations (e.g., Scherman, 2013), we think it likely that this would also be the case for our findings, but that remains to be tested. The particular negative emotions that show a bump, and/or where the bump occurs in the life span, might differ across populations, in particular across cultures, according to normative experience. Our studies revealed no gender difference in the general pattern of findings, although the particular content of remembered events may differ across genders. Thus, replication of these findings in more educationally, gender and culturally diverse samples is warranted. We collected data in an online format, but conceptually the findings should replicate if memories are prompted verbally or in other written formats. We have no reason to believe that the results depend on other characteristics of the participants, materials, or context.

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(*Appendix follows*)

Appendix

Study 1—Instructions and Questions

PART 1:

*(Instructions following the informed consent)**

In the following sections, you will see a series of behaviors this hypothetical person has done throughout his or her whole life. Try to think about the first example scenario that comes to your mind for each behavior. Your task is to estimate at what age this hypothetical person is most likely to have been engaged in these behaviors. If you think these kinds of behaviors could be engaged in at multiple times in a life course, please try to think about the most typical time this person might be expected to have done these things. Please try to estimate a single age. You will also be asked to answer some additional questions/ratings about these behaviors. There are no right or wrong answers. We are simply interested in your intuition about when each of these behaviors is most likely to occur for this hypothetical person."

(Order of appearance for each behavior is randomized)

Behavior #1

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Cheating

(Open-ended)

How old was s(he) when this happened?

(Open-ended)

What emotion(s) did this person feel as s(he) engaged in this behavior back then?

(Open-ended)

What emotion(s) does this person feel as s(he) remembers the memory of this event now?

(Scaled responses)

How **confident** are you that your estimate is in the right decade of life?

1 (*I have absolutely no confidence*) 2 3 4 5 6 7 (*I am totally confident*)

How **positive** were the emotions this person experienced as s(he) was engaging in this behavior?

1 (*not at all positive*) 2 3 4 5 6 7 (*extremely positive*)

How **negative** were the emotions this person experienced as s(he) was engaging in this behavior?

1 (*not at all negative*) 2 3 4 5 6 7 (*extremely negative*)

How **important** was this event for this person?

1 (*not at all important*) 2 3 4 5 6 7 (*extremely important*)

How **relevant** do you think this behavior is to this hypothetical person's current sense of self?

1 (*not at all relevant*) 2 3 4 5 6 7 (*extremely relevant*)

How **frequently** do you think this person has recalled/revisited the memory of this behavior?

1 (*never*) 2 3 4 5 6 7 (*always*)

How **frequently** do you think this person has shared the memory of this behavior with others?

1 (*never*) 2 3 4 5 6 7 (*always*)

(The following four questions were not included in reported analyses in this paper.)

How **prevalent** do you think this behavior is in the population (i.e., people of any ages)?

1 (*not at all prevalent*) 2 3 4 5 6 7 (*extremely prevalent*)

How **likely** do you think it is that people in the population will engage in this behavior at least once in their lifetime?

1 (*not at all likely*) 2 3 4 5 6 7 (*extremely likely*)

How **acceptable** do you find this behavior to be for the people at the age you estimated?

1 (*not at all acceptable*) 2 3 4 5 6 7 (*highly acceptable*)

How **acceptable** do you find this behavior in general?

1 (*not at all acceptable*) 2 3 4 5 6 7 (*highly acceptable*)

(Questions above were repeated for Behaviors 2–15 in identical order)

Behavior #2

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Bullying another person

Behavior #3

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Telling a serious lie

Behavior #4

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Committing a major crime

Behavior #5

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Committing a minor crime

Behavior #6

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Hurting someone physically

Behavior #7

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Hurting someone psychologically

Behavior #8

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Getting into trouble with the law

Behavior #9

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Getting into trouble with close others (e.g., family, friends, spouse)

(*Appendix continues*)

Behavior #10

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Harassing someone

Behavior #11

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Betraying someone's trust

Behavior #12

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Stealing something from another person

Behavior #13

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Helping someone in need

Behavior #14

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Donating to a charity

Behavior #15

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Volunteering in an animal shelter

Behavior #16

Imagine this hypothetical 80-year-old has engaged in the behavior below:

Comforting someone who's in distress

(Presented at after Part 1, not randomized)

Part 2: Demographics

(Multiple-choice with open-ended response option)

What is your gender?

Male

Female

Non-binary/third gender

Prefer to self-describe

Prefer not to say

(Open-ended)

How old are you?

(Multiple choice)

What is your ethnic background?

African American/Black

Asian

European/Caucasian/White

Hispanic/Latinx

Other/Mixed

(Debriefing form at the end of the survey)

*Comments in italics, did not appear in the survey.

Received December 14, 2022
Revision received August 26, 2023
Accepted September 2, 2023 ■