

Emotionally Charged Autobiographical Memories Across the Life Span: The Recall of Happy, Sad, Traumatic, and Involuntary Memories

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A sample of 1,241 respondents between 20 and 93 years old were asked their age in their happiest, saddest, most traumatic, most important memory, and most recent involuntary memory. For older respondents, there was a clear bump in the 20s for the most important and happiest memories. In contrast, saddest and most traumatic memories showed a monotonically decreasing retention function. Happy involuntary memories were over twice as common as unhappy ones, and only happy involuntary memories showed a bump in the 20s. Life scripts favoring positive events in young adulthood can account for the findings. Standard accounts of the bump need to be modified, for example, by repression or reduced rehearsal of negative events due to life change or social censure.

Many studies have examined the distribution of autobiographical memories across the life span. No studies have examined whether this distribution is different for different classes of emotional memories. Here, we compare the event ages of people's most important, happiest, saddest, and most traumatic memories and most recent involuntary memory to explore whether different kinds of emotional memories follow similar patterns of retention. For example, some clinicians have observed that trauma memories often form an exception to the normal pattern of forgetting. To examine this question, the recall of traumatic memories is compared with memories of other highly important and emotionally charged events. A related question is whether memories for the saddest and happiest events in a person's life stay equally accessible. In spite of an accumulating amount of work on the relation between emotion and memory in both cognitive psychology and neurobiology, little is known as to how pleasantness versus unpleasantness influences the long-term retention of autobiographical memories.

A second and related topic we address here is involuntary memories—that is, memories that pop into consciousness with no preceding attempts at remembering. On the very first pages in the world's first book on experimental studies of memory, Ebbinghaus

(1885/1964) drew attention to conscious memories that arise unintentionally and treated them as one of three distinct classes of memory, but did not study them himself. In his well-known textbook, Miller (1962/1974) opened his chapter on memory by quoting Marcel Proust's description of how the taste of a Madeleine cookie unintentionally brought to his mind a long-forgotten childhood memory. However, Miller goes on by recommending psychologists not to study such "fragile" and uncontrollable phenomena (p. 181). This advice seems to have been followed as very little empirical work has been done on this topic in cognitive psychology. In contrast, involuntary memories have been observed in clinical settings and mentioned as symptoms in a wide range of disturbances—especially posttraumatic stress disorder (e.g., American Psychiatric Association [APA], 1994; Harber & Pennebaker, 1992; Horowitz, 1975; Horowitz & Reidbord, 1992; van der Kolk & Fisler, 1995).

Recent studies indicate that most undergraduates view involuntary memories as a personally well-known phenomenon that takes place at least some times a week (Berntsen, 1996, 1999; Brewin, Christoulides, & Hutchinson, 1996; Roberts, McGinnis, & Bladt, 1994). In diary studies in which involuntary memories were recorded immediately after they had occurred, in most cases involuntary memories were found to have recognizable environmental cues. Recent and distinctive events were found to dominate, and the majority of the memories were rated emotionally positive or neutral (Berntsen, 1996, 1999). In a comparative study in which voluntary memories were retrieved in response to word cues, Berntsen (1998) found that involuntary memories more often referred to concrete episodes and were less rehearsed than voluntary memories. Recently, Berntsen (2001) compared involuntary memories for traumas and peak events (highly positive events) among undergraduates. Her findings indicate that while involuntary memories deal with both positive and negative events, involuntary memories for traumas may be accessible for a longer time than involuntary memories of peak experiences. Because these findings derive from studies with undergraduates, it is not entirely clear whether they can be generalized to a broader population and

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The data presented here were collected by Gallup Public, Denmark. We wish to thank Jonas Giersing and his colleagues for professional service and attention to the needs and purpose of the present study. This article benefited from comments and suggestions from Robert Belli, Jørgen Carl, Nicoline Hall, Baerbel Knaeuper, Peter Krøjgaard, Michael Ross, Jenifer Talarico, and Dorthe Kierkegaard Thomsen.

The study was supported by a grant from the Danish Research Council for the Humanities. National Institute of Aging Grant AG16340 helped fund the data analysis and writing of this article.

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especially to older respondents. One purpose of the present work was to examine the prevalence of involuntary memories across ages and the retention of positive and negative involuntary memories.

To investigate these topics, we asked a large, stratified sample of the Danish population ranging in age from 20 to 93 years how old they were when the event in their happiest, saddest, most important and most traumatic autobiographical memory occurred. We used extremes in this initial investigation to increase the chances of seeing differences and to make contact with the existing literature in autobiographical memory and clinical psychology. We then asked if they had had involuntary memories, how often, and how old they were in their most recent involuntary memory and whether this memory was happy or sad. Table 1 presents an English translation of the questions.

We begin by reviewing the relevant literature on the distribution of autobiographical memories across the life span. The predictions derived from this literature are presented in Table 2 under the Main Predictions heading. As shown later, only one of these hypotheses can account for the findings. In the discussion of our results, we therefore enlarge our focus to also include neurophysiological, clinical, and social psychological theories on the relation between emotion and memory. The purpose for this is to see whether such theories outside the literature on autobiographical memory are able to account for the findings.

The Distribution of Autobiographical Memories Across the Life Span

Rubin, Wetzler, and Nebes (1986) argued that an adequate model of the distribution of autobiographical memories across the life span should contain three components. The first component is a retention function to account for the monotonically decreasing

frequency of reported memories as a function of the time since the remembered events occurred; memories lose accessibility with the passage of time. This forgetting curve has a steep drop in the beginning of the retention period and a slower decline as retention time increases (Ebbinghaus, 1885/1964). A power function has been found to provide the best mathematical description of this curve for autobiographical memories (Crovit & Schiffman, 1974; Rubin, 1982; Rubin & Wenzel, 1996).

The second component is *childhood amnesia*—that is, a reduction of memories coming from the first years of life. Childhood amnesia has strong empirical support and many competing explanations (e.g., Bruce, Dolan, & Phillips-Grant, 2000; Eacott & Crawley, 1999; Nelson, 1993; Pillemer & White, 1989; Rubin, 2000).

The childhood amnesia component is almost always found, but the retention component is absent for vivid and important memories among older adults, who judge their vivid and important memories as coming from childhood and early adulthood, not from their recent past.

The third component is *the bump*: Substantial evidence documents that for people over the age of 40, information encoded during adolescence and early adulthood is remembered better than information encountered in the surrounding periods of life (see Rubin, Rahhal, & Poon, 1998, for an overview). The bump was pointed out by Rubin et al. (1986) in a reanalysis of data from several studies on word-cued autobiographical memories. The distribution of the memories across the life span deviated from a monotonically decreasing curve by showing an increase in memories from the second and third decades of life.

The bump has been found in studies on word-cued memories (Hyland & Ackerman, 1988; Jansari & Parkin, 1996; Rubin et al., 1986; Rubin & Schulkind, 1997a, 1997b), by asking for partici-

Table 1
Questions Presented to Respondents

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1. At some point in their life, many people have experienced an extremely happy event that they recall with much happiness and warmth. If you have at least one very happy memory from your life, how old are you in your happiest memory?
 2. At some point in their life, many people have experienced an extremely sad event that they recall with much sadness and sorrow. If you have at least one very sad memory from your life, how old are you in your saddest memory?
 3. At some point in their life, many people have had an extremely important experience which made big changes in their life or outlook and which they recall as an epoch-making event. If you have at least one memory of an epoch-making event, how old were you when your most epoch-making event took place?
 4. At some point in their life, many people have experienced a traumatic event in which they or someone else was seriously injured, maybe their own life or the life of someone else was in serious danger, and they were feeling deeply shocked, helpless, very afraid, and did not know what to do. For example, traumas may include serious accidents, assaults, abuse, the sudden death of somebody, life-threatening diseases, military combat, torture, etc. Please look back upon your life and consider whether you have ever experienced an event that was traumatic to you. If you have at least one traumatic memory, how old are you in your most traumatic memory?
 5. Sometimes a memory about our past suddenly pops up in our mind with no preceding attempts at remembering. The memory may seem to arise from nothing or it may come as an association to, for example, a sound, or a smell, or a song on the radio, etc. Some sudden memories may deal with old experiences, others with things that have happened recently. How often does it happen to you that memories suddenly pop up by themselves?
 6. Try to remember the last time you noticed a memory that suddenly popped up by itself. How old were you in the event that this memory was dealing with?
 7. Try to remember the last time you noticed a memory that popped up by itself. Was this memory dealing with a happy or sad event in your life?
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Table 2
Predictions

Main predictions
<ol style="list-style-type: none"> 1. On the basis of a cognitive account of the bump, we should expect a bump for memories of the happiest, saddest, most important, and most traumatic events as well as for involuntary memories. 2. On the basis of a narrative/identity account of the bump, we should expect a bump for memories of the most important, the saddest, and the most traumatic events as all of these are highly likely to go into the life narrative of identity formation. We should expect also a bump for memories of happiest events to the extent that they provide closure. Memories retrieved involuntarily should not deviate from this pattern. 3.^a To the extent normative life scripts organize autobiographical memory, memories of the happiest and most important events should form a bump, whereas the distribution of memories for the saddest and most traumatic events should be relatively flat, because they are unlikely to be part of the life script. This pattern should be found for both voluntary and involuntary memories. 4. On the basis of a biological explanation of the reminiscence bump, we should expect a bump for memories of the happiest, saddest, and most traumatic events and for involuntary memories. 5. On the basis of the actual distribution of emotionally charged events across the life span, we assume respondents' saddest and most traumatic memories to form a bump from age 20 to 40 and the happiest events to be more evenly distributed across all ages.
Modifications and post hoc explanations
<p>Modifications of the cognitive account</p> <ol style="list-style-type: none"> 1A.^a On the basis of a cognitive account of the bump in combination with the observation of social censure of negative events, we should expect a bump for the happiest and the most important events whereas memories for the saddest and the most traumatic events should show a less pronounced bump or no bump at all because they are less likely to be rehearsed. 1B.^a On the basis of the cognitive account in combination with the observation that negative events are followed by more life change, we should expect memories for the happiest and most important events to form a bump, whereas memories for the saddest and the most traumatic events should show a less pronounced bump or no bump at all because they are less likely to be rehearsed. 1C.^a Following Walker et al. (1997), memories for the saddest and the most traumatic events show a more pronounced recency effect than memories for the happiest events due to asymmetrical fading of emotional intensity with negative events fading more rapidly than positive events. <p>Modifications of the narrative/identity account</p> <ol style="list-style-type: none"> 2A.^a On the basis of a narrative/identity theory of the bump and the idea of social censure, both memories for the saddest and most traumatic events are less likely to be narrated and should show a less pronounced bump or no bump at all, compared to memories of the most important and the happiest events. 2B. On the basis of a narrative/identity account of the bump in combination with dissociation theory, we should expect a bump for memories of the most important, happiest, and saddest events, whereas memories for most traumatic events are less likely to be narrated and should show a less pronounced bump or no bump at all. 2C.^a On the basis of a narrative/identity account of the bump in combination with the psychoanalytic theory of repression, both memories for the saddest and most traumatic events are less likely to be narrated and should show a less pronounced bump or no bump at all, compared with memories of the happiest and most important events. 2D.^a On the basis of the notion of nostalgia and Schulster's idea of a generational "era" in young adulthood, the happiest and most important memories should be part of the bump whereas the saddest and most traumatic memories should show ordinary forgetting. <p>Modifications of the biological account</p> <ol style="list-style-type: none"> 4A. On the basis of the literature of aversive learning, respondents' most traumatic memories should be older than their happiest, saddest, and most important memories. <p>Additional assumptions derived from emotion literature</p> <ol style="list-style-type: none"> 6. On the basis of dissociation theory, the distribution of memories over the lifespan should be qualitatively different for the most traumatic memories. 7. On the basis of dissociation theory, the combined effects of immediate dissociation and delayed recall should result in more traumatic memories from the respondents' remote past than from the recent past. 8.^a On the basis of the psychoanalytic literature on repression, the distribution of the most traumatic and saddest memories should be qualitatively different from the distribution of the happiest and most important memories, but not qualitatively different from one another.

^a Indicates correct predictions.

parents' most vivid memories (Cohen & Faulkner, 1988; Fitzgerald, 1988), their most important memories (Fitzgerald, 1996; Rubin & Schulkind, 1997a, 1997b), their life narrative (Fromholt & Larsen, 1991, 1992) by asking participants to indicate their most important

events on a time line (de Vries & Watt, 1996) and by asking them to rank order a series of personal life events according to their perceived impact (Martin & Smyer, 1990). When Rubin and Schulkind (1997b) compared the same older adults, their bump for

word-cued memories was from when they were 10 to 30 years old, but their bump for important memories was from age 20 to 30. A bump has also been found in some studies addressing factual information acquired at different periods of life, such as knowledge of historical, political, and cultural events (Belli, Schuman, & Jackson, 1997; Rubin et al., 1998; Schuman & Rieger, 1992). This article is mainly concerned with the bump. No prior studies have examined the distribution across the life span of emotionally charged autobiographical memories or of memories retrieved involuntarily. Thus, on the basis of the previous findings in this area, no differences can be predicted for extremely pleasant and unpleasant memories, nor for involuntary versus voluntary memories.

Possible Accounts of the Bump

A variety of explanations has been suggested to account for the bump. According to Rubin et al. (1998), possible explanations can be divided into three main classes: a *cognitive account*, a *narrative/identity account*, and a *biological/maturational account*. Here we add a *life script* account, and we consider an explanation based on the actual distribution of emotionally charged events across life.

A cognitive account. Rubin et al. (1998) assumed a memory advantage for novel and distinctive events that are followed by a longer period of relative stability. Such events are remembered better because they are subject to more elaborate cognitive processing due to their novelty, and because they are distinctive compared with earlier events, and therefore are subject to less proactive interference. Because they are followed by a period of little change, they often serve as reference points for later organization. The period of relative stability following the events also increases the stability of the cues and increases the chances for spaced practice. All of these characteristics improve the encoding and subsequent accessibility of events in this period of life, they argue.

For people living a traditional life in a Western culture, the period between the age of 15 and 25 can be described as a transition period followed by a longer period of relative stability. For that reason, when averaging across many participants, an increase in memories from this period is found. However, in a different population with important transition periods earlier or later in life, the bump would be located differently along the time axes of the life span, according to this explanation. Studies on autobiographical memories among immigrants and others whose world changes dramatically support this assumption (Conway & Haque, 1999; Schrauf & Rubin, 1998, 2000). The cognitive explanation as formulated by Rubin et al. (1998) predicts no differences among different emotional contents or between involuntary and voluntary memories (cf. Prediction 1 in Table 2).

A narrative/identity account. According to this account, memories are built into the identity via narratives. Young adulthood is seen as a critical period for the formation of an adult identity. Therefore, this period has a privileged position in the life narrative. In this view, the bump is due to a "preferential retention of events from a period of consolidating of the self," as expressed by Conway and Pleydell-Pearce (2000, p. 280). Narratives are considered to be an important vehicle for the integration of diverse experiences into a sense of personal identity because they impose a perspective, a temporal order on distinct experiences, and draw

attention to causal and thematic relations between unique events (Barclay, 1993; Bruner, 1987; Fitzgerald, 1988; Gergen & Gergen, 1983; Habermas & Bluck, 2000; Robinson, 1996). Habermas and Bluck argued that the ability to create coherent and integrated life narratives develops only in adolescence. Their claim is consistent with the idea that the bump reflects the development of narrative structures in support of an adult identity.

As pointed out by Bluck and Habermas (2000), life narratives do not consist of single memories of important events, such as goal attainments. Typical goals to be attained in life—for example, graduation, marriage, childbirth, and the order in which they are expected to be reached—are part of the *life script*, to be described later. *Life narratives*, on the other hand, are considered here as the description and explanation of how the individual reached the desired and expected goals and developed his or her personal identity when faced by outer challenges. We consider two pertinent examples of this connection between narratives and identity to make clear the importance of both positive and negative events in life narratives (but not in life scripts): one from psychology and one from literature.

According to Erikson's (1963) theory of psychosocial development, a mature personal identity emerges in late adolescence. At this time in life, a person tries to discover who he or she is socially, vocationally, and ideologically and tries to merge these components into a coherent adult identity. In a subsequent phase in young adulthood, the developmental task is to learn to show intimacy and establish stable relationships characterized by commitment, solidarity, and mature sexuality. Many memory theorists have taken their starting point in this and related views on young adulthood. For example, Holmes and Conway (1999) found that memories of public events showed a bump in adolescence whereas memories of private events showed a later bump in the 20s, and related their findings to Erikson's (1963) theory.

Erikson (1963) posited eight developmental stages, each characterized by a struggle for a sense of identity, an experience of "sameness and continuity" (p. 261) in the face of major changes in mental and physical abilities, social roles, and societal duties. The central theme and time-demanding part of each stage is the attempt at solving a particular developmental and existential task and thereby maintaining a personal sense of identity, challenged by changes in life. Phrased in narrative terms, the story about each stage deals with this struggle and ends with the outcome.

This role of narratives in relation to identity formation is also observable in fictional literature, most clearly in the so-called *Bildungsroman* (educational novel) in which the social and emotional development of one single individual is described typically from this person's childhood till he or she settles down and establishes a family in young adulthood (Lorenzen, 1976). The *Bildungsroman* was a dominant genre in European literature during the romantic period in the nineteenth century. Among the more famous examples are usually counted Goethe's *Wilhelm Meister*, Fielding's *Tom Jones*, Dicken's *David Copperfield*, and Brontë's *Jane Eyre* (Beck, 1999; Harner, 1974).

The *Bildungsroman* is described as depicting three stages. The first stage is childhood usually characterized by stability and harmony. The second stage is adolescence, during which the person tries his or her wings, questions authorities and well-established values earlier taken for granted, and experiences confusion between old and new roles. In the third stage, the protag-

onist discovers his or her true goals and values in life, often through commitment to a person of the opposite sex, and typically settles down and develops a family (Beck, 1999). The life course as depicted in modern literature often violates this pattern by describing instability and disharmony in childhood and by not providing closure. Thus, the modern novel focuses even more on the troublesome aspects of life than the classical Bildungsroman.

Erikson's (1963) model of psychosocial development and the development of personal identity depicted in the Bildungsroman both have stages and ideal expectations as to what is supposed to be accomplished in the different phases of life. Both are more concerned with the struggle to reach the expected goal states than the goal states themselves. The emphasis on upsetting events is even more pronounced in modern literature. Thus, if the bump reflects the way individuals narrate about the development of their adult identity, it should contain memories of important and troublesome events, and happy events to the extent that they provide closure. Memories retrieved involuntarily should not deviate from this pattern (see Prediction 2 in Table 2).

Life scripts. Life script refers to normative expectations within a given culture to the patterns of individual life courses, such as the developmental changes that are expected to take place at various points in life and the different life phases that people are expected to live through at different ages (Bluck & Habermas, 2000; Clarke, 1995; Heckhausen & Krueger, 1993; Ruth, Birren, & Polkinghorne, 1996).

It is important to keep the notion of life script separate from that of life narrative. Life script is generic (it deals with cultural norms and expectations to the content and order of a typical life course), whereas a life narrative is concrete (it deals with the individual life as actually lived, reconstructed, and narrated by a concrete individual). Life script is nonpersonal (it applies to all normal members of the culture), whereas life narrative is personal (it applies to only one person). Life script deals with cultural expectations, whereas life narrative deals with personal memories. Life script represents shared public knowledge, whereas life narrative refers to private knowledge that is shared with very few people, such as friends or family. Life script deals with a fixed temporal order of events, whereas life narrative deals with a lived temporal order. Life script is a form of semantic knowledge, whereas life narrative represents autobiographical knowledge characterized by a belief in the truthfulness of the memories and a reliving of their perceptual content. Though a life script may help to structure an individual life story, the two representations may also conflict with one another. For example, getting pregnant before marriage is considered script deviant in many cultures, while the preservation of this particular order of events would be crucial in the life narrative to specify the difficulty and emotional stress experienced by the individual. In fact, conflict with life script may be one criterion for including a particular event in the life narrative. In literature, this conflict is often a central theme. Moreover, as just reviewed, life narratives deal mainly with overcoming obstacles to obtain desirable goals, whereas life scripts deal mainly with important goals in life and their expected order and tell little about how such goals are to be attained in the individual life.

We have been unable to locate any studies that examine people's life scripts for extremely positive and negative events—that is, studies that address in which decades of life such events are most likely to take place, according to shared cultural expectations.

Thus, we cannot know for sure when in life people's happiest, saddest, most important, and most traumatic events are expected to take place according to shared cultural norms. However, our intuition tells us that sad and traumatic events are not culturally expected events, in the sense that no specific time slot is allocated to such events. This intuition is consonant with the common social psychological observation that highly negative events are unexpected and conflict with basic assumptions about the world and the self (e.g., Janoff-Bulman, 1988; Janoff-Bulman & Berg, 1998). It is also supported by the fact that even the notion of midlife crisis (a relatively well-established notion in popular culture) is temporally indefinite. Wethington (2000) found that people's estimates of time for the onset of a midlife crisis varied from 17 to 75 years. Many of her participants located a midlife crisis well before age 40 or after age 50. Also, de Vries, Blando, Southard, and Bubeck (2001) asked young, middle-aged, and old participants to identify their worst and their best times in their life, based on both their memory and expectations for the future. All age groups identified the immediate past and immediate future as the best time, whereas the worst time in life was not related to a specific age. Their findings support the idea that no time slot is allocated to bad experiences. For a similar argument based on the expected time for losses and gains of desirable personality characteristics in a typical life course, see Heckhausen and Krueger (1993) and Heckhausen, Dixon, and Baltes (1989).

While highly bad events appear to deviate from our culturally sanctioned expectations, most important and positive transitional events are supposed to take place between age 15 and 30 (see review by Neugarten & Hagestad, 1976). Thus, to the extent that life scripts structure memory, we should expect only memories of the happiest and most important events to form a bump, whereas the distribution of memories for the saddest and most traumatic events is expected to be relatively flat. A similar pattern should be found for involuntary memories (see Prediction 3 in Table 2).

A biological/maturational account. Most cognitive abilities improve from childhood to adulthood and decrease later in life. A straightforward suggestion might be that the bump simply reflects such improvement and decrease in cognitive abilities across the life span. However, a general rise and fall of cognitive abilities cannot account for the bump directly. Standardized tests of memory and intelligence and laboratory tests of processing speed show an improvement from childhood to early adulthood that could match the beginning of the bump, however, the decline that follows is too slow. Linguistic abilities and crystallized intelligence stay at a high level for most of adult life, which is inconsistent with the shape of the bump.

Rubin et al. (1998) also provided some evolutionary arguments for the idea that early adulthood might be especially favored by nature with respect to cognitive skills either because it is when people have the greatest potential to reproduce, or because until very recently there was little selection pressure to maintain abilities beyond that period, or because it increases the value of older adults to a group by maintaining information not available to younger adults. The biological/maturational account presented by Rubin et al. does not specify any differences related to the emotional charging of the memory material or to involuntary versus voluntary retrieval (see Prediction 4 in Table 2).

The actual distribution of emotionally charged events across life. A fifth possible explanation is that the bump simply reflects when in life the most important things take place. The period covered by the bump is the time when most people finish their education, settle down, get married, and establish a family. Thus, it can be argued that more consequential events take place during this time than in other periods of life. When asked to recall important events, more events are consequently recalled from this time period than from other periods of life. If this account is valid, no psychological explanation is needed.

Though this explanation cannot account for all findings of the bump, it should be considered as a possible explanation of the distribution of people's memories of the saddest, happiest, and most traumatic events. Are such events evenly distributed across life when averaging across many people, or are some periods more likely than others to contain one or more of these classes of experiences? For example, one might expect young adulthood to be dominated by happy events, old age might set the stage for intensely sad events in terms of multiple losses, and middle age (by a similar intuition) could be the typical time for traumas in terms of the first shocking confrontations with one's own mortality followed by emotional and existential confusion. This commonsense account is somewhat similar to earlier, but now rejected, theories on the development of affect. Several more recent studies have shown that older adults have lower scores on measures of both frequency and intensity of negative affect. Thus, contrary to commonsense ideas, negative affect is reported and observed less often in older adults than in younger adults. Similar findings have recently been obtained in a study of young (20–35 years old) and old people (70–85 years old) in a Danish population (Kierkegaard, Mehlsen, Munk, Viidik, & Zachariae, 2001). Positive affect is associated with more mixed results. According to some studies, its prevalence increases with age; whereas, in other studies, it remains stable across life (see Charles, Reynolds, & Gatz, 2001; de Vries, Blando, Southard, & Bubeck, 2001; Mroczek, 2001, for reviews).

Because emotionality is subjective by definition, and because the findings indicate that, with age, people become less and less likely to experience negative affect, we should assume that what people actually experience as their saddest and most traumatic events are incidents that take place relatively early in life. General data for the Danish population from which our respondents were sampled give a clearer indication of when in life the most traumatic and saddest events take place. All residents of Denmark are offered financial support by the public health insurance to cover psychotherapy in response to a range of deeply sad and traumatic events. This therapy must be in response to extremely negative events of the type we asked our respondents to remember. Danmarks Statistik (the national databank in Denmark; see <http://www.statistikbanken.dk>) contains information about the number of such therapeutic sessions for each age group. This psychotherapy is given if and only if recommended by the individual's general practitioner. Thus, an independent assessment of the severity of the incident and its emotional impact on the person precedes the therapy. The therapy is offered to the following individuals: (a) victims of robbery, (b) victims of violence, (c) victims of rape, (d) victims of motor accidents, (e) victims of other accidents, (f) family and close friends to seriously mentally ill persons, (g) persons suffering from seriously disabling diseases, (h) family and close friends to persons suffering from seriously

disabling diseases, (i) family and close friends at death, (j) persons who have attempted suicide, and (k) women who have had an abortion due to medical deformity of the fetus after the 12th week of pregnancy (Dansk Psykolog Forening, 1999). Figure 1 shows the number of therapeutic sessions supported by the health insurance in each age group in 1999. As can be seen, there is a pronounced peak from age 20 to 40, after which the frequency drops.

Figure 1 is consistent with the literature on developmental trends in the experience of affect described earlier, according to which we assume that the saddest and the most traumatic events take place relatively early in life. Because the same literature describes either a slight increase or a stability in the level of happiness across life, we assume the actual life span distribution of people's happiest events to be relatively flat (see Prediction 5 in Table 2).

Method

The data were collected by Gallup Public, Denmark, as part of an omnibus survey. A representative sample of the Danish population above age 16 participated. Respondents were selected from all geographic areas of Denmark except Greenland and the Faroe Islands. All respondents were able to speak and understand Danish. In each household, 1 or 2 respondents were randomly selected via a combined criterion based on the number of household members above age 16 and their birthdays. Response rates for the entire omnibus were 60%.

Participants

Only respondents above age 19 answered the questions relevant for the present study. Table 3 shows the number of male and female respondents sorted by decade of life, and the number of respondents in each age group who answered each question by giving a date or by explicitly stating that they had no memory of that type. The relatively low number of reports on traumatic memories reflects that many respondents stated that they had never had a traumatic experience. Of the 476 who gave no date in response to involuntary memories, 155 responded that they never had involuntary memories, and 321 that they were unable to recall the last time they noticed

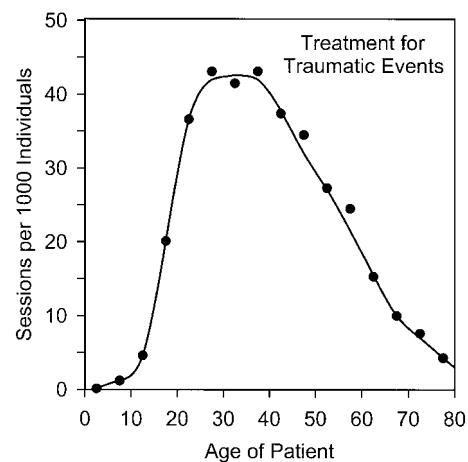


Figure 1. Number of psychotherapeutic sessions per 1,000 individuals in response to traumatic and sad events in 1999 in Denmark, by age of the patient.

Table 3
Description of Participant Population and Number of Participants With Dated Memories and With No Memories

Age range	N	Women (n)	Age	No. of respondents with a date or with no memory									
				Important		Happiest		Saddest		Traumatic		Involuntary	
				Date	No	Date	No	Date	No	Date	No	Date	No
20–29	203	112	24.89	152	43	162	25	166	28	106	93	129	47
30–39	244	138	34.61	186	43	214	11	199	30	136	91	139	56
40–49	235	117	44.23	162	62	191	27	194	31	124	98	134	56
50–59	228	119	54.17	166	46	181	27	187	23	131	85	117	61
60–69	147	73	64.61	90	43	109	17	122	18	79	57	62	47
70–92	184	113	77.53	104	65	126	27	145	27	82	87	67	54
Total	1,241	672	48.35	860	302	983	129	1,013	157	658	511	648	476

Note. No refers to no memories.

an involuntary memory. No dates were provided to any of the five questions requesting a date by 53 of our 1,241 respondents.

Procedure

The data were collected by 130 interviewers via face-to-face interviews in the respondents' homes. The questions relevant for the present study were part of a larger data collection conducted by Gallup addressing a variety of topics. Questions of relevance for the present study were preceded only by demographic questions, such as the respondents' marital status, occupation, income, level of education, and number of children. The interviews were conducted in Danish. An English version of the questions for the present study is presented in Table 1, with questions in the same order as they were asked. Question 4 was formulated to match the official criteria for a traumatic event according to the *Diagnostic and Statistical Manual of Mental Disorders (DSM-IV;* 4th ed.; APA, 1994). Each of the seven questions presented in Table 1 was followed by a limited number of response options. Response options for Questions 1–4 were as follows: (a) "I was around [age in event] years old," (b) "I have no very happy memories/no very sad memories/no memories of epoch-making events/no memories of traumatic events in my life," and (c) "I don't want to answer." Response options for Question 5 were as follows: (a) "It never happens to me," (b) "It happens some times a year," (c) "It happens some times a month," (d) "It happens some times a week," (e) "It happens some times a day," and (f) "I don't want to answer." Response options for Question 6 were as follows: (a) "I was around [age in event] years old," (b) "I don't recall the last time I noticed a memory that popped up by itself," and (c) "I don't want to answer." Response options for Question 7 were as follows: (a) "happy," (b) "sad," (c) "mixed," (d) "I don't recall the last time I noticed a memory that popped up by itself," and (e) "I don't want to answer."

The interviewer recorded responses on a laptop computer. To ensure understanding, each question and the response options for each question were printed on a demonstration card that was shown to the respondent while the question was being asked. Or, if the respondent preferred, he or she could read the questions and response options directly from the computer screen. If the respondent found one or more questions too intimate, he or she was offered the opportunity of typing his or her responses to the questions directly on the computer while the screen of the computer was turned away from the interviewer so that interviewer would not know the respondent's answer.

The questions for the present study were introduced by a brief explanation clarifying that the questions were about memories from the respondent's personal life. It was stressed that the respondent did not have to answer the question if he or she found them too private. It was also stressed

that the purpose of the study was scientific and that no political or financial interest was involved.

Results

The Distribution of Emotionally Charged Memories

Figures 2, 3, 4, 5, and 6 present the basic results of our study. Each figure presents the separate results of respondents in their 20s, 30s, 40s, 50s, 60s, and those in their 70s and above. To present all groups in one panel for each question, each younger group is offset by 0.2 so that the curves do not overlap. Because this causes the y-axis to go from 0 to 1.6 instead of from 0 to 0.5, it compresses the visual differences by a factor of three. Figure 7 presents the data from Figures 3, 4, and 6 for the 60-year-old respondents only and thus provides a more conventional view of the data. For all figures, the proportion of memories in the most recent decade was corrected for the fact that participants in that decade had, on average, lived only through about half of the decade. To do this, the mean number of years lived past the decade

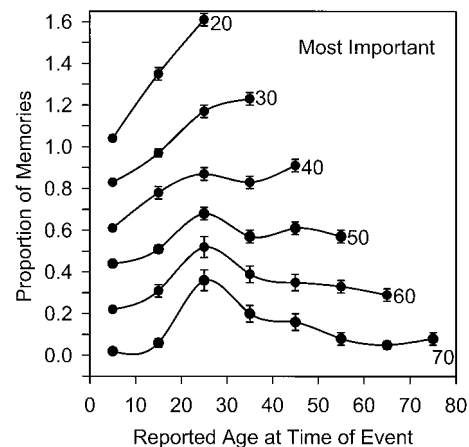


Figure 2. The distribution of most important autobiographical memories. Each decade age group is labeled by the youngest age included and is offset by 0.20 from the next oldest age group to make all plots visible. Standard errors are shown for all plots.

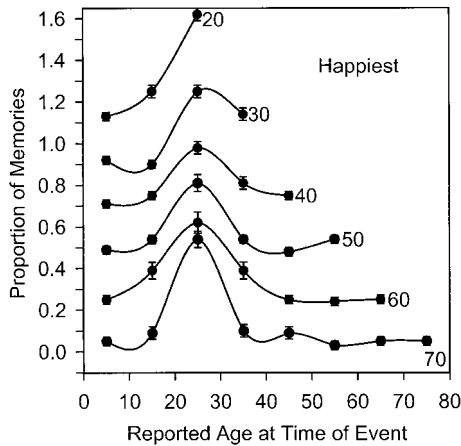


Figure 3. The distribution of happiest autobiographical memories. Each decade age group is labeled by the youngest age included and is offset by 0.20 from the next oldest age group to make all plots visible. Standard errors are shown for all plots.

boundary was calculated as the mean age of the participants in that group plus 6 months (because participants who reported their age as n years old, on average, had actually lived n and a half years) minus the decade boundary. This number was then divided into 10 (the number of years in the decade) and multiplied by the number of memories observed in that decade before the proportions shown in the figures were calculated. For instance, the average age of the participants in their 50s was 54.17. They produced 15 saddest memories in their 50s. We multiplied $15 \times 10 / (54.17 + 0.50)$ to infer that there would have been 32 memories in the decade if all participants would have been tested the day before their 60th birthday.

Figures 2–6 present the probability of a memory being reported in each decade of life along with a standard error bar equal to the standard deviation in the mean calculated as $\sqrt{[(p)(1-p)/n]}$. Given the large number of respondents, the standard errors are

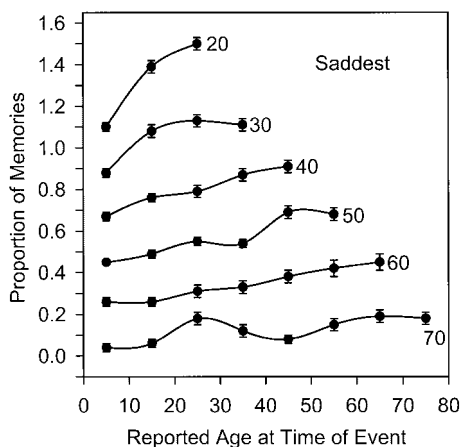


Figure 4. The distribution of saddest autobiographical memories. Each decade age group is labeled by the youngest age included and is offset by 0.20 from the next oldest age group to make all plots visible. Standard errors are shown for all plots.

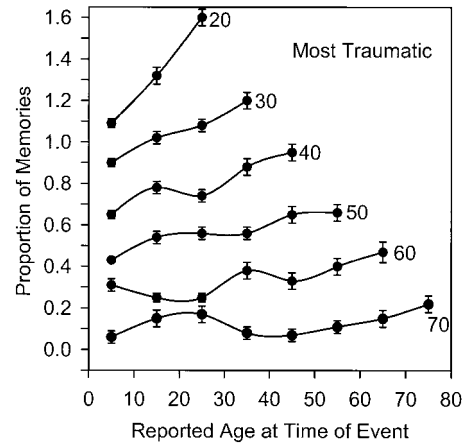


Figure 5. The distribution of most traumatic autobiographical memories. Each decade age group is labeled by the youngest age included and is offset by 0.20 from the next oldest age group to make all plots visible. Standard errors are shown for all plots.

small (.06 or less in all cases and .04 or less in all but six cases) and, therefore, at times are hidden behind the dots indicating the means. The results are robust. Within each figure, the differences we mention are greater than two standard errors, and, more important, they vary in incremental, systematic ways for the six age groups shown in each figure. The possibility of such patterns occurring by chance is exceedingly small.

Figure 2 presents the data for people's memory of their most important event. There is a peak in the 20s for all respondents over age 40, which becomes more pronounced with older respondents. Younger respondents reported memories for important events that happened recently, older respondents for events that occurred in their early adulthood. The results for the respondents who were in their 20s, 30s, 60s, and above 70 present the same picture that Rubin and Schulkind (1997b) found for participants who were exactly 20, 35, 70, or 73 and who were asked in a laboratory

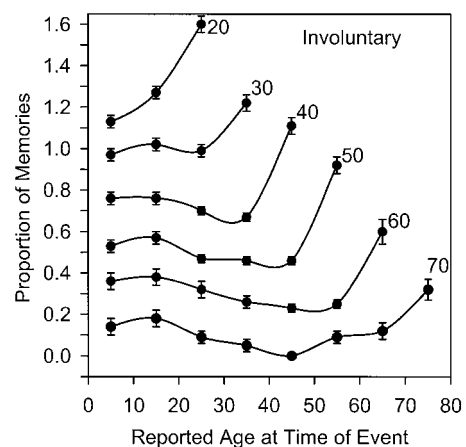


Figure 6. The distribution of involuntary autobiographical memories. Each decade age group is labeled by the youngest age included and is offset by 0.20 from the next oldest age group to make all plots visible. Standard errors are shown for all plots.

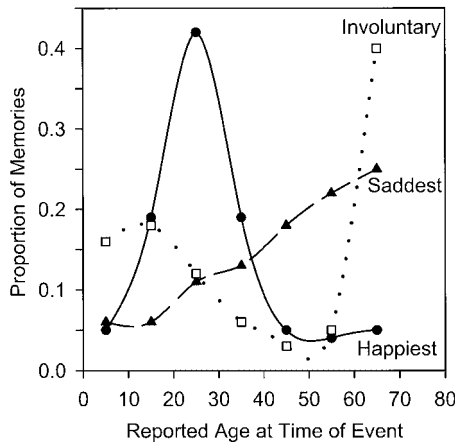


Figure 7. The distribution of happiest, saddest, and involuntary autobiographical memories of the participants in their 60s taken from Figures 2, 3, and 5.

setting for their five most important memories. This conceptual replication offers confidence in both the laboratory and survey results. The survey lacked the formality and more detailed questioning of the laboratory, but had researchers who were completely unaware of any hypotheses and tested individuals in their homes who do not usually take part in psychological experiments.

Figure 3 presents the data for people's memory of their happiest event. The pattern is similar to that of Figure 2, but the bump in the 20s is even more pronounced and is evident even for the respondents in their 30s.

Figure 4 presents the data for people's memory of their saddest event. The data are as orderly and internally consistent as the first two figures, but show a fundamentally different pattern. For all age groups, the data can be accounted for by a monotonically decreasing retention function, such as what one might choose for slow forgetting of emotionally neutral laboratory material. There is a bump in the 20s for the oldest participant group, but it is much smaller than for the important or happiest memories and does not occur for any other age group.

Figure 5, which is for people's most traumatic memory, is similar to Figure 4, though a bit noisier. Neither figure shows convincing evidence for the bump, though both show some indication of a bump only for the oldest respondents. Both are consistent with normal forgetting, and both are dramatically different from the distribution of deeply sad and severely traumatic events across different ages, as indicated by Figure 1.

Figure 6 presents the data for people's involuntary memory. This is the only question that did not ask for an extreme of importance or emotion. The data for involuntary memories are remarkably similar to those presented by Rubin and Schulkind (1997b) for participants aged 20 and 73 who were biased to produce earlier memories. These participants were asked to provide one memory for each of 124 cue words in an autobiographical memory experiment. For both of these word-cued memories and the involuntary memories, there is a bump that peaks in the teens and a marked recency effect.

The distributions in Figures 2 and 3 are similar and the distributions in Figures 4 and 5 are similar, but they differ from each

other and from the involuntary memories. To show this more clearly and to provide a summary of the results that is not diminished by the compression caused by putting many age groups on one plot, Figure 7 reproduces the data from respondents in their 60s from Figures 3, 4, and 6. Data from Figures 2 and 5 and error bars were not included to make the pattern as clear as possible. Respondents who were in their 60s were chosen for comparison with much of the data in the cognitive aging literature.

Differences in Distributions as a Function of Valence

Comparing Figures 3 and 4 and Figures 2 and 5, we found that happiest memories occurred at an earlier age than saddest memories (23.97 vs. 30.23), $t(847) = 10.22, p < .001$, and that important memories occurred at an earlier age than traumatic memories (27.89 vs. 29.64), $t(501) = 2.70, p < .01$, (the means given are for all respondents; the means for the matched t tests, which include only respondents answering both questions, are 23.90, 29.86, 27.27, and 29.05, respectively). This is counter to our expectations and counter to data we had collected on traumatic memories from young adults (Berntsen, 2001). To examine this issue further, we subtracted the age of the saddest memory from the age of the happiest memory of the same individual who had both kinds of memories and plotted the difference scores and their standard errors as a function of the age of the participant in Figure 8. The results of subtracting the most traumatic memory from the most important are also shown. Figure 8 shows clear age trends. These appear to be the result of the happiest and most important memories coming from the decade of the 20s, whereas the saddest and most traumatic memories come from the most recent decade of life, and as the age of our respondents increases, so does this difference.

To investigate the role of emotions in involuntary memories, we sorted all involuntary memories dated in Question 6 by whether they were judged to be happy, sad, or mixed in Question 7. There were more happy than mixed or sad involuntary memories (342, 149, and 130, respectively) $\chi^2(2, N = 62) = 132.94, p < .001$. To

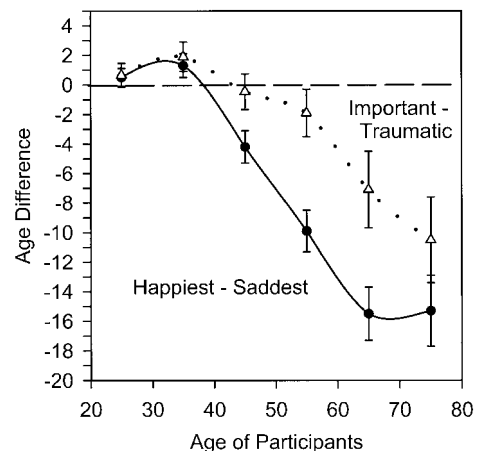


Figure 8. The mean age difference for happiest minus saddest and for most important minus most traumatic memories. Standard errors were calculated only for participants who answered both questions producing the difference.

look at the age distribution shown in Figure 6 as a function of emotion, we made two figures. Figure 9 combines the data of all respondents. Unlike all other figures included in this article it plots the data as a function of how old the memory was (i.e., the respondent's current age minus their age at the time of the memory), not how old the participant was at the time of the memory. It is therefore a retention function. We restricted the plot to the most recent 20 years as all respondents were at least this old. We plotted data for the most recent 2 years separately and then combined each of the next 2-year periods to make the plot less noisy. For the most recent year, we doubled the frequencies, because respondents, on average, had lived through only half of the year at the time of testing. Given the steepness of the retention function, this doubling of 6 months data to use as an estimate of 12 months data caused an exaggeration of the frequency for the most recent year. Even if we used 6 months data as an estimate of the whole year, there would still be a sharp drop, with most of the memories coming from the last year. Happy, sad, and mixed emotion memories follow similar curves, with happy memories remaining numerically higher at all points.

Figure 10 combines all participants who were 50 or older and plotted their data up to their 40s. In this way, we included as much data as we could without including the recency portion of the curves shown in Figures 6 and 9. The difference between happy and sad involuntary memories is like the difference between the happiest and saddest voluntary memories in that the sad memories show no bump. The happy and sad memories shown in Figure 10 have different distributions, $\chi^2(5, N = 113) = 13.42, p < .05$. Although there are many more happy memories than sad memories in the first two decades of life (57 vs. 14), there are an equal number of happy and sad memories in the next three decades (21 vs. 21). Note that the rating of valence came after the dating of the memories, so it cannot be a search strategy for happy and sad memories that led to this result.

The mean rating of the frequency of having an involuntary memory was 2.74 ($SE = 0.03$), in which 2 was "It happens some times a year" and 3 was "It happens some times a month." Women had a somewhat higher frequency than men (2.83, $SE = 0.05$

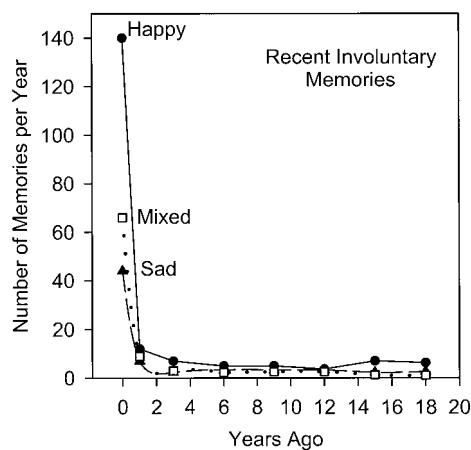


Figure 9. The retention function for happy, sad, and mixed involuntary memories for all participants. This is the only figure plotted in time since the event and not age of the participant.

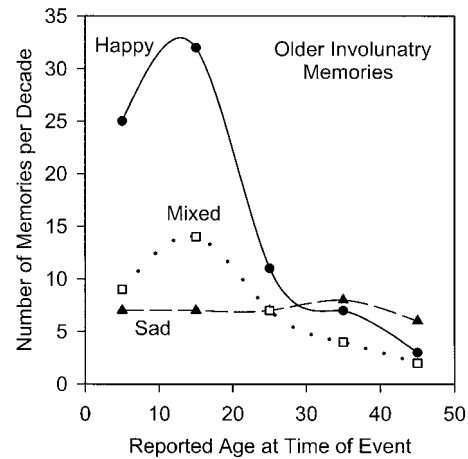


Figure 10. The distribution of happy, sad, and mixed involuntary memories from age 0 to 50 for those participants who were 50 years old or older.

vs. 2.63, $SE = 0.05$), and there was a general trend toward a decrease in reported frequency over the ages tested from the 20s to the 70s: 2.92 ($SE = 0.07$), 2.84 ($SE = 0.08$), 2.70 ($SE = 0.07$), 2.65 ($SE = 0.08$), 2.69 ($SE = 0.11$), and 2.65 ($SE = 0.10$), respectively.

Other Empirical Support

We could find only few hints in the published literature at the difference between the retention of positively and negatively valenced memories. Siegler and George (1983) interviewed 50 men and 50 women between the age of 55 and 78. As part of that study, participants were asked to remember the best and worst events of their lives. The mean age of their participants was 66 and so we doubled the number of memories from the decade of the 60s and present the data in Figure 11. For the participants' best events, there is a bump, but for their worst events the distribution is flat after the first two decades of life. Given the lack of prior research on the bump, Siegler and George made little of this difference.

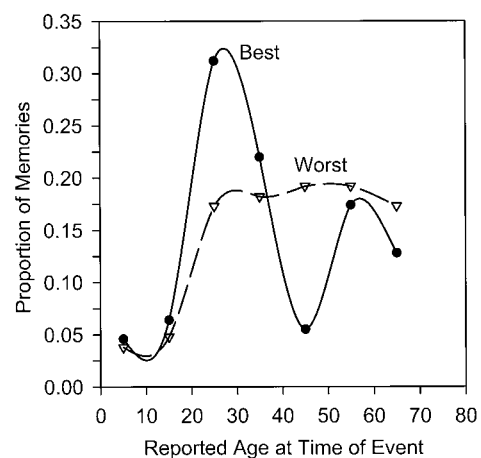


Figure 11. The distribution of best and worst autobiographical memories of the participants interviewed in Siegler and George (1983).

Rubin and Schulkind (1997a) reported on the five most important memories of 60 participants whose age was either 70 or 73. These participants showed a sharp peak in the distribution of their memories in the 20s. Ratings of pleasantness on a 7-point scale, with responses ranging from 1 (*equal to my most unpleasant memory*) to 7 (*equal to my most pleasant memory*), were available for these memories, and so we reanalyzed them, combining ratings of 1 and 2 as *unpleasant*, 3, 4, and 5 as *neutral*, and 6 and 7 as *pleasant*. Seventy-two percent of the memories were rated as pleasant. Only 12% were rated unpleasant, and 16% were rated as neutral. The life span distributions of these three classes of memories are shown in Figure 12. Consistent with the results obtained in the present study, Figure 12 demonstrates a larger bump for pleasant memories than for unpleasant memories, whereas there are more unpleasant memories from the most recent decades. There is not a complete absence of a bump for unpleasant memories as in the current data, but these memories were chosen as the most important, not as the most unpleasant. The data shown in Figure 12 are based on the 300 memories no matter which participant the memory came from. To provide a statistical test, we calculated the average age of the participant at the time of their memories for pleasant, neutral, and unpleasant memories. Because five memories were being sorted into three bins and because unpleasant memories were less common, there was substantial missing data. The mean age of the participants in the pleasant and unpleasant memories (averaging over the data for each participant rather than each memory) was 33.57 and 40.63 years, respectively, with 54 and 20 participants having at least one memory of each kind. The unpleasant memories occurred later in life than the pleasant ones, $t(16) = 2.31, p < .05$. The rating of valence was done after the dating; no search strategy for positive versus negative memories can account for the findings. Thus, data from both Siegler and George (1983) and Rubin and Schulkind provide independent support for the basic difference in the distribution of happiest and saddest memories found using different methods.

Discussion

Memories of the happiest and the most important events formed a clear bump in the 20s; the saddest and the most traumatic

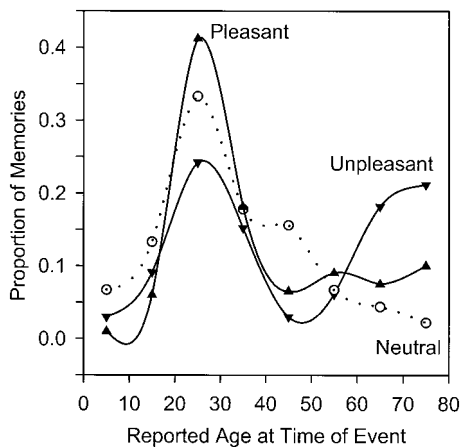


Figure 12. The distribution of pleasant, neutral, and unpleasant important autobiographical memories of 60 participants tested in a laboratory setting reanalyzed from Rubin and Schulkind (1997a).

memories did not. The fact that memories for the happiest and most important events showed a different pattern than memories for the saddest and most traumatic events cannot be explained as a carry-over effect due to question order, as question order was happy, sad, important, and traumatic (cf. Table 1). Reanalyses of data from earlier studies showed a bump for respondents' best but not worst memories and a more pronounced bump for important memories with a positive content compared with important memories with a negative content. In addition, reanalysis of earlier collected data indicated that the content of important memories was predominantly positive.

Only happy and (to a lesser extent) mixed involuntary memories showed a bump, whereas sad involuntary memories did not. Thus, the results for involuntary memories showed the same pattern as the other classes of memories. The frequency of happy, sad, and mixed memories in the youngest age group is largely similar to Berntsen's (1996) findings from a diary study with undergraduates. A pronounced increase in memories from the most recent years is also reported in this diary study. The present distribution of the involuntary memories across the life span is similar to distributions found with word-cued memories when participants were biased toward earlier memories and with odor-cued memories. As with memories elicited by cue words (Rubin & Schulkind, 1997a, 1997b) and odor cues (Chu & Downes, 2000), the involuntary memories recorded in our study showed a marked recency effect and a modest increase in memories for the first three decades of life relative to later periods. However, by using a retrospective method (instead of a diary method) we may have collected reports on what we can call "Proustian memories": involuntary memories that are remarkable and surprising and therefore remembered for a longer time. Prior research (Berntsen, 1996, 1999) indicates that only a subclass of involuntary memories possesses such characteristics. The results should be evaluated with that caveat in mind.

The great majority of the respondents in all age groups reported that they had involuntary memories, and most of these respondents were able to remember the last time they had noticed an involuntary memory. The most common estimates as to how often it happens were "some times a year" or "some times a month." These estimates are low compared with estimates in diary studies averaging around five involuntary memories per day. However, the retrospective assessments in the present study are likely to have underestimated the actual frequency of involuntary memories. Diary studies indicate that many involuntary memories go unnoticed or are rapidly forgotten, if not immediately recorded (Berntsen, 1996, 1999). Furthermore, frequency ratings were not homogeneous across the age groups in the present study. Respondents who were in their 20s rated involuntary memories as more frequent than did the older respondents. This indicates either that younger people have more unbidden memories or that they are more alert observers of their inner life. Because previous studies have involved mostly undergraduate students, this age difference may also help to explain why the present estimates are lower.

Dating of past dispositions (or past selves) may be systematically distorted by a person's current interests (see review by Ross & Wilson, 2000). However, this does not seem to distort the dating of concrete, significant episodes (Rubin & Baddeley, 1989). Studies on dating of personal events document that people's estimates are relatively precise for personally important events and that dating accuracy increases with increasing importance and emo-

tional intensity associated with the event (Betz & Skowronski, 1997; Friedman, 1993; Thompson, Skowronski, Larsen, & Betz, 1996). Moreover, as our analyses are based on 10-year periods, it is unlikely that errors in dating have played a role. In addition, we cannot exclude that in some cases respondents answered on the basis of a memory for a recurring event or a more extended period in their life (e.g., "When I was hospitalized"), as we have no access to the content of the memories. This problem is inherent to most of the research in this area. However, only if respondents dated their event in terms of a specific year is their response included in the dataset.

To summarize the main findings: Happy and important memories showed a bump, whereas memories with an emotionally negative content did not. This was true for both voluntary and involuntary memories. The data reflect some bias exerted by memory and not simply how events are distributed over life. For example, it is unlikely that around 40% of the happiest events in people's life actually take place between age 20 and 30, as would be the case if the memory data simply reflected a real-life distribution (cf. Figures 2 and 6). Also, the fact that the saddest and most traumatic memories showed a recency effect for all groups (see Figures 3 and 4) would implicate that life has been extraordinarily hard for all age groups during the latest 10–20 years in Denmark. This is also unlikely. In fact, the 1990s in Denmark were characterized by financial progress and decreasing unemployment and suicide rates (see <http://www.statistikbanken.dk>). Furthermore, we have evidence showing that the highly sad and traumatic events, for which people seek help, peak between age 30 and 40 in this population, contrary to our memory data. The question is not whether the memories of our respondents have been biased, but how.

Only Prediction 3 in Table 2 is able to account for the reduced recall of remote negative events. Unfortunately, the life script explanation is speculative as no studies have demonstrated that only positive and important events are included in life scripts and are allocated time slots that correspond to the period covered by the bump. The cognitive, the narrative/identity account, and the biological account (Predictions 1, 2, and 4, respectively, in Table 2) need to be modified by some mechanisms to account for the reduced recall of remote negative events. Such modifying mechanisms must be sought outside the literature reviewed so far.

In the following, we discuss the relation between emotional valence and retention. We review different theoretical frameworks with the purpose of modifying and supplementing our main predictions in Table 2. We restrict modifications to those cases in which clear theoretical connections can be seen between one of our main hypotheses and the theory under consideration. We set this constraint to avoid having everything modify everything, and to get families of explanations instead of many individual ideas to account for the data. Only in one case is a mechanism (social censure) seen to modify both a cognitive and a narrative/identity account. Claims with no clear theoretical relation to our main prediction are listed individually under the Additional assumptions heading in Table 2. Because the literature is vast and contradictory, several (sometimes conflicting or overlapping) predictions were derived. To help the reader keep track of our arguments, predictions consistent with the findings are marked with a superscript a. We left out theoretical contributions that can be seen as consisting of combinations of frameworks that we already included in the

review. For example, we left out Taylor's (1991) *mobilization–minimization* account because it can be seen as an attempt at combining observations from an aversive learning framework with insights from psychoanalysis. Both of these frameworks are considered independently. We do not differentiate between voluntary and involuntary memories because none of the theories we review predicted a clear interaction between voluntary and involuntary retrieval and the distribution of emotional memories across the life span. We also acknowledge at the outset that there may be room for disagreement as to exactly which of these post hoc hypotheses follow from the various accounts. The discussion follows the order of Table 2.

Modifications of the Cognitive Account

In the following, we consider possible modifications of the cognitive account. To separate these from modifications of a narrative/identity explanation, we limit ourselves to mechanisms that involve a differentiation between positive and negative memories with respect to their rehearsal, cuing or rate of forgetting, and no obligatory references to an enduring identity/self or life narrative.

Social censure. People with traumatic and sad experiences have a need to share their memories with others and to express their emotions. However, according to Harber and Pennebaker (1992), people in their social surroundings are often reluctant to listen. Potential confidants may interrupt disclosure attempts by talking about something else or, more radically, by avoiding contact with the traumatized person. One possible explanation of this behavior is that descriptions of highly aversive experiences challenge people's confidence that the world is basically good, meaningful, and that they themselves are worthy (cf. Janoff-Bulman, 1988), according to Harber and Pennebaker. Their findings show that merely listening to victims' descriptions of traumatic experiences generates increased activity in the autonomous nervous system, as measured by skin conductance level. As a consequence, people with traumatic experiences are often forced not to share their memories with others in order to maintain social contact and avoid stigmatization.

One straightforward implication of social censure is less rehearsal of highly negative events. This claim is able to modify the cognitive account of the bump. According to this modification, memories of the saddest and most traumatic events are expected to form a less pronounced bump or no bump at all, due to reduced rehearsal (see Prediction 1A in Table 2), which agrees with the results.

Social censure may also affect the life story as life narratives are generally conceived of as a social product serving mainly social functions (e.g., Barclay, 1993; Fivush, 1998; Nelson, 1993). In a radical social constructivist form, social censure of negative events would imply that memories of such events are simply excluded from people's life stories or, in a less radical version, that their actual significance is reduced relative to memories of less provoking important events. Thus, to the extent that the bump is a manifestation of an underlying life story, the saddest and the most traumatic memories should be included in the bump to a lesser extent than the most important memories, due to social censure (see Prediction 2A in Table 2), which is consistent with the results.

Life change. Highly negative life events are generally followed by more life change than highly positive events and emotionally neutral beginnings and ends. Among the 10 highest ranked events on the Social Readjustment Scale (Holmes & Rahe, 1967), 7 events are clearly negative, whereas only 1 event (marriage, which is ranked as No. 7) can be considered happy (Ruch & Holmes, 1971; Ruch, Chandler, & Harder, 1980). These findings can modify the cognitive account: Memories of the saddest and most traumatic events in a person's life are likely to satisfy only the criteria related to novelty and distinctiveness, as extremely sad and traumatic experiences are more likely to be followed by a period of instability. Highly positive events, on the other hand, are more likely to satisfy all of the criteria listed by Rubin et al. (1998): They are novel and distinctive and usually form the beginning of a stable period of life during which they are often rehearsed. Indeed, if an event had not formed the beginning of a stable period, it would hardly be considered "extremely happy" in a retrospective evaluation. Likewise, if a negative event had not set off a period of instability it is unlikely to be considered as "extremely traumatic" or "extremely sad" in hindsight. Thus, consistent with the findings, a clear bump can only be predicted for memories of the happiest and most important events, according to this modified cognitive account (see Prediction 1B in Table 2).

Fading of emotional intensity. Ratings of prior emotional states are prone to error and reconstruction (Christianson & Safer, 1996; Levine, 1997). In a radical interpretation, prior emotional states are not remembered at all but are constructed from higher order knowledge at retrieval (James, 1890/1918; see Christianson & Safer, 1996, for an overview). We take a more parsimonious position, assuming that emotions are retained in a fashion similar to other kinds of sensory and perceptual information and that they are subject to similar forgetting, though with their own forgetting rate. This implies that memories for all sorts of emotional events lose intensity over time. As a consequence, when people are asked for the memories of their happiest, saddest, and most traumatic events, they tend to report their most recent very happy, sad, and traumatic memories. In memory (but not necessarily in life), their most recent happy, sad, and traumatic experiences are their happiest, saddest, and most traumatic memories because of the fading of emotional intensity. According to this logic, we should expect memories for the happiest, saddest, and most traumatic events to all show an increase in the recent past. However, prior research has shown that ratings of emotional intensity decrease more rapidly for negative than for positive events (Walker, Rodney, & Thompson, 1997). Accordingly, the recency effect predicted previously should be more pronounced for the saddest and the most traumatic memories, which is consistent with the results (see Prediction 1C in Table 2). Still, it is not clear what causes memories of negative events to fade more quickly than positive memories. Multiple causes are indeed possible, for which reason the observation forms a rather weak explanation of the present results.

Modifications of the Narrative/Identity Account

We now consider possible modifications of the narrative/identity account. We include mechanisms that assume a difference between memory for positive and negative events by referring to an enduring identity/self (e.g., ego defenses in relation to unpleasant events) and/or dynamics in narrating about one's life.

Dissociation. According to a much disputed but highly influential view, traumatic experiences are often dissociated from consciousness and retained at an unconscious level in a form that appears to be immune to ordinary forgetting (Carlson, Armstrong, & Loewenstein, 1997; Elliott, 1997; Elliott & Briere, 1995; Nijenhuis & van der Hart, 1999; van der Kolk & Fessler, 1995). At times, the traumatized individual may reexperience fragments of the original traumatic events in terms of vivid visual images, bodily sensations, and emotions; whereas the event in its totality may stay inaccessible for conscious recollection.

One especially crucial part of the conception of dissociation is the idea of delayed recall: the claim that the trauma memory becomes more integrated and more accessible for conscious retrieval with time. The claim of delayed recall contradicts what is normally found to characterize retention; namely, that memories tend to become less accessible and less complete with the passage of time (Rubin, Hinton, & Wenzel, 1999; Rubin & Wenzel, 1996). According to proponents of the dissociation view, traumatic memories form an exception to the normal pattern of retention (Mechanic, Resick, & Griffin, 1998). The initial dissociation of the trauma is caused by the overwhelmingly unpleasant emotional arousal activated by the traumatic event. This hampers normal cognitive processing and leaves the memory inaccessible for conscious retrieval. With the passage of time, the individual is likely to be freed from some of the emotional stress connected with the traumatic experience, which allows the memory to be retrieved (partly or completely) and maybe integrated in the life story of the person. One important function of dissociation is to protect personal identity from disintegration that is due to overwhelmingly negative emotion associated with the trauma (e.g., Nijenhuis & van der Hart, 1999). Thus, the dissociation theory can be related to the narrative/identity account of the bump. It can be seen to modify this account to exclude memories of the most traumatic events from the bump (see Prediction 2B in Table 2). In addition, dissociation theory predicts that the distribution of trauma memories deviates from the distribution of other events in the sample, including memories of the saddest events (see Prediction 6 in Table 2) and that more trauma memories derive from respondents' remote rather than recent past, due to the phenomenon of delayed recall (see Prediction 7 in Table 2).

Dissociation theory is largely contradicted by the present findings. First, memories of the most traumatic events are distributed similarly to memories for the saddest events, contrary to what we would expect from dissociation theory. Second, the notion of delayed recall is contradicted by the finding that the traumatic memories were more recent than memories of the happiest and the most important events. However, the present results may suggest an alternative version of the idea of delayed recall: The increase of the saddest and the most traumatic memories in the two most recent decades of life for all age groups cannot reflect how the saddest and the most traumatic events are actually distributed across the life span in this population (cf. Figure 1). The recency of these memories implies that some of the actual saddest and most traumatic experiences have been left out. This opens the possibility that such partly or totally forgotten memories of traumatic and sad experiences may come to mind in situations with more favorable retrieval conditions, for example, due to the presence of relevant cues, and are thus "recovered," such as some studies appear to

document (Schooler, Bendiksen, & Ambadar, 1997; Williams, 1995).

Repression. Memory researchers often use the notion of dissociation synonymously with the Freudian notion of repression. However, as we argue, this is misleading as the two theories lead to different predictions about the retention of emotional events. The notion of psychic trauma was introduced in the second half of the nineteenth century by the French psychiatrist Jean Martin Charcot as an explanation of hysteria (Hackings, 1995). In his writings about dissociation, Janet (see Nemiah, 1998) maintained the idea of external traumatic events as a central etiological factor for psychopathology, whereas Freud changed the focus to internal conflicts deriving from a clash between inborn sexual drives and demands of the external cultivated world. It was the unpleasantness associated with such conflicts that motivated repression, more than shocking external events (Breuer & Freud, 1893–1895/1955; Williams, 1995).

In *DSM-IV* (APA, 1994), a traumatic event is defined as an event involving actual or threatened death or serious injury or, at least, a threat to the physical integrity of oneself and others. In addition, the person's response should involve intense fear, helplessness, or horror. According to the psychoanalytic theory of repression, on the other hand, anything that threatens the ego is likely to be repressed, which seems to mean that shocking events fitting the criteria for trauma should not lead to qualitatively different memories than other highly unpleasant experiences, such as people's saddest experiences or most embarrassing episodes. This emphasis on unpleasantness rather than fear (or trauma) per se is consistent with contemporary operationalizations of repression as reduced access to memories associated with negative emotions, such as fear, anger, and sadness (e.g., Davies, 1987; Hansen, Hansen, & Shantz, 1992).

The idea of repression is more consistent with the present findings than is dissociation. First, if the bump reflects the formation of an adult identity, it seems reasonable to assume that both the saddest and the most traumatic memories would be left out because of repression (cf. Prediction 2C in Table 2). Second, according to the notion of repression, we may expect memories of the saddest and the most traumatic events to be distributed in largely the same ways across the life span (cf. Prediction 8 in Table 2). Both predictions are consistent with the findings.

Nostalgia. According to Holbrook (1993), nostalgia is "a longing for the past" (p. 245). In addition, nostalgia often involves negative feelings toward the present and the future. It is not clear which periods in the past are especially prone to be colored by nostalgia. For instance, Holbrook claimed it may be all of the past (including the time before one was born), whereas Field (1981) showed that childhood becomes more and more favorable as people grow older. In contrast, nostalgia is specifically associated with adolescence and youth according to Schulster (1996), who argued that every generation has its "era"—that is, "a period in their past which to them, is a special time of life" (p. 146). He asked participants for films that were defining for their specific era and found that participants perceived their era to be between age 14 and 24. He linked the era to the formation of a generation-specific social identity and the development of an adult self-narrative. Because of agreement with existing work on the bump, Schulster's interpretation of nostalgia is most relevant here. His theory can be regarded as a workable modification of the narrative/

identity account of the bump: We should expect a peak of the happiest and the most important memories in early adulthood, but no similar bump of the saddest and the most traumatic memories (see Prediction 2D in Table 2), which is consistent with the results. However, which specific memory processes are involved in nostalgia is an unanswered question. Nostalgia is a description rather than an explanation of a phenomenon.

Modifications of a Biological Account

Here we consider only one framework that we refer to as an *aversive learning view*. The criterion for including this framework as a modification of a biological account of the bump is that this framework assumes a difference between emotionally pleasant and unpleasant memories by referring solely to biological and/or physiological factors.

Ledoux (1996) argued that fear creates extraordinarily durable memories. A learned fear response is never extinguished; it may only be kept passive by higher order, cortical processing: "Unconscious fear memories established through the amygdala appear to be indelibly burned into the brain. They are probably with us for life" (p. 252; see also LeDoux, 1989, 1992). A similar view is often found in the clinical notion of traumatic flashback. This notion refers to highly persistent memories of traumatic experiences that are activated automatically by features of the current environment and are accompanied by much reliving. Pitman (1988) turned to a neurobiological metaphor to explain the phenomenon and asked "what that 'acid' might be that is capable of 'etching' traumatic experience into the brain" (p. 187). A few studies in the eyewitness literature similarly indicate that highly shocking events may form extraordinarily persistent traces (Yuille & Cutshall, 1986).

According to this literature, we should expect respondents' most traumatic memories to be older than the other classes of memories (see Prediction 4A in Table 2). This prediction is contradicted by the present findings: Memories for the saddest and the most traumatic events were both younger than memories for the happiest and most important events. However, among the two youngest age groups (respondents in their 20s and 30s), the pattern was reversed. Among these younger respondents, the saddest memories were slightly older than the happiest memories and the most traumatic memories were slightly older than the most important memories (cf. Figure 8). This suggests that the increased event age of memories of the happiest and the most important experiences was primarily due to the peak of these memories in young adulthood among the older respondents. This may indicate that enhanced memory for aversive stimuli is still a valid prediction in populations with no bump, such as (presumably) young nonhuman subjects or children and (as here) young adults.

Summary and Conclusion

Only memories of the happiest and the most important events formed a clear bump in the 20s; the saddest and the most traumatic memories did not. Sad and happy involuntary memories mirrored this pattern. The reduced recall of remote negative events is a new finding in research on the bump. It is consistent with the assumption that autobiographical memory is organized by culturally shared life scripts that do not include emotionally negative events

while allocating important positive events to young adulthood. In addition to structuring retrieval at any present moment, such life scripts would also function as a mechanism of maintenance by repeatedly structuring retrieval over time and thus form the basis for spaced practice of the types of events included in the script. The monotonically decreasing forgetting curves for the saddest and most traumatic memories can simply reflect ordinary forgetting in the absence of life scripts, which would have allowed easy retrieval and maintenance of remote events of this type. If no life script existed for the happiest and most important events, similar monotonically decreasing curves would be found for such memories, according to this account. Unfortunately, we have no firm evidence that life scripts actually exclude negative events and allocate positive events to young adulthood. Thus, the current status of the life script explanation is speculative.

Neither a cognitive nor a narrative/identity account or a biological explanation of the bump can account for the reduced recall of remote negative events without modification from theories outside the bump literature. Reduced rehearsal due to either social censure or subsequent life change is able to modify a cognitive account, whereas social censure or repression may modify a narrative/identity account to become consistent with the present findings. Whether such crossbreeds are necessary or whether a life script account can do the job is a question for future research.

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Received September 26, 2001

Revision received March 25, 2002

Accepted March 30, 2002 ■

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