9

Autobiographical Memory across the Lifespan

David C. Rubin

A Brief History

Galton describes the first procedure he used to cue memories as follows. "I walked leisurely along Pall Mall, a distance of 450 yards, during which time I scrutinised with attention every successive object that caught my eyes, and I allowed my attention to rest on it until one or two thoughts had arisen through direct association.... Samples of my whole life passed before me" (1879, p. 151). He then moved from the "real world" into the "laboratory." Galton produced sheets of paper, each with one word on it, waited a few days, placed a sheet with a word on it partially under a book so that it was blocked from view until he would lean forward to see it. He recorded his associations and his reaction times to 75 words on four occasions. "It was a most repugnant and laborious work" (1879, p. 153). Of the 124 different associations he obtained, 48 were from "boyhood and youth," 57 were from "subsequent manhood," and 19 were from "quite recent events."

Crovitz and Schiffman (1974) revived Galton's technique. About the same time Robinson (1976) independently came upon the same procedure. People were asked to think of an autobiographical memory in response to each word presented to them. They were then asked to return to their memories and date each one as accurately as possible.

The distribution of memories over the lifespan of the undergraduate can be described as a power function of the time since the event occurred (Crovitz & Schiffman, 1974). Figure 1 is of a typical plot. The power function (i.e., $y = at^{-b}$) is a simple two parameter curve that has often been used in psychology (Newell & Rosenbloom, 1981; Stevens, 1975).

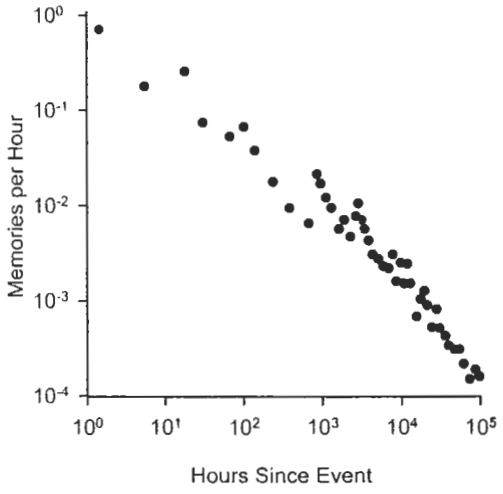

Figure 1
The relative number of autobiographical memories per hour reported by undergraduates as a function of the age of those memories. Both axes are logarithmic, so a straight line is a power function. (Adapted from Rubin, 1982, figure 2.)

When both axes are plotted as logarithmic scales, as they are in figure 1, the power function becomes a straight line (i.e., $\log(y) = -b \log(t) + \log(a)$). The fits to the curve are surprisingly good, with correlations usually over .95. If we assume that undergraduates encode an equal number of events each day of their lives, then the plot shown in figure 1 is a retention function. Because the power function is a common choice for a retention function (Anderson & Schooler, 1991; see Rubin & Wenzel, 1996, for a review), as a first approximation it appears that laboratory and autobiographical memory have similar patterns of forgetting (but see Rubin, Hinton & Wenzel, 1999).

A recurring theme can now be introduced (Rubin, 1989). Figure 1 presents some of the most regular data in memory research. Correlations over .95 are not all that common in cognitive psychology, especially when a two-parameter function is fit to over a dozen points and the function is a reasonable choice in terms of the existing literature. But figure 1 is of data that was collected with one of the least controlled experimental procedures in cognitive psychology. There are no restrictions or controls over the learning of the material or over which autobiographical mem-

ories people are to report. The function is not dependent on how the dating of memories is done; it does not change whether participants report the age of the memory with an estimate of the actual date in term of its month, day, and year or whether they use phrases of the form *n* hours, days, weeks, months, or years ago. The shape of the function does not depend on the cue words used, as it occurs when people respond to a single cue word, when they respond to different numbers of cue words, when odors are used instead of cue words, and when no cues are used at all—they respond to just a request for 50 autobiographical memories (Rubin, 1982; Rubin, Groth & Goldsmith, 1984). One reason for the regularity may be that the retention interval is large (from either 1 hour or 1 day ago to about 20 years ago) and the range of the dependent measure is large (often four orders of magnitude). Such large ranges on scales can be more easily obtained outside the laboratory.

Scott Wetzler, then a graduate student in clinical psychology, wondered what would happen if older adults were tested. After all, the undergraduates had only about 20 years of life on which to report. Would the retention function remain the same or perhaps just change its slope or intercept parameter? Would the whole shape of the function change? Robert Nebes, who was then at Duke, had data, and Scott wrote to other people for their data. They were all generous in their cooperation (their original articles were published as Fitzgerald & Lawrence, 1984; Franklin & Holding, 1977; Zola-Morgan, Cohen & Squire, 1983).

The results for older adults with a mean age of 70 are shown in figure 2. They were a surprise. No one had plotted the data this way before, and so we could find no earlier empirical demonstration of the nonmonotonic plot. The shape of the curve also appeared replicable, because it appeared in the plots of the data from 70-year-old participants from each of the three laboratories that were summed to provide figure 2 and also in the plots from three laboratories for adults who were 50 years old (Rubin, Wetzler & Nebes, 1986). For figure 2, about one half of the memories were dated as occurring within the last year and were not plotted because they would make all decades but the last have very low values; they are, however, considered in detail when retention functions for the most recent decade are plotted. The large number of memories from the recent past also shows that older adults are not "living in the

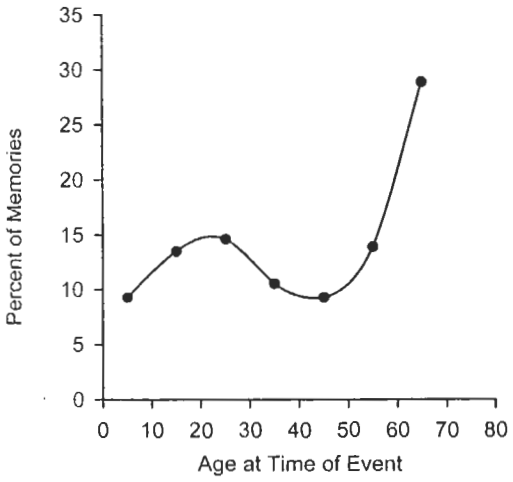

Figure 2
The distribution of autobiographical memories over the lifespan for older adults. Events dated as occurring in the most recent year are excluded. (Data from Rubin et al., 1986.)

past." From the shape of the plot and the retention-function fit for undergraduates, we assumed that the curve had three components: retention, childhood amnesia, and a *bump* or increase in the number of memories recalled from adolescence and early adulthood. Because the topic of this chapter, the increase in memories from ages 10 to 30, is defined empirically by what is left after the retention and childhood amnesia components are removed, these two components are considered briefly before concentrating on the nonmonotonic component.

The first component is a retention function that covers the whole lifespan, but that has most of its memories distributed over the most recent two decades of life; for periods more than two decades ago, it is too small to produce a measurable number of memories. If one assumes that the retention function of figure 1 holds for people of all ages without systematic age changes in the slope (an assumption supported by considerable data, e.g., Rubin et al., 1986; Rubin & Schulkind, 1997a, 1997b), then for a typical slope of −.8, the number of memories per hour decreases by a factor of .57 every time the retention interval doubles. If from a month that occurred three months ago an older adult recalled 10

memories, from months that occurred $\frac{1}{2}$, 1, 2, 4, 8, 16, 32, and 64 years ago that adult would recall 6, 3, 2, 1, .6, .4, .3, .2, and .1 memories. Thus, without some modification of the function, older adults would recall little from their youth.

The second component is childhood amnesia. When undergraduates were tested, there was an inflection in the power-function curve (Wetzler & Sweeney, 1986), but it is hard to argue that some other curve would not naturally fit this inflection. However, when adults of different ages were tested, it became clear that a function was needed that went to zero at or near the birth of the person no matter whether their birth was 20, 50, or 70 years before the date of testing. Thus a childhood-amnesia component based on age at the time of the event rather than time since the event had to be added to ensure that the curves of people of different ages all went to zero at birth. In mathematical terms, there had to be a function in terms of age at the time or the event (or equivalently, retention interval – current age) in addition to a function in terms of retention interval (i.e., $f(t - \text{age})$ as well as $f(t)$, where t is the time since the event). This component is very stable over numerous studies, having the same basic shape no matter what method is used to produce the data, as long as the participants come from the United States (Rubin, 2000). Thus, as with the retention component, the data are remarkably regular, though the experimental procedure has minimal control. The childhood-amnesia component is, however, affected by culture, and within some cultures by gender (Mullen, 1994; MacDonald, Uesiliana & Hayne, 2000). Figure 3 provides a sample plot.

The third component is the increase in memories from when older adults were between 10 and 30 years old compared to what would be expected from the other two components or from any monotonically decreasing function. We termed it "the bump" to emphasize our lack of theoretical understanding, a lack due to the paucity of an organized existing literature. Our later searches of the literature, however, found a multitude of possible theoretical explanations that could have predicted the bump, but that somehow did not lead to empirical tests.

The initial description of the bump was based on data from several laboratories. Since that time there have been consistent findings using the word-cue technique with older adults (Hyland & Ackerman, 1988;

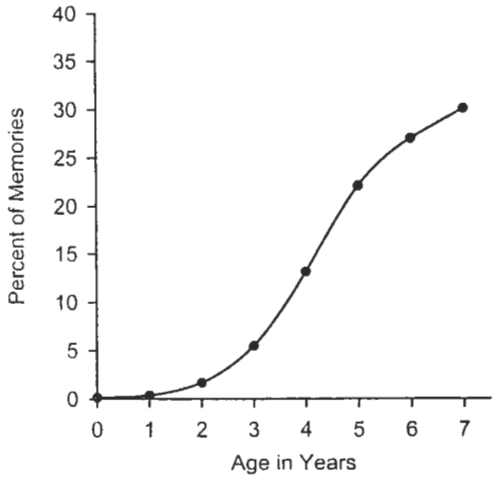

Figure 3
The distributions of 10,118 memories dated as occurring before age 8 from published studies. (Data from Rubin, 2000.)

Jansari & Parkin, 1996; Rubin & Schulkind, 1997a, 1997c; see Rubin, 1999, and Rybash, 1999, and the articles that follow in his special issue of the *Journal of Adult Development* for reviews). Minor differences exist in the shape of the distribution with changes in procedure and subject population, but the bump appears repeatedly, even for individuals (Rubin & Schulkind, 1997c). This literature indicates that the bump occurs when as few as 10 to 20 and as many as 900 word cues are given to each person; so the bump is not caused by just a few highly available memories.

The word-cue technique is useful to help people produce memories. It helps ensure that each memory is not cued mainly by the memories recalled previously, and thus provides a wider sampling of memories. But this is only one way to access autobiographical memories and not the one most commonly used in everyday life. A series of studies from Denmark first demonstrated that the bump occurs even when a life narrative is obtained from older adults and the distribution of experimenter-defined events from that life study is plotted (Fromholt & Larsen, 1991; Fromholt, Larsen & Larsen 1995; see Schrauf & Rubin, 2000, for a replication).

Differences in the Properties of Autobiographical Memories

The summary of this section is that there are few differences in the memories retrieved over the lifespan and none that distinguish the bump period. Basically, there are just more memories from the bump period. It is as if there were increased availability or accessibility for these memories (Tulving & Pearlstone, 1966). The properties that lead to this ease of retrieval do not change with the age of the memories.

Rubin and Schulkind (1997a) tested adults of different ages: 60 seventy-year-old adults, 20 thirty-five-year-old adults, and 40 twenty-year-old adults. Each adult provided a memory to each of 124 cue words. No consistent differences in reaction time as a function of the age of the memories were found, though the younger adults were much faster. Thus, participants were not spending more time trying to get memories from the bump period, or any other period. This observation argues against strategies that involve more elaborate searchs by subjects for various life periods and supports the interpretation of the bump as an increase in the ease of accessing memories from between the ages of 10 and 30 rather than as the result of a search strategy. There were also no gender differences in this data (Rubin, Schulkind & Rahhal, 1999).

One autobiographical memory from each of the 14 five-year periods of each older adult's life was selected. Each participant was asked to rate these 14 memories on several properties. There were five seven-point scales: vividness, pleasantness, significance, novelty of the event, and frequency of rehearsal. A three-point emotionality scale was calculated as the absolute value of the difference of the pleasantness rating from neutral. Separate analyses were performed for each scale, but none of the scales provided statistically significant differences in the bump period, even though there was considerable statistical power when all 60 older participants were combined. Conway and Haque (1999) obtained similar findings for ratings on three scales similar in wording to the ones Rubin and Schulkind (1997a) used: significance, novelty of the event, and frequency of rehearsal, as well as a scale that directly measured emotional intensity. This observation supports the interpretation of the bump as an increase in the ease of accessing memories from between the

ages of 10 and 30 rather than as the result of a specific properties of memories from that period increasing their recall.

Rubin and Schulkind (1997b) investigated whether differences in the properties of the cue words produced differences in the autobiographical memories obtained. Imagery, concreteness, and meaningfulness ratings of the cue words correlated .34, .38, and .47, with the average age of the memory (i.e., the time between the date of the event and the date of the recall) for the 40 twenty-year-old participants and .25, .28, and .29 for the 60 seventy-year-old participants. For the 20 thirty-five-year-old participants, the correlations were smaller, perhaps because the smaller number of participants produced less reliable data. For reaction time, the correlations with imagery, concreteness, and meaning were −.37, −.36, and −.43 for the twenty-year-old participants and −.67, −.65, and −.64 for the older participants. In contrast to these fairly large correlations, the correlations of the percentage of memories that fell in the 10-to-29 bump period with imagery, concreteness, and meaning were .22, .18, and .14. None of the ratings of goodness or emotionality correlated greater than .20 with age of memory, reaction time, or percentage of memories in the bump period. Thus, the properties of the cue words did not differentiate memories that came from the bump from other memories. This observation also supports the interpretation that the bump results from an increase in the ease of accessing memories from between the ages of 10 and 30 rather than from specific properties of the cues used to prompt the memories.

Rybash and Monaghan (1999) asked 40 alumni of Hamilton College to recall an autobiographical memory associated with each of 18 cue words. For each memory, they were also asked to indicate whether they had a recollective experience in which they seemed to reexperience some of the same emotions, perceptions, and thoughts that they had at the time of the original event (i.e., whether they had a "remember" memory) or whether they just knew the event without any sense of reliving, even though they might know a good deal about the details of the event. There was a clear reminiscence bump, but no difference in the shape of the bump between the recollective or "remember" memories and the "know" memories. Their data, which are shown in figure 4, argue that

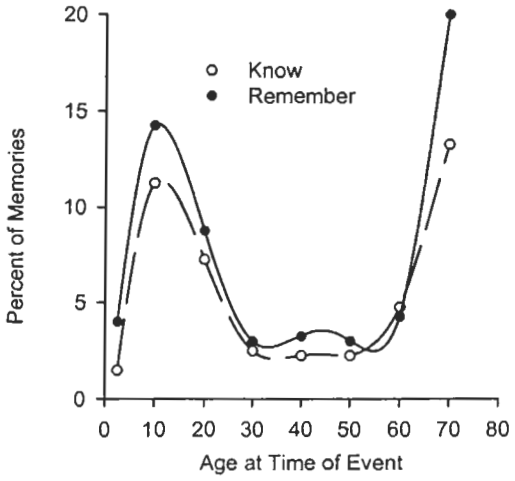

Figure 4
The distribution of older adults' lifespan autobiographical memories judged as remembered versus judged as just known. (Data from Rybash & Monaghan, 1999.)

this especially important phenomenological property of autobiographical memories does not differ over the lifespan.

The Role of Emotions

The effect of emotional states on the recall of autobiographical memories and the recall of the emotions present in autobiographical memories have been studied from many perspectives (for reviews, see Christianson & Safer, 1996; Robinson, 1996; and Williams, 1996). Less attention has been paid to the effect of emotions on the distribution of autobiographical memories over the lifespan. The studies cited in the previous section found no differences across the lifespan in the ratings of pleasantness, emotional intensity, or a sense of reliving, which was defined to include emotional reliving.

There are studies that examine the effect of clinical disorders involving emotional state on the distribution of autobiographical memory. The only data in which bump memories appear to be different than recent

memories is in a study of older adults who suffered their first major depression. These patients provided brief life narratives, both during the period of their depression and six months later (Fromholt et al., 1995). Alzheimer's patients from an earlier study (Fromholt et al., 1991) were included in addition to healthy controls in an attempt to provide data that could aid in the differential diagnosis between dementia and depression in older adults. All three groups of participants showed a clear bump, but the depressed patients had more recent memories than the other two groups. Depressed patients also had less temporal coherence in their life narratives than the other two groups. As might be expected, depressed patients had more emotionally negative memories, though the increase in negative memories came only from the most recent five years. Depressed patients reported memories similar in emotional tone to the other two groups for memories older than five years, which was well before the onset of their depression. After six months, when most of the depressed patients had recovered, the recent memories of the depressed patients had the same emotional tone as their older memories and as the recent memories of the other groups. Thus, for older adults suffering from their first depression, memories retrieved from the bump did not change in emotional tone during the depression, though more recent memories did.

In addition to depression, posttraumatic-stress disorder differentially affects autobiographical memory across the lifespan. Vietnam War veterans with posttraumatic-stress disorder had more memories from the time of the Vietnam War than did veterans without posttraumatic-stress disorder (McNally, Lasko, Macklin & Pitman, 1995). In addition, veterans with posttraumatic-stress disorder, like patients with depression (Williams, 1996), had difficulty recalling specific autobiographical memories and had more difficulty producing specific memories when the cue words were positive traits as opposed to negative traits. The differences in the distribution of autobiographical memories and in the specificity of those memories were greatest for those veterans with posttraumatic-stress disorder who wore Vietnam War regalia to the testing sessions. These veterans did not differ from the other veterans with posttraumatic-stress disorder in terms of depression, anxiety, and combat experience,

excluding these factors as an explanation. Thus, although there are no differences in the ratings of emotional intensity of autobiographical memories across the lifespan in most populations, in some populations differences can be observed.

The Role of Language

One way to study the role of language in autobiographical memory is to test sequential bilinguals who learn their two languages at different periods of their lives. By asking sequential bilinguals to recall autobiographical memories from across their lifespan in both of their languages, the extent to which autobiographical memory is stored in a language as opposed to other forms of representation can be studied. Clinicians have observed that childhood and traumatic memories are more easily accessed in bilinguals' first language (Aragno & Schalet, 1996; Javier, 1995; Schrauf, 2000), and thus childhood amnesia may be greater for bilinguals tested in their second language. For memories in general (Bugelski, 1977) and for autobiographical memories in particular (Marion & Neisser, 1997), sequential bilinguals tend to recall older memories in the first language.

Schrauf and Rubin (1998, 2000) tested older sequential bilinguals who were highly proficient and literate in both Spanish and English. These bilinguals failed to produce older memories when they were cued and asked to respond in their first language. However, when they were asked about the "internal language" of the memory, that is, the language in which the memory came to them as opposed to the external language of the testing session, their first language produced older memories. Similar findings occurred with Polish-Danish sequential bilinguals who learned Danish in their early 20s. Those who learned Danish in their early 30s and who had become less proficient in Danish had earlier memories when cued in Polish in addition to showing the "internal language" effect. Figure 5 shows a typical result. Taken together, these studies show that autobiographical memories are to some extent coded in a language or at least have language as a sensory or phenomenological quality (Larsen, Schrauf, Fromholt & Rubin, 2002).

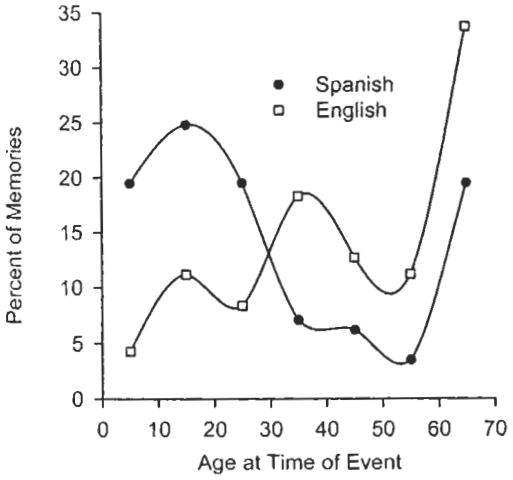

Figure 5
The distribution of memories that came to the participant in each language independent of the language being spoken in the session.

Is the Bump Just for Autobiographical Memory?

The studies reviewed so far are all about autobiographical memory. But once one starts to look, one finds plots similar to the bump in autobiographical memory in other domains as well. A full explanation of the bump needs to take such plots into account and decide whether they are relevant to processes occurring in autobiographical memory. The oldest such plot I know about appears in Ribot (1882). He claims that for most people, imagination rises and drops in a fashion similar to the plots shown for autobiographical memory. For a select few, such as Ribot, I assume, it continues at a high level though old age. Like the bump, it has components. Early in the lifespan, imagination is used for play, then for sexual fantasy, and finally for more mature use.

Other classic theories also have peaks that correspond to those in the bump. Identity formation in personality theories is the most obvious (Erickson, 1950). Ideas similar to the bump are common, especially when the effects of narrative on autobiographical memory are considered (Holmes & Conway, 1999; Fitzgerald, 1988; Gergen & Gergen, 1983; Robinson, 1996). However, even evolutionary theory would predict a

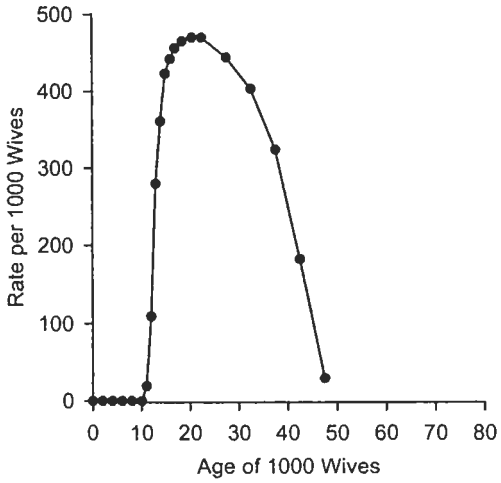

Figure 6
Births per 1,000 wives in traditional societies as a function of the age of the wife. (Data from Menken, Trussell & Larsen, 1986.) The data up to age 20 are hypothetical values based on the percentage of women reaching menarche. (Data from Komura, Miyake, Chen, Tanizawa & Yoshikawa, 1992.)

bump if the increase in memories is due to increases in cognitive abilities that happen to occur when we are most likely to be making decisions about childbearing and child raising. Figure 6 is a plot of when in the lifespan births occur in traditional societies without modern birth control. Such evolutionary ideas are not without behavioral support. We are faster during the period in which the bump occurs, as shown in figure 7. We also do better on standardized memory tests, such as the Wechsler Memory Scale, and so need more items correct during this period to obtain any percentile score, as shown in figure 8. A more recent theoretical plot was presented by Fredrickson and Carstensen (1990) to account for social contact and for the observation that it is most varied in early adulthood. In the course of a normative life in our culture, two motives for social contact peak near the peak of the bump: self-concept development and information seeking.

In summary, many empirically observed abilities, and the many theoretical constructs needed to explain them, peak at about the same time as the bump (for others see, Rubin, Rahhal & Poon, 1998). But so do many

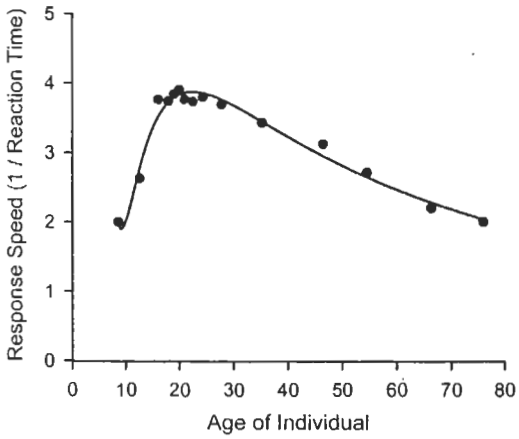

Figure 7
The reciprocal of the reaction times of people of different ages in a simple task. (Data from Noble, Baker & Jones 1964.)

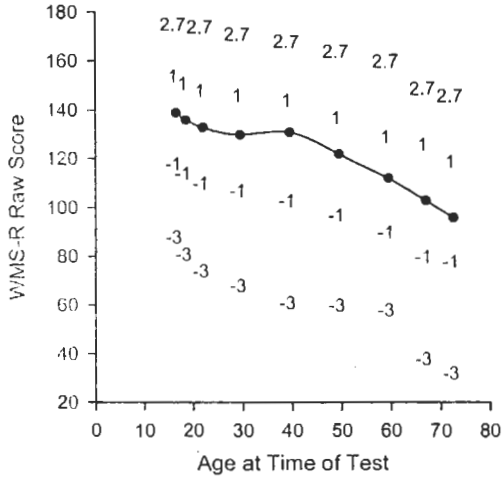

Figure 8
The raw scores needed on the Wechsler Memory Scale to score as average for a given age. Included without a line are the raw scores needed to be 2.7 and 1 standard deviation above the mean and 1 and 3 standard deviations below the mean.

other forms of memory or preference. People are more accurate in recalling public events (Rubin et al., 1998) and music (Schulkind, Hennis & Rubin, 1999) that occurred when they were between 10 and 30 years old. They prefer or are personally most affected by music (Holbrook & Schindler, 1989; Schulkind et al., 1999), films (Sehulster, 1996), and books (Larsen, 1996) from this period. They judge public events that occurred when they were in this period of life to be more important (Schuman, Belli & Bischoping, 1997). They concentrate on this period when choosing important events in their lives in psychology experiments (Fitzgerald, 1996; Fromholt & Larsen, 1991, 1992; Rubin & Schulkind, 1997a) and in written autobiographies (Mackavey, Malley & Stewart, 1991). Some of these findings are more directly related to the bump in autobiographical memory than others, but they all point to an increase in memory and preference for events from the bump period.

How to Explain These Findings

As usual in developmental processes, there are two broad classes of explanation: nature and nurture. As usual, it is impossible and unwise to separate them; their interaction is the important factor. On the side of nature or biological maturation, as reviewed in the previous section, people are faster and better at simple memory tasks in the bump period. On the side of nurture or environment, also as reviewed in the previous section, the bump period is a time of many culturally defined important events, a time of identity formation, and a time of the formation of a sense of generation. Using standard principles of experimental psychology, we postulated the cognitive theory of the bump (Rubin et al., 1998) to explain how such events would lead to increased recall of memories.

Events from the bump period are remembered best because they occur when rapid change is giving way to relative stability that lasts at least until retrieval. In times of rapid change many novel events are encountered. Such events benefit from three major processes that increase their encoding: (1) increased effort to understand the event, i.e., effort after meaning (Bartlett, 1932), (2) minimal proactive interference (see Rubin, 1995, for a brief review of this large literature), and (3) distinctiveness (Hunt & Smith, 1996). Periods of stability produce less encoding but

have two major beneficial effects for retrieval: (1) a memory organization that is the same at encoding as it is at retrieval, i.e., encoding specificity (Tulving & Thomson, 1973), and (2) more retrieval, especially more spaced retrieval (Braun & Rubin, 1988; Dempster, 1988). The cognitive theory as just formulated falls into the nurture camp. However, if during this period people are also best at encoding new information because of maturation, the effects would be even stronger. To cloud the nature-nurture distinction even further, the cognitive theory could be extended to include the adolescent period of rapid change followed by relative stability in biology, as well as in a person's interactions with his environment.

The cognitive theory can explain other bump-period findings. The events on which people first base their understandings of the world should be judged as more important than other events and should come to mind more easily when the recall of an important event is requested. In addition, preference can be based on familiarity and understanding (see Bornstein, 1989, and Zajonc, 1980, for reviews).

Showing That the Environment Has an Effect

Superior memory ability can be demonstrated for the bump period from standardized tests. How can we show that environmental change also affects the bump and thus that the bump is not a purely maturational effect. From the perspective of the cognitive theory of the bump, the ideal experiment to do would be to introduce a major disruption followed by a period of stability at a time after the bump should have occurred. This would both remove the stability needed for spaced practice and provide a second period in which many new things would be learned and practiced.

According to the cognitive theory, such a major disruption should make the standard bump smaller because spaced practice is removed, but it should create a second, later bump. Such experiments cannot be planned, but they can be observed in the world. Immigration often changes a person's physical environment, his culture, and the language used to code and report new events. If we collapse over the language of testing in the data from immigrants discussed in the section on language (because it is not the question of interest here and because in most cases it did not affect the distribution of memories over the lifespan), we can

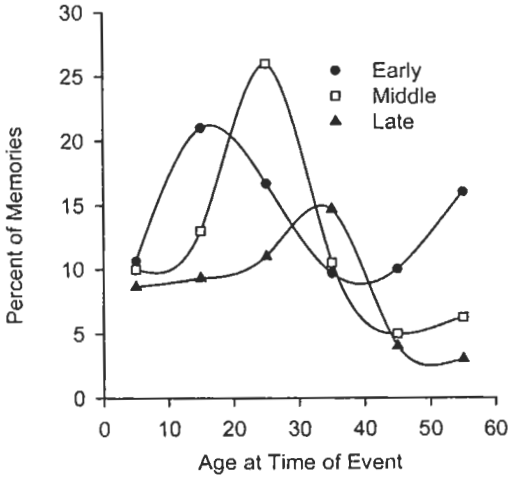

Figure 9
The distribution of events reported in a life narrative for people who immigrated around ages 21 (early), 26 (middle), and 34 (late).

ask how the distribution of autobiographical memories of people who immigrated at different times in their lives differ. Such data provide strong support for the cognitive theory. Figure 9 provides a sample plot. Conway and Haque (1999) provide similar results from a study after the Bangladeshi fight for independence, which involved major changes in a political system but did not involve changes in language or location.

Future Directions: Multiple Systems across the Lifespan

Up to this point autobiographical memories have been considered as single entities. An alternative view is that they consist of information stored in component processes, each process occurring in a separate behaviorally and neurally defined system (Rubin, 1995, 1998; Rubin & Greenberg, 1998, in press, 2000; Rubin, Greenberg & Schrauf, 2000). According to available evidence, these component processes are an integrative memory system (which is classically attributed to the hippocampus and more recently expanded to include the frontal lobes), imagery in each individual modality and a multimodal spatial-imagery system, language, narrative reasoning, and emotions. On this view, having a full-blown

autobiographical memory requires the use of the integrative memory system, at least one modality-specific imagery system (usually visual imagery), spatial imagery, to varying degrees imagery in the other senses, language, narrative reasoning, and emotions. For different memories within an individual and for different clinical populations, the degree to which each system contributes varies. Thus, for instance, flashbulb memories are more likely to have considerable visual and spatial imagery, and people who are depressed or who have posttraumatic-stress disorder are likely to have voluntary memories that lack sensory details and narrative coherence. In contrast, the intrusive memories of people with posttraumatic-stress disorder are likely to have considerable sensory detail and, compared to other memories, sensory details in the olfactory and gustatory system. There is considerable support for this view from behavior (Rubin, Greenberg & Schrauf, 2000) and neuropsychology (Rubin & Greenberg, 1998, 2000), but what does it mean for understanding the bump?

How do the individual processes needed to produce a full-blown autobiographical memory develop over the lifespan? It is hard to know for sure because the processes are usually not studied developmentally in a way that would provide a direct answer. Figure 10 is my best guess. It is based on a what has been measured and some poorly supported assumptions, which I will make explicit. Figure 10 serves to clarify our level of ignorance and to frame questions for future investigation. I assume that the integrative memory system develops and declines something like fluid intelligence, that the language system develops something like vocabulary, that the narrative reasoning system and especially the narrative skills needed to tell a life story develop more slowly than language (Habermas & Bluck, 2000), and that visual imagery declines with age. I have no idea of how to plot the development of the system that processes emotion. From figure 10, the bump would result from the interaction of the component systems and how they interact with the environment present at the time. For example, under such a view, flashbulb memories, which require a strong visual component, would be more likely to form earlier in the lifespan (see Cohen, Conway & Maylor, 1994, for some support), and childhood memories should have less narrative coherence. Similarly, the same traumatic event would be more

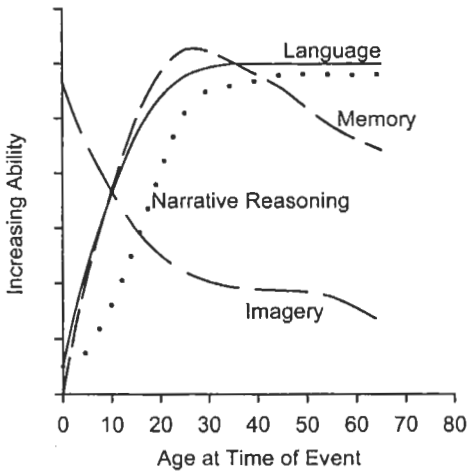

Figure 10
Hypothetical developmental trajectories of abilities needed to form autobiographical memories.

likely to produce a vivid intrusive memory not well integrated into the person's life story if it occurred early in the lifespan, when imagery was fully functioning and narrative coherence was not, as opposed to if it occurred later in the lifespan, when the imagery system was weaker and narrative reasoning was stronger.

Earlier the section "Differences in the Properties of Autobiographical Memories" provided evidence that the ratings of memories do not differ over the lifespan; there are just more memories from the bump period. There is an apparent discrepancy between this finding and the theory just put forth. If, for instance, visual-imagery ability decreases and narrative-reasoning ability increases over the lifespan, then one might expect older adults to rate memories from youth higher in imagery and lower in narrative coherence. Two possible resolutions exist. First, the ratings we have are measures of the ability of older adults now to produce a visual image and a coherent narrative from what was encoded a long time ago. Thus, the effects of differences in encoding might be minimal in comparison with the effects of current retrieval abilities. As reviewed earlier, we know that cuing with high-imagery words does produce older memories, and so it still might be the case that cues that differentially tap systems

may be able to access memories from periods when a particular system was functioning best.

The second possible resolution is that if all memories could be accessed, there might be differences in the properties of the memories across the lifespan, whereas for the memories that come most easily to mind, this is not observed, because what makes the memories easy to recall is that they are high on several of the properties rated. An experiment to approximate an exhaustive search would have older adults spend an hour or two recalling and rating memories from a single year from when they were 10, 25, and 50. One might expect the memories from age 10 to be rated higher on imagery and lower on narrative coherence relative to the memories from age 50, whereas the bump memories might rated highly on both scales. I know of no data on these issues.

Phenomenon-Centered Research

I gave this chapter a semihistorical presentation partly because it reports on a program of research that I and my collaborators stumbled into, one observation at a time, without a strong theory to guide us. I wanted to portray a research program that is less common than the hypothetical-deductive one favored for the final reporting of research in most journals and required for the planning of research in grant proposals. Though less favored, I believe that it is one approach that needs to be used if science is to advance in an efficient manner. In his intellectual autobiography, my thesis adviser, Roger Brown, wrote, "While no one seems to recommend a phenomenoncentered approach to research, it can be argued that its record is at least as good in psychology as that of theory-centered work.... My research style ... has always started with some phenomenon and only later become theoretical.... I have tended to pick some mystery and poke it and prod it and turn it all around in an effort to figure it out" (1989, p. 50). I have expressed similar ideas less eloquently (Rubin, 1989, 1992, 1995). Here I hope I have shown by example that the phenomenoncentered approach is an efficient way to add to our knowledge of human behavior and even to theory.

The strength of the approach used here is that it documents and notes the limits of a robust phenomenon. The weakness is that a theoretical

account of the data is not as easy to obtain as it is when all experiments are derived from a single theory. At its current level of understanding, cognitive psychology needs both robust findings and good theories (see Newell, 1973). We cannot obtain a useful or complete description of cognition if we limit ourselves to a collection of phenomena or to a collection of theories, each of which accounts for a limited set of experimental procedures. Both the phenomenon-centered approach and the theory-driven approach must be expanded and integrated. One advantage of the bump is that it is a robust phenomenon that stretches the limits of current theories and thus invites a wide range of theoretical speculation.

Acknowledgments

I wish to thank Herb Crovitz, Dan Greenberg, and Bob Schrauf for their comments and the National Institute on Aging for grant number RO1 AG16340.

References

Anderson, J. R., & Schooler, L. J. (1991). Reflections of the environment in memory. *Psychological Science*, *2*, 396–408.

Aragno, A., & Schlachet, P. J. (1996). Accessibility of early experience through the language of origin: A theoretical integration. *Psychoanalytic Psychology*, *13*, 23–34.

Baltes, P. B. (1997). On the incomplete architecture of human ontogeny: Selection, optimization, and compensation as foundation of developmental theory. *American Psychologist*, *52*, 366–380.

Bartlett, F. C. (1932). *Remembering: A study in experimental and social psychology*. Cambridge: Cambridge University Press.

Bornstein, R. F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968–1987. *Psychological Bulletin*, *106*, 265–289.

Braun, K., & Rubin, D. C. (1988). The spacing effect depends on an encoding deficit, retrieval, and time in working memory: Evidence from once presented words. *Memory*, *6*, 37–65.

Brown, R. (1989). Roger Brown. In G. Lindzey (Ed.), *A history of psychology in autobiography* (vol. 8, pp. 36–60). Stanford: Stanford University Press.

Bugelski, B. R. (1977). Imagery and verbal behavior. *Journal of Mental Imagery*, *1*, 39–52.

Christianson, S.-A., & Safer, M. A. (1996). Emotional events and emotions in autobiographical memory. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical remembering* (pp. 218–243). Cambridge: Cambridge University Press.

Cohen, G., Conway, M. A., & Maylor, E. A. (1994). Flashbulb memories in older adults. *Psychology and Aging*, 9, 454–463.

Conway, M. A., & Haque, S. (1999). Overshadowing the reminiscence bump: Memories of a struggle for independence. *Journal of Adult Development*, 6, 35–44.

Crovitz, H. F., & Schiffman, H. (1974). Frequency of episodic memories as a function of their age. *Bulletin of The Psychonomic Society*, 4, 517–551.

Dempster, F. N. (1988). The spacing effect: A case study in the failure to apply the results of the psychological research. *American Psychologist*, 43, 627–634.

Erickson, E. (1950). *Childhood and society*. New York: Norton.

Fitzgerald, J. M. (1988). Vivid memories and the reminiscence phenomenon: The role of a self-narrative. *Human Development*, 31, 261–273.

Fitzgerald, J. M. (1996). Intersecting meanings of reminiscence in adult development and aging. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical memory* (pp. 360–383). Cambridge: Cambridge University Press.

Fitzgerald, J. M., & Lawrence, R. (1984). Autobiographical memory across the lifespan. *Journal of Gerontology*, 36, 692–698.

Franklin, H. C., & Holding, D. H. (1977). Personal memories at different ages. *Quarterly Journal of Experimental Psychology*, 29, 527–532.

Fredrickson, B. F., & Carstensen, L. L. (1990). Choosing social partners: How old age and anticipated endings make people more selective. *Psychology and Aging*, 5, 335–347.

Fromholt, P., & Larsen, S. F. (1991). Autobiographical memory in normal aging and primary degenerative dementia (dementia of the Alzheimer's type). *Journal of Gerontology: Psychological Sciences*, 46, 85–91.

Fromholt, P., & Larsen, S. F. (1992). Autobiographical memory and life history narratives in aging and dementia (Alzheimer type). In M. A. Conway, D. C. Rubin, H. Spinnler & W. A. Wagenaar (Eds.), *Theoretical perspectives on autobiographical memory* (pp. 413–426). Dordrecht: Kluwer Publishing.

Fromholt, P., Larsen, P., & Larsen, S. F. (1995). Effects of late-onset depression and recovery on autobiographical memory. *Journal of Gerontology: Psychological Sciences*, 50, 74–81.

Galton, F. (1879). Psychometric experiments. *Brain*, 2, 149–162.

Gergen, K. J., & Gergen, M. M. (1983). Narratives of the self. In T. R. Sarbin & K. E. Scheibe (Eds.), *Studies in social identity* (pp. 254–273). New York: Praeger.

Habermas, T., & Bluck, S. (2000). Getting a life: The emergence of the life story in adolescence. *Psychological Bulletin*, 126, 748–769.

Holbrook, M. B., & Schindler, R. M. (1989). Some exploratory findings on the development of musical tastes. *Journal of Consumer Research*, *16*, 119–124.

Holmes, A., & Conway, M. A. (1999). Generation identity and the reminiscence bump: Memories for public and private events. *Journal of Adult Development*, *6*, 21–34.

Hunt, R. R., & Smith, R. E. (1996). Accessing the particular from the general: The power of distinctiveness in the context of organization. *Memory and Cognition*, *24*, 217–225.

Hyland, D. T., & Ackerman, A. M. (1988). Reminiscence and autobiographical memory in the study of the personal past. *Journal of Gerontology: Psychological Sciences*, *43*, 35–39.

Jansari, A., & Parkin, A. J. (1996). Things that go bump in your life: Explaining the reminiscence bump in autobiographical memory. *Psychology and Aging*, *11*, 85–91.

Javier, R. A. (1995). Vicissitudes of autobiographical memories in a bilingual analysis. *Psychoanalytic Psychology*, *12* (3), 429–438.

Komura, H., Miyake, A., Chen, C., Tanizawa, O., and Yoshikawa, H. (1992). Relationship of age at menarche and subsequent fertility. *European Journal of Obstetrics and Gynecology and Reproductive Biology*, *44*, 201–203.

Larsen, S. F. (1996). Memorable books: Recall of reading and its personal context. In M. S. MacNealy & R. Kreuz (Eds.), *Empirical approaches to literature and aesthetics* (pp. 583–599). Norwood, N.J.: Ablex.

Larsen, S. F., Schrauf, R. W., Fromholt, P., & Rubin, D. C. (2002). Inner speech and bilingual autobiographical memory: A Polish-Danish cross-cultural study. *Memory*, *10*, 45–54.

Mackavey, W. R., Malley, J. E., & Stewart, A. J. (1991). Remembering autobiographically consequential experiences: Content analysis of psychologists' accounts of their lives. *Psychology and Aging*, *6*, 50–59.

Marian, V., & Neisser, U. (1997). Autobiographical memory in bilinguals. Poster session presented at the 38th Annual Meeting of the Psychonomic Society, Philadelphia.

MacDonald, S., Uesiliana, K., & Hayne, H. (2000). Cross-cultural and gender differences in childhood amnesia. *Memory*, *8*, 365–376.

Menken, J., Trussell, J., & Larsen, U. (1986). Age and infertility. *Science*, *233*, 1389–1394.

Mullen, M. K. (1994). Earliest recollections of childhood: A demographic analysis. *Cognition*, *52*, 55–79.

Newell, A. (1973). You can't play 20 questions with nature and win: Projective comments on the papers of this symposium. In W. G. Chase (Ed.), *Visual information processing* (pp. 283–308). New York: Academic Press.

Newell, A., & Rosenbloom, P. S. (1981). Mechanisms of skill acquisition and the law of practice. In J. R. Anderson (Ed.), *Cognitive skills and their acquisition* (pp. 1–55). Hillsdale, N.J.: Erlbaum.

Noble, C. E., Baker, B. L., & Jones, T. A. (1964). Age and sex parameters in psychomotor learning. *Perceptual and Motor Skills, 19*, 935–945.

Ribot, T. (1882). *Diseases of memory: An essay in the positive psychology*. New York: D. Appleton.

Robinson, J. A. (1976). Sampling autobiographical memory. *Cognitive Psychology, 8*, 578–595.

Robinson, J. A. (1996). Perspective, meaning, and remembering. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical remembering* (pp. 199–217). Cambridge: Cambridge University Press.

Rubin, D. C. (1982). On the retention function for autobiographical memory. *Journal of Verbal Learning and Verbal Behavior, 21*, 21–38.

Rubin, D. C. (1989). Issues of regularity and control: Confessions of a regularity freak. In L. W. Poon, D. C. Rubin & B. A. Wilson (Eds.), *Everyday cognition in adult and later life* (pp. 84–103) Cambridge: Cambridge University Press.

Rubin, D. C. (1992). Constraints on memory. In E. Winograd & U. Neisser (Eds.), *Affect and accuracy in recall: Studies of "flashbulb" memories* (pp. 265–273). New York: Cambridge University Press.

Rubin, D. C. (1995). *Memory in oral traditions: The cognitive psychology of epic, ballads, and counting out rhymes*. New York: Oxford University Press.

Rubin, D. C. (1998). Beginnings of a theory of autobiographical remembering. In C. P. Thompson, D. J. Herrmann, D. Bruce, J. D. Reed, D. G. Payne, and M. P. Toglia (Eds.), *Autobiographical memory: Theoretical and applied perspectives* (pp. 47–67). Mahwah, N.J.: Erlbaum.

Rubin, D. C. (1999). Autobiographical memory and aging. In D. Park & N. Schwartz (Eds.) *Aging and cognition: A student primer* (pp. 131–149). Philadelphia: Psychology Press.

Rubin, D. C. (2000). The distribution of early childhood memories. *Memory, 8*, 265–269.

Rubin, D. C., & Greenberg, D. (1998). Visual memory-deficit amnesia: A distinct amnesic presentation and etiology. *Proceedings of the National Academy of Sciences, 95*, 5413–5416.

Rubin, D. C., & Greenberg, D. L. (in press). The role of narrative in recollection: A view from cognitive and neuropsychology. In G. Fireman, T. McVay & O. Flanagan (Eds.), *Narrative and Consciousness: Literature, Psychology, and the Brain*. New York: Oxford University Press.

Rubin, D. C., Groth, L., & Goldsmith, D. (1984). Olfactory cuing of autobiographical memory. *American Journal of Psychology, 97*, 493–507.

Rubin, D. C., Rahhal, T. A., & Poon, L. W. (1998). Things learned in early adulthood are remembered best. *Memory and Cognition, 26*, 3–19.

Rubin, D. C., & Schulkind, M. D. (1997a). Distribution of important and word-cued autobiographical memories in 20, 35, and 70 year-old adults. *Psychology and Aging, 12,* 524–535.

Rubin, D. C., & Schulkind, M. D. (1997b). Properties of word cues for autobiographical memory. *Psychological Reports, 81,* 47–50.

Rubin, D. C., & Schulkind, M. D. (1997c). The distribution of autobiographical memories across the lifespan. *Memory and Cognition, 25,* 859–866.

Rubin, D. C., Schulkind, M. D., & Rahhal, T. A. (1999). A study of gender differences in autobiographical memory: Broken down by age and sex. *Journal of Adult Development, 6,* 61–72.

Rubin, D. C., & Wenzel, A. E. (1996). One hundred years of forgetting: A quantitative description of retention. *Psychological Review, 103,* 734–760.

Rubin, D. C., Wetzler, S. E., & Nebes, R. D. (1986). Autobiographical memory across the adult lifespan. In D. C. Rubin (Ed.), *Autobiographical Memory* (pp. 202–221). Cambridge: Cambridge University Press.

Rybash, J. M., & Monaghan, B. E. (1999). Episodic and semantic contributions to older adults' autobiographical recall. *Journal of General Psychology, 126,* 85–96.

Rybash, J. M. (1999). Aging and autobiographical memory: The long and bumpy road. *Journal of Adult Development, 6,* 1–10.

Schrauf, R. W. (2000). Bilingual autobiographical memory: Experimental studies and clinical cases. *Culture and Psychology, 6,* 387–417.

Schrauf, R. W., & Rubin, D. C. (1998). Bilingual autobiographical memory in older adult immigrants: A test of cognitive explanations of the reminiscence bump and the linguistic encoding of memories. *Journal of Memory and Language, 39,* 437–457.

Schrauf, R. W., & Rubin, D. C. (2000). Internal languages of retrieval: The bilingual encoding of memories for the personal past. *Memory & Cognition, 28,* 616–623.

Schulkind, M. D., Hennis, L. K., & Rubin, D. C. (1999). Music, emotion and autobiographical memory: They're playing your song. *Memory & Cognition, 27,* 948–955.

Schuman, H., Belli, R. F., & Bischoping, K. (1997). The generational basis of historical knowledge. In J. W. Pennebaker, D. Páez & B. Rimé (Eds.), *Collective memory of political events: Social psychological perspectives* (pp. 47–77). Hillsdale, N.J.: Erlbaum.

Sehulster, J. R. (1996). In my era: Evidence for the perception of a special period of the past. *Memory, 4,* 145–158.

Stevens S. S. (1975). *Psychophysics: Introduction to its perceptual, neural, and social prospects.* New York: John Wiley & Sons.

Tulving, E., & Pearlstone, Z. (1966). Availability versus accessibility of information in memory for words. *Journal of Verbal Learning and Verbal Behavior, 5,* 381–391.

Tulving, E., & Thompson, D. M. (1973). Encoding specificity and retrieval processes in episodic memory. *Psychological Review, 80*, 352–373.

Wetzler, S. E., & Sweeney, J. A. (1986). Childhood amnesia: An empirical demonstration. In D. C. Rubin (Ed.), *Autobiographical memory* (pp. 191–200). Cambridge: Cambridge University Press.

Williams, M. J. G. (1996). Depression and the specificity of autobiographical memory. In D. C. Rubin (Ed.), *Remembering our past: Studies in autobiographical remembering* (pp. 244–267). Cambridge: Cambridge University Press.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35*, 151–175.

Zola-Morgan, S., Cohen, N. J., & Squire, L. R. (1983). Recall of remote episodic memory in amnesia. *Neuropsychologia*, 21, 487–500.

Lifespan Development of Human Memory

edited by Peter Graf and Nobuo Ohta

A Bradford Book
The MIT Press
Cambridge, Massachusetts
London, England

2002