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# A Study of Gender Differences in Autobiographical Memory: Broken Down by Age and Sex

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Data from 40 older adults who produced autobiographical memories to word cues and to the request to list five important memories, and data from 60 older adults who answered factual multiple-choice questions for events spread across their lives, were analyzed for gender differences. In spite of considerable statistical power, there were no gender differences in the distribution of autobiographical memories over the lifespan, in the distribution of important memories, in various ratings provided to these memories, or in the distribution of knowledge for events. The only gender difference found was that men performed better on factual questions about current events and baseball. Thus, counter to what might be expected from Darwinian theory and some behavioral data, gender differences were minimal.

**KEYWORDS:** Aging; autobiographical; gender; memory; reminiscence.

## INTRODUCTION

The study of autobiographical memory lies at the intersection of controlled laboratory research and observational fieldwork. Researchers interested in autobiographical memory apply standard techniques of experimental cognitive psychology in an attempt to uncover lawful, regular, repeatable findings in the very aspects of a life that make a person unique. Although the precision of the laboratory is lost, the opportunity to study issues beyond the scope of the laboratory is gained (Bahrick, 1989). One such area of investigation is how differences in biology and in societal gender stereotypes interact with life events to produce an individual's autobiographical memories. The purpose of the current paper is to gain a better understanding of the distribution of autobiographical memories by examining gender differences in two separate but related domains: autobiographical memory and very-long term episodic memory for public events. As will be reviewed, there are several lines of research that suggest that gender differences should, in fact, be observed. This renders the lack of an existing literature on the subject in the cognitive psychology of adult autobiographical memory a bit surprising. More importantly, the existence, or nonexistence, of gender differences will help us evaluate different explanations for the distribution of autobiographical memories over the lifespan. Before outlining these different explanations, a brief review of recent work in autobiographical memory is provided.

The distribution of autobiographical memories can be described by three separate components. The first component is a retention function described mathematically by the power function $y = a \cdot t^{-b}$. Taking the logarithm of both sides of the equation yields $\ln(y) = \ln(a)\text{-}b\ \ln(t)$, so plotting $\ln(y)$ versus $\ln(t)$, as we do later, yields a straight line with a slope of $-b$. We choose the power function because it is what Crovitz and Schiffman (1974) used in the first quantitative description of the distribution of autobiographical memories since Galton (1879), and because it provided the best overall fit when compared with the linear, logarithmic, and exponential functions (Rubin, 1982; Rubin & Wenzel, 1996). Although dif-

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ferences exist between autobiographical memory and laboratory episodic retention functions, the power function also provides one of the best fits to laboratory retention studies (see Rubin & Wenzel, 1996, for a review), and so the power function describes retention from both kinds of episodic memory studies. This supports the interpretation that the recency portion of the autobiographical memory distribution is, in fact, a retention function.

The power-function retention component is extremely reliable in spite of the lack of controls placed on the participants. Not only do different laboratories produce the same power-function retention function for the most recent decades of life (Rubin, Wetzler, & Nebes, 1986), but the function also exists when an individual's responses or responses to individual words are analyzed (Rubin, 1982), when visual or olfactory instead of verbal cues are given (Rubin, Groth, & Goldsmith, 1984), and even when participants produce responses in the absence of any cue words (Rubin, 1982). It holds for the most recent 10 to 20 years of junior high school students, college students, middle-aged, and older participants (Fitzgerald & Lawrence, 1984; Rubin et al.'s (1986) reanalysis of Franklin & Holding, 1977). Moreover, the slopes of the power function do not vary with age, implying that the retrieval of autobiographical memories are similar for the most recent 20 years of adult participants' lives independent of their age. This finding is consistent with the laboratory literature that shows that older adults do not have any large or consistent deficits in retention (see Rubin & Wenzel, 1996, for a review).

A second component of the autobiographical memory distribution is a reduction in the memories coming from the earliest years of participants' lives: an early childhood memory or childhood amnesia function. Much work has surrounded this function (e.g., Cowan & Davidson, 1984; Eacott & Crawley, 1998; Freud, 1899/1950; Friedman & Pines, 1991; Mullen, 1994; Waldfogel, 1948), so its boundaries are relatively well known. Here, childhood amnesia is a mathematical necessity needed to force the function describing the distribution to go to zero at birth: It is difficult to fit data from people of different ages without both a retention component based on the time between encoding and recall (i.e., $t$) and a childhood amnesia component based on age at the time of the memory (i.e., current age $-t$).

We call the third component the "bump" to highlight its empirical nature and its lack of a unique theoretical framework. More autobiographical memories are recalled from when a person was between 10 and 30 years old than would be expected from the other two components. The definition of the bump used here was derived from empirical studies of autobiographical memory that used the cue-word technique (see Rubin, Rahhal, & Poon, 1998, for a review).

Recent work has also demonstrated the presence of a bump in very-long term memory for factual information. Rubin et al. (1998) found that older adults are better able to answer factual questions about public events that occurred during the period when they were 10 to 30 years old than for any other period of life except possibly the most recent decade. This finding is important because it demonstrates that the bump is not due to people selectively sampling memories from a favored period of their life, i.e., "The Good Old Days." It also allows memory to be tested using objective information. Although the bump data in autobiographical memory are reliable in that the phenomenon has been replicated in numerous labs using numerous testing procedures, there was rarely any objective way to verify that the retrieved memories ever occurred, or occurred near the date provided by the participant. The data from Rubin et al. addressed this problem and still found the bump.

The present paper is concerned with assessing gender differences in the distribution of autobiographical memory. More specifically, are the retention, childhood amnesia, and bump components of the distribution similar in men and women? Some data in the literature suggest that men and women perform differently on long-term memory tasks, including both laboratory episodic memory and autobiographical memory. For example, a review of recent experimental and longitudinal studies shows that women perform better at episodic memory tasks than do men. This result holds even when other factors are taken into account and in the absence of differences in semantic memory, working memory, and priming tasks (Herlitz, Nilsson, & Bäckman, 1997). Although Herlitz et al. found gender and age-at-testing differences across the adult lifespan, they found no interaction of gender and age at test, indicating that these gender effects were stable over the lifespan. Similarly in a review of over 5,000 participants, Meinz and Salthouse (1998) found many gender and age differences. Although their tasks did not reveal an overall gender difference for their com-

bined episodic memory or knowledge tasks, they did show that women did better on verbal episodic memory tasks. Consistent with the Herlitz et al. study, there was no interaction of gender and age at test.

A series of studies by Bahrick and his colleagues found little evidence for gender differences in very long-term retention of "knowledge" rather than episodes, that is, when semantic as opposed to episodic memory was tested. Bahrick and his colleagues have found that gender differences in retention tend to be small and usually disappear when other factors are taken into consideration (Bahrick, 1983, 1998; Bahrick, Bahrick, & Wittlinger, 1975; Bahrick & Hall, 1991). For instance, females showed superior memory for names and faces of high school classmates, but this difference disappeared when initial acquisition was controlled (Bahrick et al., 1975). Similarly, the small male superiority in the retention of the geography of the city in which they went to college disappeared when number of subsequent visits and having driven a car on campus were controlled (Bahrick, 1983). One possible exception was a male superiority for high school algebra (Bahrick & Hall, 1991).

In addition to these measures of amount or accuracy of recall, women are better in some qualitative aspects of the recall of autobiographical memories. Women's memories have been judged to be more accurate, more vivid (Ross & Holmberg, 1990), and more personally revealing, and they are generally longer (Thompson, Skowronski, Larsen, & Betz, 1996). In some (Cowan & Davidson, 1984; Friedman & Pines, 1991; Mullen, 1994; Waldfogel, 1948) but not all (Eacott & Crawley, 1998) studies of early childhood autobiographical memories, women have reported earlier memories, or a greater number of early memories, or more detailed early memories. Although not a large enough effect to be seen in all studies, it is consistent with observations of early parent-child interactions (Fivush, 1998). Both mothers and fathers reminisced differently with their 40- and 70-month-old sons and daughters. When reminiscing with daughters, parents elaborated more, provided more feedback, and discussed emotional aspects of the past more often, especially negative emotions. Perhaps because of this differential treatment, the daughters recalled more information in part by adding more spatial-temporal and evaluative context to their recalls.

The quantitative data on dating provides a similar picture, with women dating events more accurately. For instance, Auriat (1992) found that men were more likely than women to make an error in dating the couple's move from one city to another. Similarly, Thompson et al. (1996) and Skowronski and Thompson (1990) found that women were more accurate in dating events they recorded in a diary. When the effect was examined more closely, Thompson et al. found that the difference could be explained by the number of events dated correctly. Women made fewer errors than did men, but once an error was made its magnitude was the same for men and women.

Thus, the research on very long-term autobiographical, episodic memory suggests that women generally outperform men, though it is important to note that, when gender differences are obtained, they are usually small. Thus, one might predict that women will perform better on a questionnaire designed to assess memory for public events over the last 60 years. Similarly, one could predict that women will score significantly higher than men on measures of the qualitative aspects of autobiographical memory such as vividness or emotionality. Finally, some evidence indicates that women should retrieve more memories from early childhood than men, or, put another way, that the average age of autobiographical memories retrieved by women will be older than that for men. The viability of these predictions is somewhat tenuous, however, because gender differences in the literature are usually small in magnitude.

Other predictions regarding gender differences are possible. For example, Rubin et al. (1998) have recently proposed several competing theoretical accounts for the bump, many of which would not predict any gender differences in autobiographical memory. For example, a cognitive account for the bump can be based on standard principles of experimental psychology applied to a situation in which the environment is changing. Under this account, events from early adulthood are remembered best because they occur during a period in which rapid change is giving way to relative stability. Novel events from a time of rapid change benefit from a host of memory-enhancing processes including increased effort to understand the event, minimal proactive interference, and distinctiveness. However, there are also mnemonic costs to rapid change that occur mostly after encoding. These include a memory organization that is not the same at encoding as it is at retrieval and less retrieval, especially less spaced retrieval. Periods of stability produce the opposite effects. Thus,

the best situation for memory is the beginning of a period of stability that lasts until retrieval. Events from such a period are still novel but are more likely to be retrieved later and thus will benefit from both memory-enhancing processes available during periods of change and periods of stability. Unless there are gender-linked changes in the life course in a particular society, one would expect no gender differences from this account.

A second account based on an inflection in cognitive abilities also predicts no gender differences. Many cognitive abilities, as indexed by processing speed or scores on standardized tests, rise and fall as a function of age. For these indices there is a rapid, major increase in abilities followed by a period of slow decline. This pattern could account for the bump, if a nonlinear relation between abilities and amount learned (e.g., ability cubed) were assumed. A third account can be based on identity formation (Erickson, 1950), which develops in late adolescence. Identity formation could provide its own explanation or could be used as an added motivation for using the cognitive mechanisms of the first account. Again, unless there are fairly large gender differences in the time course of identity formation, no gender differences in autobiographical memory would be predicted from this account.

Although these three models differ in terms of the hypothesized mechanism for the bump, none would predict gender differences. A fourth account, based on Darwinian theory, does predict gender differences. The period of the bump could be special because it is the time of greatest fecundity, of the greatest potential to reproduce. The increase in memory during the bump could be in the service of cognitive functions needed in selecting the best mate. This account predicts a gender difference in that there are gender differences in fecundity over the lifespan, with men having a more gradual decline than women (Menken, Trussell, & Larsen, 1986). Thus, a strong and unique prediction from Darwinian theory is that men should have a more shallow decline of lifespan memories than women, with the bump extending later in life (i.e., into their forties).

In sum, recent empirical work predicts small gender differences in autobiographical and long-term episodic memory, with women showing a slight advantage over men. Recent theoretical work, on the other hand, makes two different predictions. A variety of theoretical explanations for the bump (novel environment, cognitive speed, and identity formation) predict no gender differences, whereas one (Darwinian) predicts a shallower, broader bump for men. To examine these predictions of potential gender differences, autobiographical and factual memory for events encoded over the lifespan were examined using data we had collected earlier. In particular, in the next section, titled Autobiographical Memory, we examined the autobiographical memories of 40 adults aged either 70 or 73 who were cued by 124 words and who were also asked for important memories (Rubin & Schulkind, 1997a, 1997b, 1997c) and in the section titled Memory for Public Events we examine the accuracy of multiple-choice answers of 60 adults between the ages of 66 and 72 to public event questions in three domains (Rubin et al., 1998). We also report, with less emphasis, the data from the undergraduates who served as comparison groups for the older participants.

## AUTOBIOGRAPHICAL MEMORY

Over the course of two sessions 40 older adults (20 male and 20 female), half of whom were 70 years old and half of whom were 73 years old, and 20 undergraduates (8 male and 12 female) took part in the following procedures, which are described more fully in Rubin & Schulkind (1997a). In individual testing, each participant was first cued with 124 nouns. For each noun they were asked to record a brief description of an event from any point in their lives. It was stressed that the memory should be for an event that occurred at one particular place and time. Participants worked at a desk facing a wall so that the experimenter was out of sight. After all 124 cue words had been presented, the participants were asked to return to each of their descriptions and date it using a month, day, and year. The participants were then asked to record in two to three sentences the five most important events of their lives and to date them. The experimenter prepared a histogram of the dates of the 124 events, broken down into 5-year blocks, and randomly selected one from each block for the older adults and five per block for the younger adults.

When participants were finished with the descriptions of the five important events, they were asked for similar descriptions of the memories selected from the 124 cued events. After those descriptions were complete, participants were asked to answer a series of questions about each of the de-

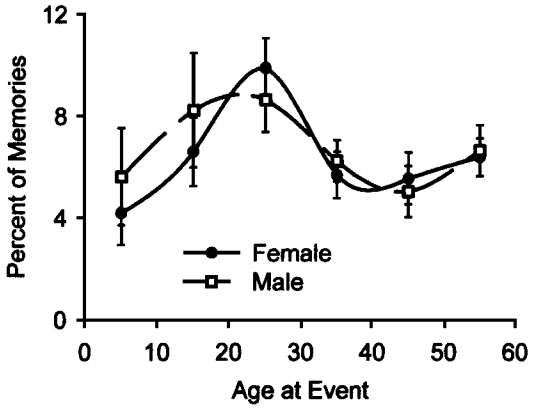


**Fig. 1.** The distribution of the word-cued autobiographical memories for the 70- and 73-year-old men and woman by decade. The values for the 60-70 decade, which are not shown to avoid compressing the *y*-axis, are: female, 64.68% (*SE* =5.37%); males, 59.56% (*SE* = 6.84%). Error bars are ± 1 standard error.

scriptions, both the five important ones and the experimenter-selected ones. Five questions used 7-point rating scales to evaluate the following aspects of the events: Vividness (no image to as clear as the original), Pleasantness (equal to my most unpleasant memory to equal to my most pleasant memory), Significance (made no difference in my life to changed my life as much as any event), Novelty (totally routine to equal to my most unusual event), and Frequency of Rehearsal (never to as often as any event in my life). One question used a 3-point scale. It asked from what memory perspective (Nigro & Neisser, 1983; Robinson & Swanson, 1993) the event was visualized: +1 if from the field of view of the original participant as a perceiver, -1 if from the point of view of an observer, and 0 if neither perspective fit. An Emotionality scale was calculated as the absolute value of the Pleasantness scale value minus 4 (i.e., absolute distance from neutral).

We present the distribution of word-cued memories for the older adults by gender, organizing these results into three sections: (a) memories from the lifespan as a whole, displayed by decade, (b) memories from the earliest decade of life, displayed by 2-year intervals, and (c) memories from the most recent decade, displayed on logarithmic scales. For the undergraduates, their earliest and most recent decades accounted for their entire 20 years of memories. Because they differed little from the older adults, our current focus, and because they showed no gender differences, we do not display their results. Next, we attempt to further understand the memory retrieval process by using (d) the distribution of the five most important memories and (e) the rating-scale responses that participants made to their important memories and their word-cued memories.

### The Distribution of Word-Cued Memories over the Lifespan

Figure 1 shows the distribution of memories for the 70- and 73-year-old males and females for each of the first six decades of their life. The 60 to 69 decade contains more than 10 years, extending beyond 69 into these participants 70th or 73rd year. Because so many memories came from this decade, it is left off the graph to avoid compressing the scale. The values for that point are: female, 64.68% (*SE* = 5.37%); males, 59.56% (*SE* = 6.84%). Overall, the male and female plots are similar. There appears to be a tendency for the males to have more early memories, but this is not significant. An 7 (Decade) × 2 (Gender) analysis of variance (ANOVA) showed an effect of decade [$F(6, 228) = 114.25$, $MS_e = 156.16$, $p < .0001$] but no effect of gender [$F(1, 38) = 0.00$, $MS_e = 21.87$] nor of their interaction [$F(6, 228) = .37$, $MS_e = 156.16$]. Because each participant gave the same number of memories, the lack of a gender effect was designed into the experiment. In contrast, a Decade × Gender interaction was possible. This interaction has the same error term as the decade main effect, which was significant at the $p < .0001$ level, and so there was sufficient power to detect an interaction much smaller than the decade effect shown in Fig. 1. A more sensitive measure of the effect of gender on the distribution of autobiographical memory might be to provide a mean age-of-memory measure for each participant. The distribution of age of memories is highly skewed, as indicated in the power function fit that will be shown in Fig. 3. Thus, a logarithmic transformation was used to avoid having the presence or absence of a few old memories swamp differences among the more recent memories. When the average logarithm of the age of the memories from each participant was calculated, the males and females did not differ in the age of their memories [$F(1, 38) < 1$]. The geometric mean ages of memories for males and females were 347and 272 days, respectively.

Focusing on the bump, there were more memories in the 10- to 30-year period regardless of whether this bump period was compared with the surrounding years [0 to 10 and 30 to 40; $F(1, 38) = 15.45$, $MS_e = 23.48$, $p < .001$] or the following years [30 to 50; $F(1,$

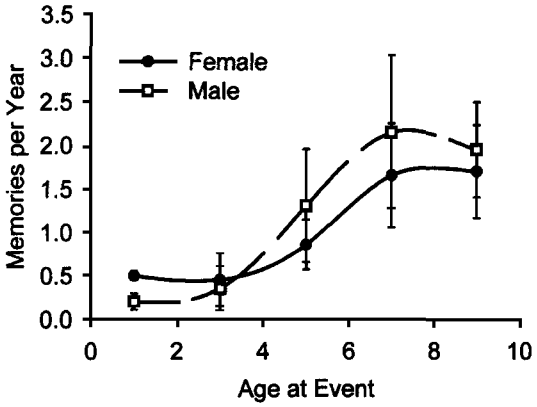


**Fig. 2.** The distribution of the word-cued autobiographical memories for the 70- and 73-year-old men and women for the first 10 years of their lives. Error bars are ± 1 standard error.

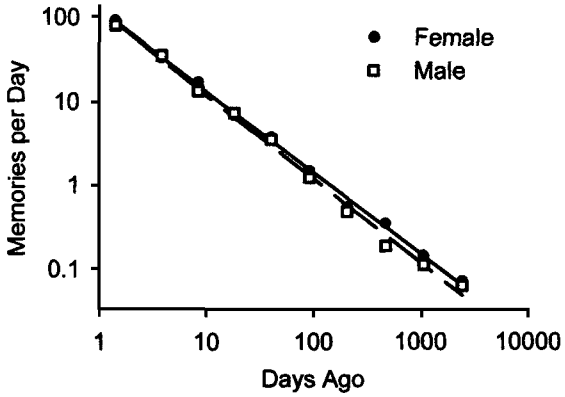


**Fig. 3.** The distribution of the word-cued autobiographical memories for the 70- and 73-year-old men and women for the most recent 10 years of life plotted on logarithmic axes.

38) = 4.55, $MS_e$ = 67.26, $p < .05$]. In neither case was there a significant effect of gender, nor did gender interact with bump effect (all $F$s < 1).

### The Distribution of Word-Cued Memories over the Earliest Decade

To fully describe the distribution of autobiographical memories, a component is needed that goes to zero at some age between 0 and 3. People do not retrieve autobiographical memories from before they were born, and few memories are reported from before the age of 2 or 3. This component must be different from a retention function, which is based on time ago rather than time from birth (i.e., age). Figure 2 plots the average number of memories per participant for the older participants separated by gender over the first 10 years of life, using bins that are 2 years wide to reduce the noise in the data. An ANOVA corresponding to the points in Fig. 2 showed an effect of 2-year period [$F(4, 152) = 9.67$, $MS_e = 2.69, p < .0001$], but no effect of gender [$F(1, 38) = 0.24$ $MS_e = 13.05$] nor of a Period × Gender interaction [$F(4, 152) = 0.22$, $MS_e = 2.69$].

### The Distribution of Word-Cued Memories over the Most Recent Decade

Figure 3 presents the distribution of males and females from the most recent 10 years of life. In examining the retention of memories over the most recent 10 years, we used logarithmic scales because in past work (Rubin, 1982; Rubin & Wenzel, 1996; Rubin et al., 1986) the retention function for recent years has been a power function, that is, a straight line on logarithmic scales. We excluded memories less than 1 day old because the dating procedure did not distinguish well among them. The remaining period of 3,652 days between one 1 and 10 years was divided into 10 equal steps on a logarithmic scale, each step being approximately twice as long as the one more recent than it. The number of memories falling within each step was calculated for each group as a whole.

Fits were made with the power function expressed as $\ln(y) = \ln(a)\text{-}b\ \ln(t)$. For the males and females, the slopes (with standard errors in parentheses) were -1.01 (0.02) and -0.97 (0.02). The $r^2$ values were .995 and .998, respectively. These values agree with earlier work and again provide little indication of gender differences.

### The Distribution of Important Memories over the Lifespan

The distribution of the memories selected by the participants as being their five most important is shown in Fig. 4. There was an effect of decade [$F(6, 228) = 21.47$, $MS_e = 267.43, p < .0001$]. Again, there was no effect of gender, nor was the interaction significant (Both $F$s < 1). For both men and women, the distribution of important memories peaked mainly in the 20 to 29 decade. There was a striking difference between the distribution of word-cued and important memories. First, the important memories in the bump were concentrated in the single 20 to 29 decade. Second, there is a lack of important memories from recent years, whereas in the word-

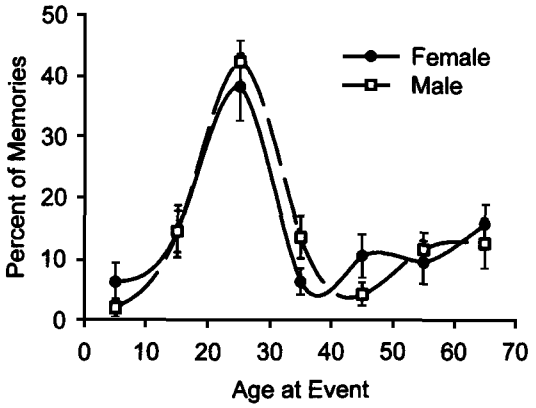


**Fig. 4.** The distribution of the five important memories for the 70- and 73-year-old men and woman by decade. Error bars are ± 1 standard error.

cued memories the most recent decade accounted for about 60% of the memories. Nonetheless, again there were no gender differences.

*Ratings of Selected and Important Memories*

After the 124 cue words were given, up to 14 memories were selected from among those cued to produce a uniform distribution of memories over the lifespan. Each of these memories, as well as the important memories, were rated on five 7-point rating scales (Vividness, Pleasantness, Significance, Novelty, and Frequency of Rehearsal) and on one 3-point scale (Memory-Perspective). In addition, emotionality was calculated as the absolute value of the Pleasantness rating minus 4, the neutral value on the scale. The scales appear to have some validity. For five scales that one would assume to have higher ratings for the important memories than the word-cued memories (i.e., Vividness, Significance, Novelty, Frequency of Rehearsal, and Emotionality) the important memories were rated statistically more highly than word-cued memories in all cases. However, no gender differences appeared in the ratings when data from only the older participants were analyzed in 14 separate ANOVAs (seven questions for both important and word-cued memories). When data from the younger and older participants were included in 2 (Age) × 2 (Gender) ANOVAs there were age effects, but only two significant gender effects: Vividness for word-cued memories [$F(1, 55) = 5.33$, $MS_e = .47$, $p < .05$, females mean = 5.96, males mean = 6.38] and Novelty for important memories [$F(1, 55) = 7.75$, $MS_e = .55$, $p < .05$, females mean = 4.80, males mean = 4.26]. In addition, there was one Age × Gender interaction for Pleasantness in the word-cued memories [$F(1, 55) = 6.00$, $MS_e = 1.65$, $p < .05$], which was caused by the fact that older males' ratings were quite a bit higher than those of the younger males (5.89 vs. 4.05) whereas the older and younger females' ratings did not differ (5.19 and 5.10, respectively). Given that there were 14 gender main-effect comparisons and 14 Gender × Age comparisons, we cannot rule out that these effects occurred by chance.

## MEMORY FOR PUBLIC EVENTS

A questionnaire was assembled and administered which provides a direct test of the claim that events from early adulthood are remembered best. Rather than testing for gender differences in the recall of personal autobiographical memories, here we tested for gender differences in the multiple-choice recognition of semantic, general knowledge of public events learned at different periods of life. In forming the questionnaires (a) we included questions that were chosen in a mechanical or algorithmic fashion to have *nominally* equal difficulty; (b) we made questionnaires for different knowledge domains to ensure our results would not be limited to one area; (c) we formed questions for almost every year, but averaged across years to provide a value for each decade to minimize the effect of a few especially easy or hard questions; and (d) we administered the questionnaire to different groups at two different times separated by a decade so that we could further average over particular questions. Five different sets of five-alternative multiple-choice questions were formed: (1) What two teams competed in the World Series? (2) What movie won the Academy Award for best picture? (3) Who won the Academy Award for best actor or actress? (4) What was the most important current event for a particular year? and (5) Who lost the presidential election? These five domains were collapsed into three topics for the analysis presented here: World Series, Academy Awards, and current events.

In 1984, tests were given to 30 Duke University undergraduate students and 30 older adults from the laboratory pool of the Mental Performance and Aging Laboratory at the Boston Veteran's Administration Hospital. Ten years later, in 1994, tests were given to 30 Duke University undergraduate students and 30 older adults from the Duke Center of Aging and De-

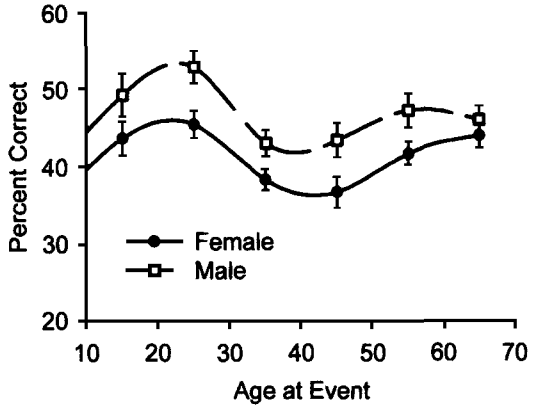


**Fig. 5.** The percent of correct answers of the older men and women to a weighted combination of all the five-alternative multiple-choice questionnaires as a function of their age at the time of the event. The *y*-axis begins at the chance guessing level of 20%. Error bars are ± 1 standard error.

velopment. Participants were tested in small groups. Each person was given a questionnaire packet that consisted of several questionnaires. They were instructed to answer the questions as quickly as possible. Participants were informed that, because of the nature of the information requested, no one would be likely to be able to answer all of the questions accurately, and therefore, they should guess if necessary. The order of the questionnaires was counterbalanced. Participants were given as much time as needed to complete the questionnaire packet and usually finished within 2 hours. For more details on the questionnaire and participants see Rubin et al. (1998).

Data were grouped by the average age of the participant's group at the time of testing regardless of the year of the test. Performance of the older adults on a combined measure for all questionnaires based on the average number of questions in each questionnaire is shown in Fig. 5. The *x*-axis denotes the age of the participants at the event described in the questions. The *y*-axis denotes the mean percentage correct responses. Because each question had five possible answers, the *y*-axis begins at the one-in-five or 20% chance responding level. Each point on the graph represents the mean percentage correct responses made across 10-year periods and is placed at the midpoint of each 10-year decade (e.g., 15 for the 11-20 decade). The older participants were generally more accurate at responding on questions derived from the decades in which they were 11 to 30 years of age than any other decade except, possibly, the most current decade of their lives.

Several ANOVAs were used to investigate gender differences. Corresponding to Fig. 5, we performed a 7 (Decade) × 2 (Gender) ANOVA. There was a main effect of decade [$F(6, 348) = 15.28$, $MS_e = 69.60$, $p < .0001$] and gender [$F(1, 58) = 6.81$, $MS_e = 418.26$, $p < .05$], but not of the interaction [$F(6, 348) = 0.66$, $MS_e = 69.60$]. The decade main effect, which was significant at the $p < .0001$ level, and the Decade × Gender interaction had the same error term, so there was sufficient power to detect an interaction much smaller than the decade effect shown in Fig. 5. We also examined differences among age groups and the three topic or content domains of World Series, Academy Awards, and current events in a 3 (Topic) × 2 (Gender) × 2 (Age) ANOVA. Decade was not included to allow the older and younger participants to be compared. Here there were main effects of topic [$F(2, 232) = 204.24$, $MS_e = 91.61$, $p < .0001$], age [$F(1, 116) = 13.65$, $MS_e = 22{,}846$, $p < .0005$], and gender [$F(1, 116) = 16.87$, $MS_e = 22{,}846$, $p < .0001$]. Of the interaction terms, only the Topic × Gender interaction was significant [$F(2, 232) = 5.60$, $MS_e = 91.61$, $p < .005$]. The *F*s for the remaining interaction terms were all less than 1, with the exception of the Topic × Age interaction [$F(2, 232) = 2.23$, $MS_e = 91.61$, $p = .11$].

To further investigate the Topic × Gender interaction, the effect of gender was assessed separately for each knowledge domain. Significant effects of gender were obtained for current events [$F(1, 116) = 18.51$, $MS_e = 146.66$, $p < .0001$] and the World Series [$F(1, 116) = 6.76$, $MS_e = 187.96$, $p < .05$], but not for entertainment ($F < 1$). The means (and standard errors in parentheses) for World Series, Academy Awards, and current events were 32.29 (1.29), 36.18 (0.71), and 55.66 (1.18), respectively. The means (and standard errors in parentheses) for younger and older participants were 38.88 (1.07) and 43.86 (1.14, respectively). The means (and standard errors in parentheses) for men and women were 44.24 (1.29) and 38.60 (0.88), respectively. The interaction of gender and domain appears to have been caused by the differences between men and women being 9.51 for the current events, 6.51 for the World Series, and 0.90 for the Academy Awards. Thus, males tended to perform better than females, older adults performed better than younger adults, current event questions were easier to answer than either Academy Award or World Series questions, and the gender differences were larger for World Series and current event questions. There was no interaction of

gender and the decade of life in which the factual events occurred.

One set of explanations for the gender differences found on the factual information study can be derived from the literature on gender differences in multiple-choice testing procedures. Males tend to perform more accurately than females when a multiple-choice testing format is employed on many standardized tests (Wester, 1995) and this gender difference is evident across several areas of information such as math and English achievement (Bolger & Kellaghan, 1990). Several hypotheses as to why this occurs have been posited. Gellman and colleagues found that, although males show a preference for multiple-choice tests over all other testing formats, females overwhelmingly prefer essay questions (Gellman & Berkowitz, 1993). Males are also more likely to guess on a multiple-choice question. Ben-Shakhar and Sinai (1991) demonstrated that males outperformed females on a variety of multiple-choice tests, but this difference was diminished for every domain when guessing was corrected for in the analyses. Such studies provide a possible explanation for the gender differences found here. Males prefer, guess more often, and typically outperform females on multiple-choice tests, but the gender difference in performance is diminished when the test format is changed or a correction for guessing is imposed. Such general factors documented outside our study, rather than memory for facts acquired over the lifespan, may be causing part of our gender differences. However, it is unlikely that a simple guessing-versus-not-guessing strategy is the explanation, as our participants were strongly encouraged to guess and left few answers blank. Rather, any guessing explanation would have to be based on the effort or sophistication used in the guessing strategies.

There is additional evidence that a different test format would not completely remove the gender difference. Botwinick and Storandt (1974) had similar questions for current events and entertainment, but used both recall and recognition. For both test formats, there were gender differences for the current events questions. Thus, it is likely that some of the gender difference obtained here reflected a difference in knowledge for specific domains.

## DISCUSSION

Negative findings often add little to the literature, but here negative findings for gender and for Gender × Decade interactions occurred in the presence of the power to find $p < .0001$ level effects for other factors, and so add to the generality of the results. Moreover, to the extent that such results disagree with an existing theory, they provide disconfirmation of that theory. Within the precision of the data obtained, men and women did not differ in their distributions of autobiographical memories over the lifespan, in the distributions of important memories, in a set of seven theoretically motivated rating scales provided to these memories, and in the distribution of knowledge for events. The only gender difference found was that men performed better than women on questions about current events and baseball. These results were largely in keeping with recent work in the field which sometimes does and sometimes does not reveal small effects of gender. Although the direction of the one statistically significant finding was different from what is usually obtained—men outperforming women, instead of the opposite—these results appeared to have more to do with overall knowledge or test-taking strategies than with changes in episodic or autobiographical memory over the lifespan. Thus, if any gender differences in the distribution of autobiographical or event memory over the lifespan did exist, they must have been small.

The most telling interpretation of the results has to do with the Darwinian explanation for the bump. This account makes predictions about the nature of gender differences in the distribution of autobiographical memories. Men's peak period for reproduction lasts longer; therefore, they should show a broader peak in autobiographical memory retrieval. None of the data reported or reviewed in this paper support this claim. Thus, by default, accounts based on the novelty of the environment, cognitive speed, and/or identity formation are supported over the Darwinian account. Although the data reported here do not help us choose one of these explanations over the other, some recent work has shown that changes to the environment do have a significant effect on the bump. Schrauf and Rubin (1998) found that immigration from one country to another that occurred when the person was over age 30 reduced the number of memories in the 10- to 30-year-old bump and increased the number of memories that occurred after the migration.

Finally, a potentially interesting result was the lack of gender differences on the qualitative measures of autobiographical memories. Several lines of

research reviewed above led us to expect that women would score significantly higher than men on these measures. They did not. However, one possible explanation for the lack of gender differences may have to do with baseline levels of Vividness, Emotionality, and other scales used by men and women. If men and women rated their memories against all other events stored in memory, as they were instructed, and women's memories have higher baseline levels on these scales, the testing procedure would have failed to uncover any effect. Thus, gender differences in the quality of autobiographical memories may yet be found to exist if a testing procedure can be devised that circumvents this problem.

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