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Music, emotion, and autobiographical memory: They're playing your song

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Very long-term memory for popular music was investigated. Older and younger adults listened to 20-sec excerpts of popular songs drawn from across the 20th century. The subjects gave emotionality and preference ratings and tried to name the title, artist, and year of popularity for each excerpt. They also performed a cued memory test for the lyrics. The older adults' emotionality ratings were highest for songs from their youth; they remembered more about these songs, as well. However, the stimuli failed to cue many autobiographical memories of specific events. Further analyses revealed that the older adults were less likely than the younger adults to retrieve multiple attributes of a song together (i.e., title and artist) and that there was a significant positive correlation between emotion and memory, especially for the older adults. These results have implications for research on long-term memory, as well as on the relationship between emotion and memory.

The belief that music is a powerful mnemonic device is widespread. For example, preliterate societies often use music to help transmit important cultural information (Rubin, 1995), and the advertising industry makes frequent use of music under the assumption that it will enhance memory for a product and its attributes. People often claim to remember the words and melody of a long-forgotten song after hearing a brief excerpt on the radio.

Empirical evidence confirms that text is remembered better when it is accompanied by music (Wallace, 1994; Wallace & Schulkind, 1999; Yalch, 1991), at least over relatively short retention intervals. Evidence of the mnemonic power of music over longer retention intervals is less abundant, although very long-term memory for some types of information (Bahrack, 1983, 1984a, 1984b; Bahrack, Bahrack, & Wittlinger, 1975; Rubin, Rahhal, & Poon, 1998; Rubin, Schulkind, & Rahhal, 1999), including music (Bartlett & Snelus, 1980), has been documented. For example, Bartlett and Snelus (1980) measured memory for music popular across the 20th century. Older adults (70–86 years of age in 1977) reported a high degree of familiarity with songs popular from the 1920s through the 1940s. They correctly estimated the decade of popularity for 40% of the songs that they rated as familiar and recalled at least three lines from 25% of these songs. Because the objective memory measures were not broken down by decade, we

cannot be sure from how far back these listeners were able to retrieve objective information. However, the data from them show that people retain detailed knowledge of popular songs over the course of their lifetimes.

The experiment reported in the present paper was designed to provide a more complete picture of the durability of memory for music, using a methodology similar to that used by Bartlett and Snelus (1980). One group of older adults (65–70 years old) and one group of younger adults (18–21 years old) listened to a series of songs that were popular from the years 1935–1994. In addition to providing objective information about the songs (artist, title, year of popularity), the subjects rated their preference for and their emotional response to each song. Finally, the subjects were asked whether each song reminded them of a general period or a specific event from their lives.

The study was designed to address three specific issues. First, we were interested in examining memory for popular music across very long retention intervals. Previous work on lifespan memory of older adults has revealed a consistent pattern. Of particular interest is the fact that memory tends to be best for events that occur in young adulthood (Rubin et al., 1998; Rubin & Schulkind, 1997a, 1997b; Rubin, Wetzler, & Nebes, 1986). The present experiment was expected to reveal a similar pattern, especially because most people begin to lose interest in popular music after young adulthood. However, we must be certain that older adults' superior memory for older songs does not arise because these songs are "classics" familiar to everyone. Therefore, a group of younger adults was tested so that we could be certain that people born much later in the century did not share the knowledge demonstrated by older adults.

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Although it would be very surprising if older adults did not demonstrate better memory for songs from the first half of the century than from the second half, it is difficult to predict exactly how much information they will remember. Will they have little more than a feeling of familiarity with these songs? Or will they be able to sing them as if they had heard them only yesterday? In other words, how will long-term retention of musical stimuli compare with long-term memory for other types of information (see, e.g., Bahrick, 1984b)? We addressed this question by comparing the older and younger adults' memories for songs that they had heard prior to the experimental session.

The second issue of interest was the efficacy with which music would serve as cues for autobiographical memories. Most studies of autobiographical memory have adopted the cue-word technique of Galton (1879) as adapted by Crovitz and Schiffman (1974); subjects are read a word and are asked to retrieve a memory based on the cue. Subsequent research has shown that personally relevant cues reduce the latency to produce autobiographical memories (Conway & Bekerian, 1987). However, personally relevant cues tend to be highly idiosyncratic to individual subjects and therefore are difficult to use in experiments. Popular music might be particularly useful for eliciting autobiographical memories because it is both universally available and personally relevant (if one takes into account when and where the music was heard).

Third and finally, the experiment addressed the relationship between emotion and memory. One explanation for why music may be retained over long retention intervals is that it induces, or at the very least represents, emotion (see, Krumhansl, 1997, for a discussion). In fact, emotional response is frequently given as the primary reason for listening to music (Pansepp, 1995). According to Bower (1981), emotional feelings serve as retrieval cues for memories associated with that emotion. Therefore, songs that elicit more emotional responses should be remembered better and should also elicit more autobiographical memories than should songs that elicit more moderate emotional responses. In other words, Bower's theory predicts that there should be a high elicitation correlation between emotionality and the various memory measures employed in the present study.

METHOD

Subjects

Eighteen Duke University undergraduates (12 females) between the ages of 18 and 21 ($M = 19.0$, $SD = 1.2$) received partial credit toward a course requirement. Eighteen older adults (7 females) between the ages of 66 and 71 ($M = 67.5$, $SD = 2.2$) were contacted through the Subject Register of the Center for the Study of Aging and Human Development at Duke University Medical Center. The older adults received \$5 for their participation. The experiment was conducted between September and December of 1997.

Before the experiment began, all subjects completed a background questionnaire. On average, the older adults had completed

16.1 ($SD = 2.65$) years of education, whereas the younger adults had completed 13.8 ($SD = 0.94$); this difference was significant [$t(34) = 3.51$, $p < .01$]. The subjects were also asked to rate their overall health on a 4-point scale (1 = *poor*, 4 = *excellent*). Both the older ($M = 3.67$, $SD = 0.49$) and the younger ($M = 3.39$, $SD = 0.50$) adults reported themselves to be in good health. The two groups did not differ significantly on this measure [$t(34) = 1.69$, $p > .10$].

Materials

Sixty songs that were originally released between the years of 1935 and 1994 were selected. Every song met the following criteria. First, it had been among the 20 most popular songs for the year of its release, but not the No. 1 or 2 song for that year. Second, the song had never appeared in the "Top 20" in any subsequent year; this included "cover" versions recorded by different artists. These criteria were verified by consulting two sources (Elrod, 1994; Whitburn, 1993). Finally, songs from the most popular artists (e.g., Elvis Presley, The Beatles) were excluded, because these songs were likely to have appeared on subsequent "Greatest Hits" or "Best of" compilations. An attempt was made to select one song from each year. However, there were several years for which recordings were not available for any song that met the selection criteria. Songs from those years were replaced by an additional song from one of the surrounding years (see the Appendix). Because it was not always possible to locate a recording by the original artist, some excerpts were taken from versions recorded by other artists. An effort was made to choose recordings from approximately the same time period. For example, Bing Crosby's 1937 recording of "Pennies from Heaven" was replaced with a version performed by Count Basie and his Orchestra from the same year. This use of original, contemporaneous recordings preserved the style, instrumentation, and words of the songs as well as the melody. Although confounding these aspects of the recording probably elevated recall performance over that which the melody alone would have produced, original recordings were used to facilitate emotional responses and autobiographical memory retrieval.

Twenty seconds of each song were dubbed onto audio tape. The excerpts never contained the title of the song or a section from a repeating chorus. The songs were divided into 10-year blocks (1935–1944, 1945–1954, etc.). Presentation order was randomized, with the constraint that one song from each block must be sampled before a second song could be drawn from a particular block.

After hearing each excerpt, the subjects were asked the following questions in the following order (when relevant, response options are given in parentheses): (1) Have you ever heard this song before today (yes/no)? (2) What year was the song popular? (3) How much do you like this song (dislike a lot/moderately dislike/neutral/moderately like/like a lot)? (4) How does this song make you feel (very unhappy/moderately unhappy/neutral/moderately happy/very happy)? (5) Does this song remind you of anything from your life (Yes, a specific event/Yes, a general period/No)? (6) What is the title of this song? (7) What singer/band recorded it? For the final question, the subjects were given a single line from the song and were asked to provide the next four to five words in the song. Neither the cue nor the response was part of the title or chorus, nor did they appear in the excerpts played for the subjects.

Procedure

The subjects were tested either individually or in groups of up to 4. Those tested individually (12 older adults; 8 younger adults) gave verbal responses that were recorded by the experimenter; those tested in groups wrote their responses in a booklet. They were then given detailed instructions about the stimuli that they would hear and the questions that they would be asked. The stimuli were presented on a stereo cassette player controlled by the experimenter. After each excerpt, the tape was paused while the subjects answered the ques-

tions for that excerpt. The subjects were given as much time as they needed to record their responses and were given the opportunity to take a break halfway through the experiment. After each trial, the experimenter read the correct title, artist, and year of popularity. For this reason, the subjects were not allowed to change a response from a previous trial. The entire experiment took approximately 1.5 h, although some older adults required up to 2 h.

RESULTS

The data for each subject were partitioned into decades (1935–1944, 1945–1954, etc.); average values were calculated for each decade. For the year of popularity measure, the average absolute difference between the subject's estimate and the actual year of popularity was calculated. The artist and title measures (percentage of correct responses) were combined with the data from the cued lyric test (percentage of words recalled from the target line) to form a composite recall memory measure. All analyses reported for this combined recall memory measure held for each of the individual measures with one exception: There was a significant effect of age (younger adults performed better than older adults) on the artist measure but not on the combined recall measure. Finally, the data for the general period and specific event measures represented the percentage of songs that elicited one or the other type of memory. These data were subjected to 2 × 6 mixed factorial analyses of variance (ANOVAs). Age (older vs. younger) was a between-subjects variable, and decade was a within-subjects factor. The results of these analyses ($\alpha = .05$ for every analysis reported in the paper) are presented in Table 1, with the relevant data displayed in Figures 1–5).

The analyses revealed significant age differences for the familiarity, year of popularity, and specific event measures, and marginally significant age differences on the general period measure. Younger adults dated songs more accurately than older adults and also produced more of both kinds of autobiographical memories; in fact, older adults retrieved specific event memories on less than 5% of the trials. However, older adults reported greater familiarity with the music than did younger adults, possibly because they were alive for the entire period under study. The analyses also revealed significant effects of decade for every dependent measure; the effect was marginal for

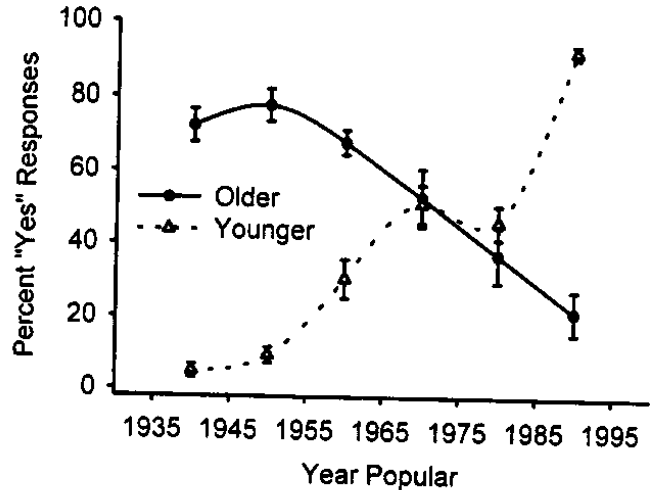


Figure 1. Mean percent songs rated familiar by decade and age of subject. For all figures, error bars represent one standard error.

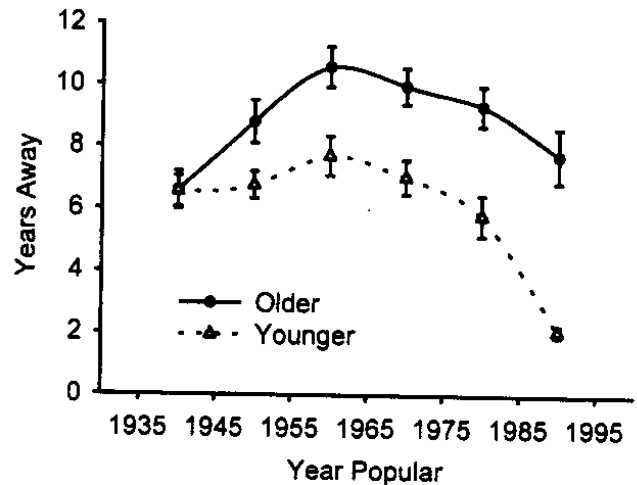


Figure 2. Mean absolute difference between actual year of popularity and subjects' ratings by decade and age of subject.

the emotionality ratings. In most cases, the decade effect appears to have been due to extremely high values generated by the younger adults for the most recent decade. Both the recall and the familiarity ratings show a small rise for the 1965–1974 decade. This might represent an item effect because some of the performers from this decade currently receive airplay on “oldies” or “classic rock” stations (e.g., Elton John, Jackson 5, Moody Blues, BeeGees).

More importantly, the analyses for every dependent measure revealed significant age × decade interactions. For all but two measures, this occurred because of the predicted cross-over effect: The older adults yielded higher scores than did the younger adults for the more remote decades, with the opposite occurring for more recent decades. The two exceptions were the specific event mea-

Table 1
F Values and MS_es for the 2 (Age) × 6 (Decade) ANOVAs for Each Dependent Measure

Measure	Age (df = 1,34)		Decade (df = 5,170)		Age × Decade (df = 5,170)	
	F	MS _e	F	MS _e	F	MS _e
Familiarity	8.03	0.17	8.97	0.02	130.77	0.02
Year popular	27.01	16.3	17.30	4.71	6.47	4.70
Recall	1.81	0.05	28.98	0.01	96.32	0.01
Emotionality	0.39	0.06*	2.58	0.09†	18.27	0.09
General period	3.36	0.20†	5.33	0.03	15.64	0.03
Specific event	9.59	0.03	10.87	0.09	15.64	0.09

*Not significant. †.05 < p < .10.

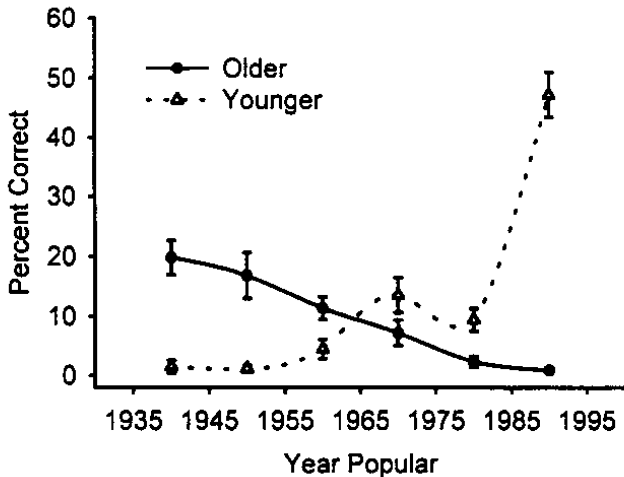


Figure 3. Mean percent correct on combined recall measure (title, artist, and cued lyric recall) by decade and age of subject.

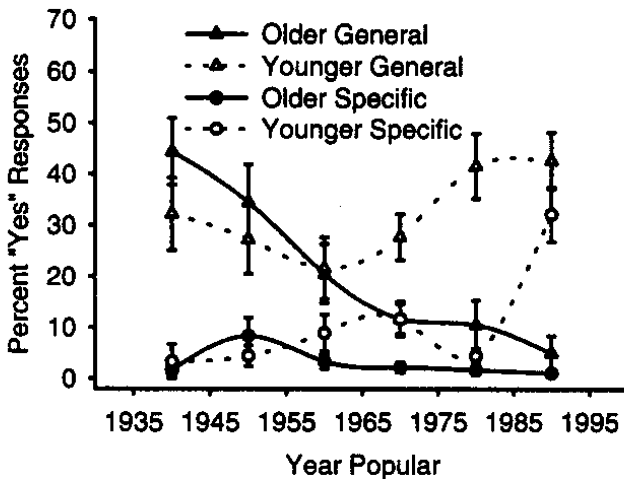


Figure 4. Mean percent of songs that elicited a memory of a general period of life or a specific life event by decade and age of subject.

sure and the year of popularity measure. For the former, the interaction appears to have resulted because, whereas both age groups reported very low numbers of specific event retrievals for the early decades, the younger but not older adults reported being reminded of many specific events from the most recent decade. The year of popularity interaction appears to have arisen because, although both age groups showed some improvement for the earliest and latest decades, the improvement for the most recent decade was more pronounced for the younger adults.

Secondary analyses were conducted in an attempt to partially separate the effects of exposure and initial learning from those of later retention by assessing age differences after excluding trials on which subjects rated the target song unfamiliar. This was a conservative correction, because it eliminated any songs that might have been heard before but were not remembered well enough to have been recognized. The decade variable was dropped from these

analyses because few of the younger adults were familiar with songs from the first three decades and few of the older adults were familiar with songs from the last three decades. Thus, the relevant data were subjected to one-way between-subjects ANOVAs with age as the lone independent variable. These analyses revealed that the younger adults outperformed the older adults on both the recall [32% vs. 16%; $F(1,34) = 22.31, MS_e = .02$] and the year of popularity [4.18 vs. 7.53; $F(1,34) = 48.69, MS_e = 2.1$] measures. Thus, even when one considers only songs that were recognized, the older adults retrieved significantly less information than did younger adults. The younger adults also retrieved more specific events than did the older adults [25% vs. 4%; $F(1,34) = 16.96, MS_e = .02$], but no age differences were observed for either the emotionality or the general period measures (both $F_s < 1.15$).

These results suggest that the younger adults' memories for the songs that they had heard previously were better than the older adults' memories for songs that were familiar to them. Additional support for this claim comes from the fact that the associations among a familiar song and its various attributes were much weaker for the older adults than for the younger adults. In particular, when subjects were able to answer at least one of the objective memory questions (e.g., title), the younger adults were more likely than the older adults to be able to answer a second question (e.g., artist, cued lyric recall) as well. There were no age differences in the probability of being able to answer at least one question correctly [older, $M = 22.0\%$, younger, $M = 23.1\%$; $F(1,34) < 1$]. However, if we consider only the trials on which at least one question was answered correctly, the older adults and younger adults correctly answered an average of 1.27 and 1.66 questions, respectively. This difference, which was significant [$F(1,34) = 27.43, MS_e = .05$], represents a 30% advantage for the younger adults. Overall, these data do not support the idea that memory for popular music remains intact over the course of a lifetime.

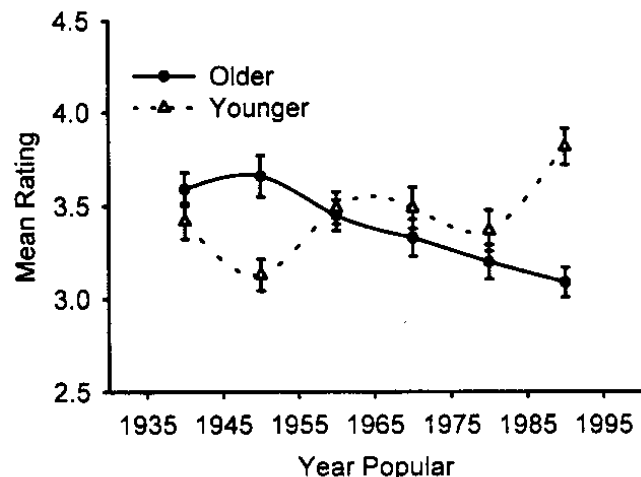


Figure 5. Mean emotionality ratings by decade and age of subject.

Correlation analyses were conducted to examine relationships among the nine dependent measures. Data for the younger and older adults were analyzed separately, with songs as the unit of analysis. The correlation matrix appears in Table 2 minus the year of popularity measure, because that measure failed to yield any significant correlations. All of the 20 remaining correlation coefficients were positive, and 19 were significant at $\alpha = .05$. This suggests that there was a very high degree of covariance among our factors but also that the results that we obtained were unlikely to have been due to chance.

Of particular interest in the correlation matrices is the significant positive relationship between emotion and the other dependent measures. This indicates that both the younger and the older adults were more likely to recall information or retrieve an autobiographical memory when they were cued by a song that moved them emotionally. However, the significant positive correlation between emotionality and familiarity leads one to question whether the aforementioned correlations might only reflect the fact that people were moved by songs that they knew and thus knew more about the songs that moved them. To address this alternative interpretation, we conducted the correlation analyses again after excluding trials on which subjects rated the target song unfamiliar. For the older adults, the emotionality rating still yielded a significant correlation with the recall [$r(59) = .39$], general period [$r(59) = .47$], and specific event [$r(59) = .43$] measures. However, none of these correlations were significant for the younger adults (all r s $< .21$, all p s $> .10$). Thus, for the older but not the younger adults, emotionality had an effect on memory above and beyond the effect of familiarity.

Finally, for the older adults, every dependent measure correlated more highly with the likelihood of being reminded of a general period, as opposed to being reminded of a specific event. This pattern probably reflects the fact that the older adults very rarely reported being reminded of a specific event. However, the opposite was true for the younger adults; for them, the dependent variables were correlated more highly with the specific event measure than with the general period measure. Thus, songs that the

older adults remembered well and that made them feel happy tended to elicit thoughts of a general time period, whereas songs that the younger adults remembered well and that made them feel happy tended to elicit memories of specific events. This result may be attributed either to increased forgetting due to the longer retention interval for the older adults or to age-related declines in recall ability, but it also suggests that music may have been more integrated into the lives of the younger adult subjects. Whether this represents a memory effect or a cohort effect is a topic for future research.

DISCUSSION

The present experiment yielded several interesting results regarding lifespan memory for popular music. The main prediction was that older adults would prefer, know more about, and have stronger emotional responses to the music popular during their youth in comparison with music popular later in life. This prediction was supported. Every dependent measure (with the exceptions of the year of popularity and specific event retrieval) revealed a pattern in which older adults yielded higher scores than did younger adults for songs from the first part of the century, whereas younger adults yielded higher scores than did older adults for songs popular in the latter part of the century. That younger adults knew little about songs from the beginning of the century confirms that the older adults' knowledge did not occur because the songs selected from the 1930s and 1940s are still popular today.

However, the data contradicted the prediction that people retain a great deal of knowledge about popular music over the course of their lives. Although the older adults did know considerably more about the songs of their youth than they knew about more recent songs, they were never able to score higher than approximately 20% on the recall measure, whereas the younger adults greatly surpassed this level of performance for the most recent decade. Although the older adults knew more about the songs of their youth than they knew about other songs, they did not retrieve nearly as much information about these songs as the younger adults were able to retrieve about the songs familiar to them. Furthermore, the associations between the melody, title, artist, and lyrics were weaker for the older adults; that is, if the younger adults knew one attribute of a song, they were more likely than the older adults to be able to retrieve the remaining ones. Thus, older adults did show marked losses in recall for popular music over the course of their lifetime.

These results closely match the data from very long-term memory studies conducted by Bahrck (1983, 1984b; Bahrck et al., 1975). Bahrck tested the memories of different groups of subjects for the same information at various retention intervals, ranging from a few months to approximately 50 years. The older adults' performance from the earliest decades in the present experiment (when they were about 20 years old) can be used as an approximation of how much younger adults would remember about the

Table 2
Correlation Matrix by Age of Subject

	Fam	Rec	Emo	Gen	Spec
Older adults					
Familiarity	—	.48	.83	.77	.52
Recall	.48	—	.48	.55	.36
Emotionality	.83	.48	—	.74	.54
General period	.77	.55	.74	—	.38
Specific event	.52	.36	.54	.38	—
Younger adults					
Familiarity	—	.72	.42	.44	.69
Recall	.72	—	.39	.30	.71
Emotionality	.42	.39	—	.25	.46
General period	.44	.30	.25	—	.09*
Specific event	.69	.71	.46	.09*	—

Note.—Year of popularity is not included in the table, because it failed to yield any significant correlations. *Not significant.

songs popular between 1985 and 1994 if their memories were tested in 50 years. Using this approximation, one would predict that the younger adults' 50% recall score for the most recent decade would drop to approximately 20% if their memories for this information were tested in 2047. These values are nearly identical to those obtained by Bahrck et al. (1975, Table 4) for the free recall of high school classmates' names at his shortest and longest retention intervals.

Although popular songs produced results similar to those generated by Bahrck, the music was learned under vastly different encoding conditions. First, most of the stimuli used by Bahrck were encountered more systematically, on a daily basis over the course of many years. The same cannot be said of the material used here; even at the height of its popularity, it is unlikely that any song would be encountered every day or for a period of more than a few months. Interestingly, Bahrck (1984a) failed to obtain evidence of permastore when he measured teachers' memories for the students in their courses; in this case, learning was limited to one or perhaps two academic terms. Bahrck's stimuli were also more significant in the lives of his subjects. Singing the words to a popular song, even one that is well liked, is not nearly as important as being able to find one's way home. Therefore, one might argue that popular music is retained better than the types of information studied by Bahrck and his colleagues because, despite differences in the length of the encoding period, the frequency of rehearsal, and the importance of the to-be-remembered information, musical stimuli yield comparable levels of recall.

Still, the present data fail to support anecdotal claims that people can frequently remember the words to a song that they have not heard in years. In fact, memory for—but not necessarily familiarity with—popular music appears to deteriorate as rapidly as the overlearned information that Bahrck studied. There are several explanations for why remembering songs over long retention intervals might seem to occur with greater frequency than the present data suggest. For example, infrequent exposures (perhaps every 4 or 5 years) to a given song might be easily forgotten, thus leading to the impression that a given song had not been heard for a much longer duration. Alternatively, the number of songs that people remember over long intervals may be limited to a handful of songs that have been rehearsed often, or that have been particularly meaningful (e.g., the song we danced to at our wedding). The infrequent exposures to these well-rehearsed songs may be extremely salient, thus leading people to overestimate how much they remember about the songs of their youth.

Just as people's memories for popular songs were less detailed than we expected, the stimuli did not spontaneously cue many specific events from people's lives. There was only one cell (the most recent decade for younger adults) in which more than 10% of the stimuli elicited the retrieval of specific events. This result was surprising, because previous research has shown that older adults can retrieve a large number of memories from

their young adulthood (Rubin & Schulkind, 1997a, 1997b). However, the failure to obtain stronger results does not contravene the potential use of popular music as cues in studies of autobiographical memory, because subjects were not strongly encouraged to retrieve memories from their lives. They were simply asked to report whether any such retrieval occurred spontaneously, and general memories typically come easier than specific ones (Conway & Rubin, 1993). Simple nouns have revealed interesting empirical results, even though it is unlikely that these words spontaneously cue autobiographical memories. Similarly, popular music may prove a more valuable cue for autobiographical memories when subjects are told specifically to retrieve them.

Unlike the data related to memory, the emotionality ratings showed no signs of decline even over the long retention intervals used in the present study. There were no age differences in how much the older and younger subjects liked the songs of their generation, nor was there any difference in how much emotion the songs induced. This result is important, because it indicates that the age differences for the objective and autobiographical memory questions did not arise because the younger adults were more engaged by the experimental task.

Finally, for both age groups, there were high positive correlations between the emotionality measure and the objective memory measures. This finding is in keeping with Bower's (1981) theory of the relationship between emotion and memory. Even though older adults performed worse than younger adults on the recall measure, emotion had a significant effect on their memories above and beyond any effect of familiarity; this was not true of the younger adults. In other words, in comparison with that of the younger adults, the older adults' ability to retrieve the title or performer of a song was more related to whether or not the song elicited an emotional response. Because the older adults retrieved information over longer retention intervals than did the younger adults, this result might be interpreted as evidence that the effect of emotion on memory becomes more pronounced as the retention interval increases. Although some research has shown that emotion impairs memory at short retention intervals but facilitates memory at longer intervals (Burke, Heuer, & Reisberg, 1992; Christianson, 1992), the literature on this topic is quite mixed (see Heuer & Reisberg, 1992, for a discussion). Furthermore, the data presented here are correlational and thus are open to many interpretations. For example, older adults generally believe that their memories are not as good as they once were (Cavanaugh & Green, 1990; West & Berry, 1994). Therefore, the emotion reported by the older adults might have reflected their happiness over being able to remember something from the distant past. In other words, it is unclear whether the emotion elicited the memory, or the memory elicited the emotion.

In closing, a cautionary note must be sounded. In order for the interpretation of the data presented here to hold, one must assume a rough similarity in the availability of popular music across the time frame that was tested. In

other words, one must assume that the older adults had the same exposure to popular music in 1938 as the younger adults had in 1988. One might argue that the recent explosion in media outlets would make current songs more "popular" than their predecessors were. However, the increase in the number of media outlets might be canceled by the increased competition between different media. Although there were fewer radio stations in 1938 than in 1988 and MTV was a product of the 1980s, the radio stations—and consequently, the songs—that did exist in the 1930s faced less competition for the ears of their era. Thus, although we cannot be sure that prevalence of popular music has remained consistent across the century, there is some reason to think that it might have.

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APPENDIX

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APPENDIX (Continued)

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