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Reminiscence bump invariance with respect to genre, age, and country

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James Renwick[1] **and Matthew H. Woolhouse**[2]

Abstract

We report a cross-cultural study investigating musical reminiscence bumps, the phenomenon whereby adults remain emotionally invested in the music they preferentially listened to in adolescence. Using a crowdsourcing service, 4,824 participants from 102 countries were each required to recall five songs (titles and artist names), resulting in a 24,120-song study. In addition, participants provided demographic information and answered questions relating to the songs they recalled, such as age first listened to, levels of nostalgia, and associated emotions. Song titles and artist names were cleaned and genre information established through fuzzy matching recalled information to songs within an open-source music encyclopedia. These data, plus participants' demographic information, allowed reminiscence bumps differentiated by age, sex, country, and genre preference to be explored. Recency-bias effects of recalled songs were also investigated. Results demonstrated that the musical reminiscence bump phenomenon is common to all age groups and both sexes, pervasive across all countries, and is not restricted to particular genres. In sum, musical reminiscence bumps appear to be biologically and culturally ubiquitous.

Keywords

recall, nostalgia, memory, identity, adults, aging

> [The patient] had a military background, so patriotic/military songs were loaded on his iPod. The first thing he did upon hearing the music was stand up and salute (Alzheimer's Association, New York City Chapter, 2011).

Recounted by Louise Dueno, Director of Therapeutic Recreation at Cobble Hill Health Center in New York, this anecdote serves to illustrate the close association between music, memory, and some of our most formative experiences. Given the relative ease and accuracy with which music

[1]McGill University, Montreal, QC, Canada
[2]McMaster University, Hamilton, ON, Canada

Corresponding author:
James Renwick, McGill University, 555 Sherbrooke St. W., Montreal, QC H3A 1E3, Canada.
Email: james.renwick2@mcgill.ca

can be recalled, in some cases heard decades previously (Levitin & Cook, 1996), musical memories may serve to connect the present with the past, and in doing so create a sense of personal, individual continuity and cohesion (Ruud, 1997). Moreover, by helping to bind together different strands of people's lives into a consistent whole, musical memories can be a powerful force contributing to human wellbeing and mental health (Sixsmith & Gibson, 2007), as was apparently the case for Dueno's Veteran patient.

In this article, we report a pan-national study examining musical reminiscence bumps, the psychological phenomenon whereby older adults remain emotionally invested in the music they preferentially listened to in late adolescence and early adulthood. More broadly, the term "reminiscence bump" or "reminiscence effect" refers to a general psychological process in which memories pertaining to events, places, and people are encoded more strongly when experienced in adolescence and early adulthood. Music is of specific interest due to its common connection to an individual's most formative experiences and its close association with memory. This article investigates the existence and prevalence of musical reminiscence bumps across age, gender, nationality, and the genre of recalled songs.

Reminiscence bumps

The reminiscence bump phenomenon is the tendency for memories pertaining to events, places, and people from adolescence and early adulthood to be encoded more strongly in individuals (Koppel & Rubin, 2016). These memories encompass all autobiographical items including events in which the individual has participated, such as sports and more passive experiences like listening to music. To assess autobiographical memories across an individual's lifespan, two broad approaches have been implemented (Koppel & Berntsen, 2015): (a) the *cue word method*, when investigators administer cue words to individuals, who are then asked to generate memories in correspondence to the words, and (b) the *important memories method*, when individuals are asked to report personally meaningful memories, either with specific prompting questions or through free recall. Although we use the second method, both approaches have been adopted as standard methods for investigating reminiscence bumps.

The mechanism behind the reminiscence bump phenomenon remains unclear. However, Munawar et al.'s (2018) systematic review highlights four leading theories. The first, the cognitive account, surmises that many novel events occur in the second and third decades of life, leading them to be more deeply encoded as memories. The cognitive abilities account explains that individuals entering life stages of adolescence and older have more advanced cognitive function and mental capacity as a result of maturation to better encode memories. The cultural life script account postulates that societal and cultural expectations on individuals puts implicit pressure on them to value memories in the second and third decades of their life more heavily. The narrative/identity account suggests that events occurring in adolescence and early adulthood are vital to an individual's character and identity development and are thus encoded more deeply as memories. Ultimately, several mechanistic reasonings exist to explain reminiscence bumps, but a clear consensus has not yet been reached.

Previously, researchers investigating the recall of autobiographical memories only found a clear reminiscence bump when the study was conducted with participants older than 40 (Schulkind et al., 1999). These studies suggested that there is a transition between the ages of 35 and 45 when a review of one's life occurs, and thus the reminiscence bump is a property unique to older adults undergoing an active-life review (Jansari & Parkin, 1996).

However, recent studies have discovered that the reminiscence bump is present for all adolescent-and-above ages. Studies that have observed the reminiscence bump in younger age groups have done so by suppressing the recency effect. For example, Jansari and Parkin (1996) used

two groups of participants—a *recency* group and a *no-recency* group. In the *recency* group, they instructed participants to recall memories from any point in their lives, while the participants in the *no-recency* group were asked to recall memories from anytime in their lives besides the past 2.5 years. This resulted in an observable reminiscence bump for participants younger than 40 years (Jansari & Parkin, 1996). Janssen et al. (2005) developed another method that used encoding functions that were estimated from a memory chain model, in which memories move through a series of "memory stores" that shift from short-term to long-term memory (Chessa & Murre, 2001). Using this model, they were able to observe the reminiscence bump phenomenon in participants of all ages (Janssen et al., 2005).

Considering the presence of the reminiscence bump in all individuals who have experienced adolescence, research has been conducted to determine the musical reminiscence bump's age range Although studies differ as to the precise peak of the "bump," the consensus is approximately 15–25 years of age. For example, in a relatively early music-recollection study, in which popular songs were rated for likability, Holbrook and Schindler (1989) ascertained the "song specific age" by subtracting participants' year of birth (YOB) from the years of the recalled songs' popularity maxima. Thus, if a recalled song was popular in 1950, and a participant's YOB was 1930, the song-specific age was 20 (1950 minus 1930). For the participants in Holbrook and Schindler (1989), the aggregate song-specific age followed an inverted U-shaped curve, reaching a peak at 23.5 years. Holbrook and Schindler (1989) proposed that both intrinsic (e.g., a developmental phase of heightened sensitivity; Somerville et al., 2010) and extrinsic factors (e.g., social pressures from peer groups; Brown et al., 1986) might account for their non-monotonic findings.

Krumhansl and Zupnick (2013) analyzed music and the reminiscence bump from a new perspective, cascading reminiscence bumps. Participants listened to 110 songs, each of which was grouped into one of 11 5-year time spans. For each group, participants reported the percentage of songs they recognized, any personal memories attached to the songs, with whom they listened to the songs, and a number of other similar statements. They showed several interesting findings: (a) there was a large increase in personal memories associated with songs between 1990 and 2009, which is the formation of a reminiscence bump, and (b) there was a memory peak associated with music between 1980 and 1984 compared with music from 1985 to 1989 and from 1975 to 1979. Krumhansl and Zupnick considered this to be a cascading reminiscence bump (i.e., the parent's reminiscence bump being passed to the child). Other recent studies include Jakubowski et al. (2020), Krumhansl (2017), and Schubert (2016). Krumhansl (2017) asked participants for their knowledge, preference, and emotional reactions to popular music from the past 10 decades. The results showed the presence of musical reminiscence bumps, while also demonstrating different listening habits across generations. To better understand the reminiscence bump in young adults, Schubert (2016) asked participants between 20 and 22 to "recall a single memorable musical event." Results showed a bump between ages 13 and 14. And in the largest exploration of musical reminiscence bumps undertaken prior to the study reported here, Jakubowski et al. (2020) asked 470 participants to rate the degree to which they had autobiographical memories associated with songs, as well as the extent to which they were familiar with and liked each song. They, too, found a reminiscence bump in adolescence, peaking around age 14.

Music, identity, and memory

The presence of musical reminiscence bumps suggests a deep connection between music and identity. Although music is considered a universal human phenomenon (Merker, 2000),

musical taste is highly personalized and is associated with individual emotions, memories, and experiences (Allett, 2010). An individual's musical tastes and their reasons for liking specific songs or genres are unique; they are varied and dynamic, which makes music an integral part of personal identity (Allett, 2010). For example, musical taste can be influenced by an individual's characteristics, such as when individuals who are categorized with "extraversion" and "openness to experience" prefer rhythmic and energetic music (Lamont & Loveday, 2020). Moreover, music has been shown to play a large role in friendship formation and expressing oneself, illuminating its unique role in providing an avenue for an individual's identity (Lamont & Loveday, 2020). Music also intellectually engages an individual when they decide regarding what music to listen to (Hallam, 2010). This is an example of self-expression and assertion of one's sense of self (Frith, 1996). As a result, music creates a deep connection between itself and the listener that changes depending on how it is experienced, both physically and emotionally (Allett, 2010). By accessing these deep connections with music, both feelings and emotions associated with specific songs and musical genres are elicited and, furthermore, memories are recalled (Allett, 2010).

Studies have shown that music is an effective mnemonic device and musical memory is strong over both short and long retention intervals (Schulkind et al., 1999). For example, music enhances memory of text over short retention intervals (Yalch, 1991). For longer retention intervals, musical memory is sometimes spared from the cognitive deficits associated with dementia and Alzheimer's disease (Cuddy & Duffin, 2005). As music affects the acquisition and retention of memories, trends in the encoding of these memories can be insightful. One such trend involves preferential encoding of music-associated memories relating to the development of self-identity in adolescence and early adulthood (Holmes & Conway, 1999). This development of self-identity and the strong memories with which it is associated is the "reminiscence bump" phenomenon. This presence of a reminiscence bump suggests that the events in one's youth are encoded more intensely and retrieved more frequently than events from any other time (Janssen et al., 2005). According to Holmes and Conway (1999), the peak in memories occurs during the range of 10–30 years of age. Narrower age ranges vary between studies. Reminiscence bump research has also shown that the bump occurs across both genders and cultures, although there are some small differences between groups (Janssen et al., 2005). Reminiscence bumps are also closely tied to life-scripts, which are prescriptive timetables for the progression of major life events (Haque & Hasking, 2010).

The effect of the reminiscence bump specifically on music recall, and the deep connection between the two has been well documented. Janssen et al. (2007) conducted a study that found the reminiscence bump in the distributions of favorite books, movies, and records and that all three distributions peaked between ages 16 and 20 (Janssen et al., 2007). Furthermore, the results showed that the proportion of favorite records from adolescence and early adulthood was larger than the proportion of favorite books and movies (Janssen et al., 2007). Based on this finding, Janssen et al. (2007) speculated that music might play a greater role in the formation of identity than the other mediums). Schulkind et al. (1999) also conducted a study relating to music and reminiscence in which they examined subjects' memories for popular music across long retention intervals. The results suggested that older adults (65–70 years old) prefer, have more knowledge about, and have stronger emotional responses to the music popular during their youth than the music popular later in their lives. In addition, younger adults (18–21) show greater retrieval of song information than older adults, which suggests that older adults depend primarily on emotionality rather than familiarity when retrieving memories on songs from their youth (Schulkind et al., 1999).

Feelings of nostalgia are closely related to memory and reminiscence bumps. This core human experience is a function of memory and language in which events are temporally ordered and dramatized, creating an emotional narrative (Stewart, 1988). Nostalgia is also closely related to autobiographical memories and reminiscence bumps, especially when music is involved (Batcho, 2007; Janssen et al., 2007). Barrett et al. (2010) studied music-evoked nostalgia in detail. The study consisted of 226 participants who listened to 15-s song samples from Billboard Top-100 Pop, Hip Hop, and R&B lists and answered questions related to nostalgia. They found that listening to nostalgic songs was associated with both happiness and sadness. In addition, the strength of nostalgia was strongly predicted by arousal, familiarity, elicitation of emotions, and autobiographical salience.

The present study looks to expand previous research by investigating musical reminiscence bumps on a larger scale than has been the case thus far and from several novel perspectives. The information was gathered by surveying more than 4,000 participants who varied in age, country, sex, and recalled musical genre, allowing us to analyze these variables. Through this analysis, the study aims to provide a clearer picture of the reminiscence bump as a universal phenomenon and whether the bump persists through a variety of strata.

Method

Apparatus

The survey was conducted using CrowdFlower, a website for which people sign up as a contributor to complete a task or survey for a small monetary benefit. CrowdFlower was purchased by Appen in April 2019 (https://appen.com/). In a similar manner to Amazon Mechanical Turk (https://www.mturk.com/), clients uploaded tasks to the platform along with funds to be distributed to account holders once they had completed the requisite task(s). The platform we used in this study was global in that it allowed account holders to be located in any country. However, the clients (e.g., the authors of this article) were able to apply filters whereby account holders from certain countries could be excluded based on their ID profiles. While this did not guarantee the nationality of account holders, we were keen to ensure maximum plurality with respect to user location/country. Given the populous nature of China and India, and the finite funds available for the study, we chose to exclude users from these two countries to maintain our desire for plurality, as stated above.

Participants

The total number of participants was 4,824 (3,012 males and 1,812 females) between the ages of 18 and 90 ($M = 32.8$; $SD = 10.6$). The participants resided in 102 countries. The top 10 countries in which most participants resided accounted for 55% of the data, while participants from the remaining 92 countries accounted for the remaining 45% (see Appendix C in Supplementary Materials). Participants received US$0.50 for their involvement in the study and gave written informed consent in accordance with the requirements of the Ethics Review Board of the host institution. Participants had no previous exposure to the test materials.

Procedure

From January 27 to February 14, 2014, participants provided demographic information and answered questions relating to song recall using the crowd-sourced website CrowdFlower. The

requested demographic information concerned the city and country of current residence, and biological sex and YOB. To encourage participants to feel free to recollect any memorable song, they were given a relatively open-ended prompt that asked them to recall five songs from any time in their life, with no restrictions regarding style or genre. Questions relating to recall of songs asked participants to write the title, artist, and the age at which they first listened to the songs. In addition, participants were asked to rate each song's "then-and-now" importance and level of nostalgia. Then-and-now importance was separated into two questions. The first question asked for importance during the age at which a song was first heard (then), while the second question asked for importance at the time of participation (now). The answers to both questions relating to importance were given on a Likert-type scale, ranging from 1 (*unimportant*) to 5 (*very important*). Level of nostalgia was also given on a 5-point scale: 1 (*not nostalgic*) and 5 (*very nostalgic*). Finally, participants answered questions relating to emotions associated with each song, other specific associations, and who introduced them to the song. The emotions from which to choose included "Happy," "Sad," "Angry," "Peaceful," and "Neutral"; the options for other specific associations included "Person/People," "Place(s)," "Event(s)," and "None." An example survey can be found in Appendix A in Supplementary Materials.

Data recording and cleaning

Survey results were analyzed for completeness and accuracy. Song titles and artist names were inputted into a Yahoo BOSS application, via Python 2.7.4, where they were spell-checked. Yahoo BOSS corrected spelling errors in titles but did not input proper capitalization. Python 2.7.4 was further used to enter spell-checked artists and titles from Yahoo BOSS into an open-source music encyclopedia called MusicBrainz (https://musicbrainz.org/) where information pertaining to title, release date, artist, and artist's gender, and country was obtained for each song. The difflib Python library was used to conduct approximate string matching—also known as fuzzy string matching by comparing the level of similarity between two strings of words—spell-checked titles and artists from Yahoo BOSS, and titles and artists from MusicBrainz. As titles and artists were already spell-checked, wording and capitalization were the only factors that affected the level of confidence in matching. Examples of fuzzy string matching for survey results can be found in Appendix B in Supplementary Materials. Any recalled songs that showed confidence in matching less than 60% were not included in further analyses of the data. For example, one participant completed the survey by filling "9999" into any short-answer question. This participant was one of 173 contributors (from the original 4,997) whose answers were excluded because their answers did not match any song or artist. Nearly, all the remaining 4,824 participants contributed five songs, resulting in a total of 24,052 recalled songs.

Additional genre information was matched for each song. To achieve this, a program was written with Python 2.7 (modules: sys, csv, codecs, urlib2, json, and readline) that used the MixRadio application programming interface (API) to access MixRadio's large database of music information, including artist and genre (since conducting this experiment MixRadio has ceased operations). By submitting the participant-inputted artists to the MixRadio API, the website would output a JavaScript Object Notation (JSON) formatted response in one of three conditions. The first condition, which occurred when the API found an exact artist name match, would return a JSON that contained the artist's genre information, and add that genre to the study's data as metadata for the artist. The second possible condition occurred when the API could not find an exact match and it returned a list of what it considered to be the best match candidates. This portion required manual intervention. The program would present a list of potential matches, which were manually evaluated, and the most appropriate match was chosen. If there was no

appropriate match, the user could type "null" and an NULL would be added to the artist metadata in place of a genre. The third and final possible condition is when the API returned no matches and no appropriate candidates. In this case, an NULL would be added to the artist metadata in place of the genre. After all the songs had gone through one iteration of the program, the NULL data were reevaluated using the aforementioned fuzzy string matching to ascertain the genres of less well-known artists. In total, 15,639 recalled songs were matched to specific genres.

Statistical design and analysis

A statistical design was implemented so as to determine whether or not different groups of participants (independent variable) show the presence of a musical reminiscence bump (dependent variable). Different groups of participants are created by sorting them based on age, sex, national origin, and genre preference.

With respect to age, participants were divided into six 10-year age groups: 18–24, 25–34, 35–44, 45–54, 55–64, and 65–71. Songs first heard between the ages of 1 and 71 were then counted. The counts were converted into percentages of the total number of recalled songs and plotted in a line graph (see Figure 1). To establish the presence of a reminiscence bump, a between-subjects one-way analysis of variance (ANOVA) was used by placing recalled age into 5-year bins. In other words, for each 10-year age group, all songs reported in 5-year periods were binned and counted. For example, songs for participants aged 25–34 that were reported as first heard between the ages 16 and 20 were placed into the same bin. These 5-year bins were the independent variable, while the dependent variable was the number of recalled songs within each 5-year bin. Post hoc pairwise Tukey's least significant difference (LSD) tests were conducted to identify differences between pairs of bins and to determine whether or not the relationship between the peak bin and its *adjacent* bins form a statistically significant "bump." The same statistical procedures were implemented for the analysis of sex, country of user, and genre preference. Finally, two secondary analyses explored the effects of recency and nostalgia on song recollection.

Results

Across age

The ANOVA revealed statistically significant differences between the percentage of songs recollected that had been first heard between the ages 16 and 20, compared with the percentage of songs first heard at other ages (Table 1, Column 4). Seeing as the ANOVA test determined that songs heard between the ages of 16 and 20 were the most recalled, statistically significant results with post hoc pairwise Tukey's LSD tests show that the bins adjacent to "ages 16 to 20" form a continuous growth and decline around the peak bin, rather than an erratic peak. All age ranges showed a statistically significant preference for song recollection between the years 16 and 20 (Table 1, Column 5). Participants aged 18–24 and 65–74 showed statistically significant pairwise differences between 16–20, and both 11–15 and 21–25 ($p < .001$). For the 25–34 group, there was a significance between 16–20 and 11–15 ($p < .001$), but not between 16–20 and 21–25 ($p = .058$). The remaining age groups all showed significant difference between pairs 16–20 and 11–15, and 16–20 and 21–25.

Across sex. Results were similar when male and female participants were analyzed separately (see Figure 2). After conducting the same statistical procedure as above, both groups were

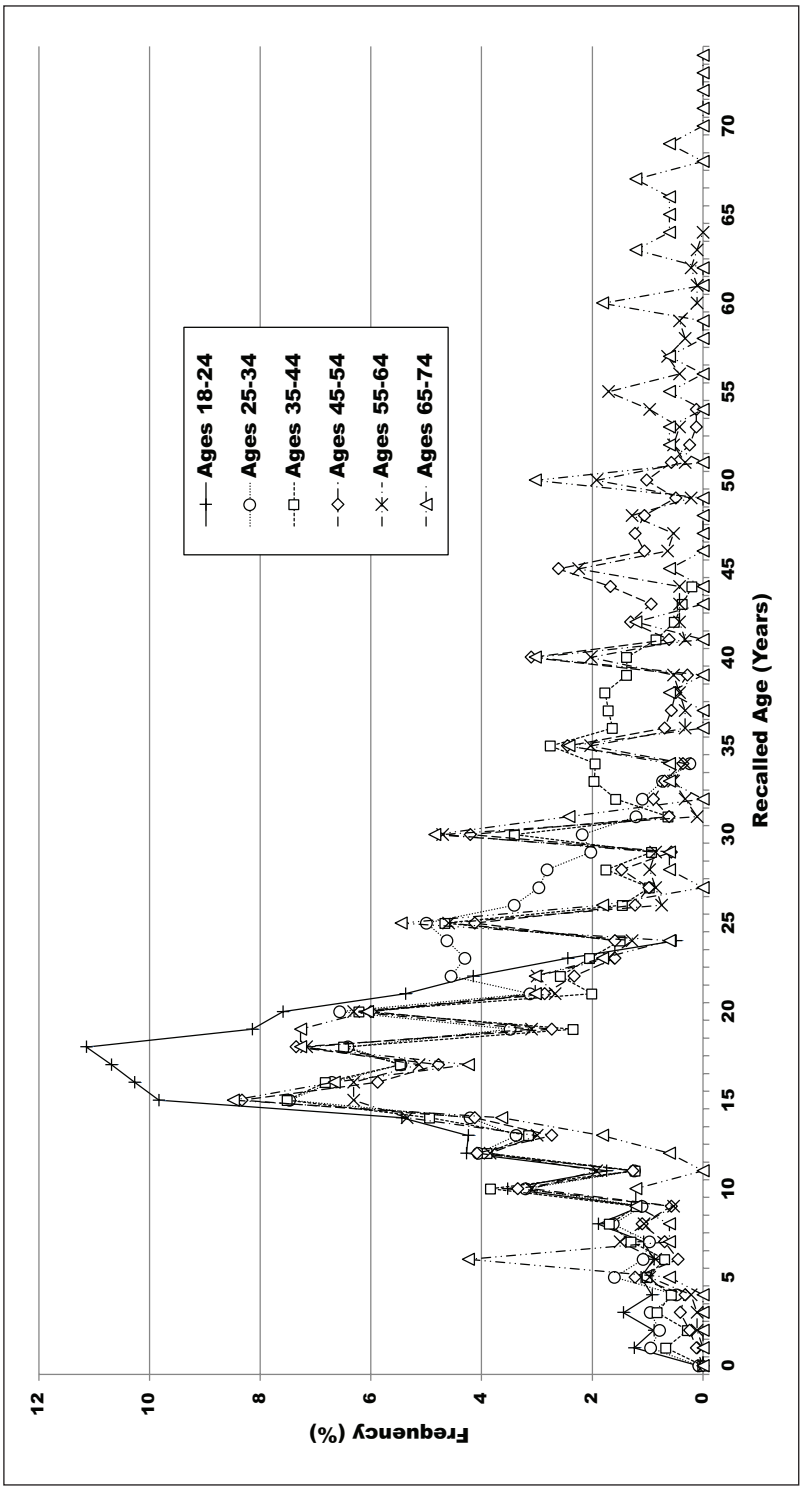

Figure 1. Recalled Ages With Participants Grouped by Age.

Table 1. Results of ANOVA and Post Hoc Tukey's LSD Tests for Each Age Group.

Age range	Reported songs (*n*)	Peak 5-year bin	Statistical significance (*p* for ANOVA test)	Statistical significance (*p* for Tukey's LSD test)
18–24	5,971	16–20	<.001	<.001 (11–15) <.001 (21–25)
25–34	9,446	16–20	<.001	<.001 (11–15) .058 (21–25)
35–44	5,087	16–20	<.001	.005 (11–15) .001 (21–25)
45–54	2,448	16–20	<.001	.001 (11–15) <.001 (21–25)
55–64	935	16–20	<.001	.005 (11–15) .001 (21–25)
65–74	165	16–20	<.001	<.001 (11–15) <.001 (21–25)

Note. ANOVA = analysis of variance; LSD = least significant difference.

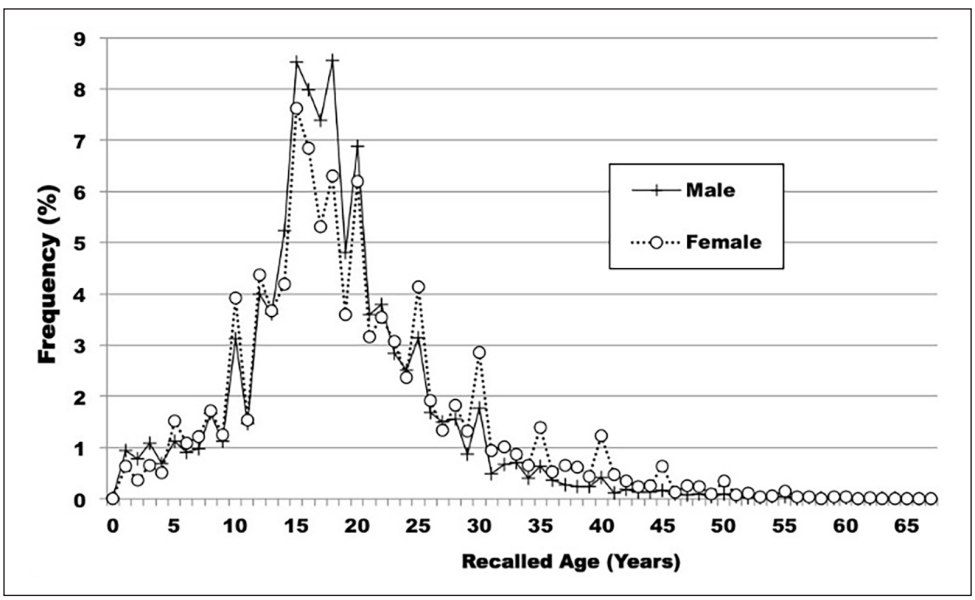

Figure 2. Recalled Ages With Participants Grouped By Sex.

significant with respect to the ANOVA test ($p < .001$) and showed peaks in the 16–20 bins (see Table 2). The male participants' peak bin was significantly greater than adjacent bins ($p < .001$ and $p < .001$). Similarly, female participants showed significant differences between 16–20 and 11–15 ($p = .011$), and between 16–20 and 21–25 ($p < .001$).

Across country. In selecting which countries to analyze, a heuristic decision was taken to choose a representative nation from four distinct geographical regions: North America, Western Europe, Eastern Europe, and Asia. A further criterion was to select the country with the highest

Table 2. Results of ANOVA and Post Hoc Tukey's LSD Tests by Sex.

Sex	Reported songs (*n*)	Peak 5-year bin	Statistical significance (*p* for ANOVA test)	Statistical significance (*p* for LSD test)
Female	9,064	16–20	<.001	.011 (11–15) <.001 (21–25)
Male	14,981	16–20	<.001	<.001 (11–15) <.001 (21–25)

Note. ANOVA = analysis of variance; LSD = least significant difference.

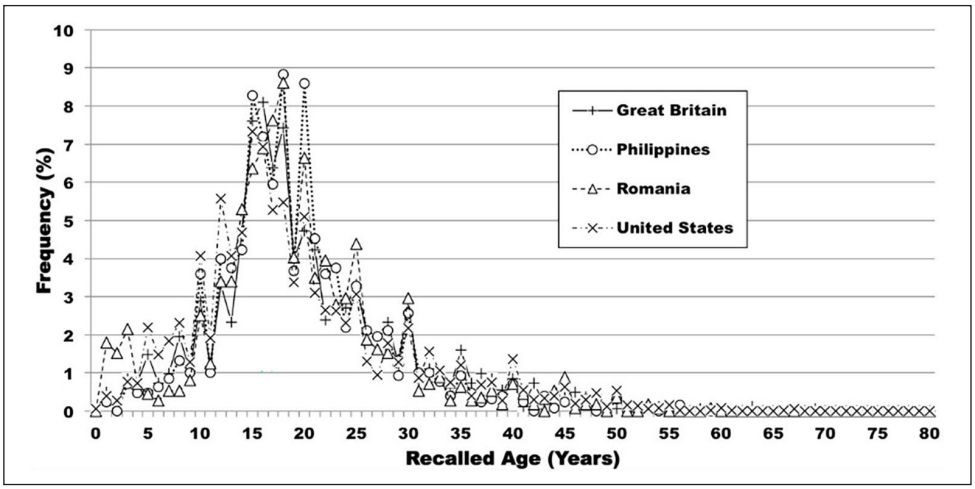

Figure 3. Recalled Ages With Participants Grouped by Country.

number of participants. For example, with respect to North America, there were 722 U.S. participants versus 337 Canadian. Accordingly, the United States was selected as the representative country for this region over Canada. This procedure resulted in the selection of four countries for the analysis: United Kingdom (Western Europe), Philippines (Asia), Romania (Eastern Europe), and the United States. Countries from Africa and South America were not included due to relatively low participant numbers in these geographical regions.

For each country, songs first heard between the ages of 1 and 71 were counted, binned, and plotted as a line graph (see Figure 3). The counts were then converted into percentages of the total number of recalled songs. Again, one-way ANOVA tests were run on the binned data, with post hoc Tukey's LSD test used to identify differences between adjacent bins. The ANOVA tests were significant for each country, with consistent peaks at 16–20 (see Table 3, Column 4). Participants from each country had significant differences between the peak bin of 16–20 and adjacent bins 11–15 and 21–25 (see Table 3, Column 5).

Across genre. Recalled songs from participants were organized by genre. For each genre, the songs were grouped by age first heard and counted. The counts were then converted into percentages of the total number of recalled songs. Dance, Metal, Pop, and Rock were chosen from the possible genres because of their high number of recalled songs (see Figure 4). ANOVA and LSD tests were used as before. All genres showed a peak between 16 and 20 years of age and a *p*

Table 3. Results of ANOVA and Post Hoc Tukey's LSD Tests by Country.

Country	Reported songs (*n*)	Peak 5-year bin	Statistical significance (*p* for ANOVA test)	Statistical significance (*p* for LSD test)
United Kingdom	1,550	16–20	<.001	<.001 (11–15) <.001 (21–25)
Romania	1,120	16–20	<.001	<.001 (11–15) .001 (21–25)
Philippines	1,285	16–20	<.001	<.001 (11–15) <.001 (21–25)
United States	3,600	16–20	<.001	.001 (11–15) <.001 (21–25)

Note. ANOVA = analysis of variance; LSD = least significant difference.

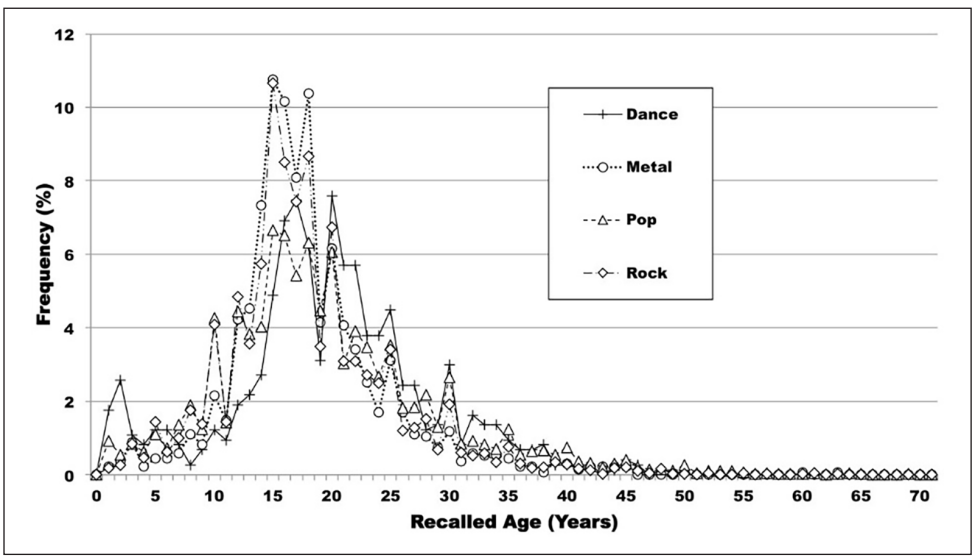

Figure 4. Recalled Age-Bin Peaks With Recalled Songs Divided by Genre.

value of <.001 for the ANOVA tests (see Table 4, Column 4). All results showed statistically significant differences when the LSD test was conducted. Between 11–15 and 16–20, Metal had a significance of $p = .01$, Rock a p value of .026, and both Dance and Pop had less than .001. Between 16–20 and 21–25, Metal, Rock, and Pop all had p values of less than .001, while Dance had .002.

Recency

The purpose of this analysis was to determine the effect of recently heard songs on song recall—to what extent were participants influenced by recently heard songs as opposed to many years previously? For this analysis, participants were grouped into 10-year age bins. The data were converted into years that the songs were first heard: (YOB of participant) + (age first heard for song) = (year first heard). These were then counted and converted into percentages of the total

Table 4. Results of ANOVA and Post Hoc Tukey's LSD Tests by Genre Preference.

Genre preference	Reported songs (*n*)	Peak 5-year bin	Statistical significance (*p* for ANOVA test)	Statistical significance (*p* for LSD test)
Metal	1,327	16–20	<.001	.01 (11–15) <.001 (21–25)
Rock	3,840	16–20	<.001	.026 (11–15) <.001 (21–25)
Dance	752	16–20	<.001	<.001 (11–15) .002 (21–25)
Pop	4,047	16–20	<.001	<.001 (11–15) <.001 (21–25)

Note. ANOVA = analysis of variance; LSD = least significant difference.

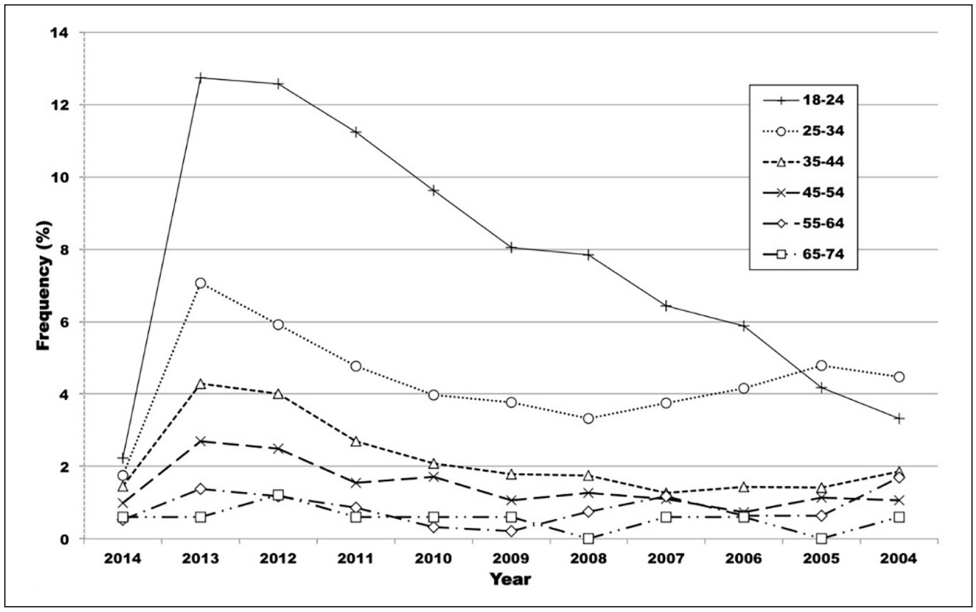

Figure 5. Years From Which Songs Were Recalled.
Note. Participants divided into age groups.

number of recalled songs (see Figure 5). For each age group, there was a peak within the 3 years prior to the conducting of the study. The highest recency peak was for the 18–24 age group with 13% of songs first being heard a year before the survey. For each subsequent age group, the recency was in the same year (a year before the survey) but lessened (except for 65–74). A Jonckheere–Terpstra test for ordered alternatives showed a statistically significant trend of higher percentage of recalled recent songs with younger age groups (from 65–74, 55–64, 45–54, 35–44, 25–34 to 18–24 age groups), $T_{JT} = 351.00$, $p < .0005$. This result suggests that younger participants were more prone to recall recently heard songs versus participants from older age groups.

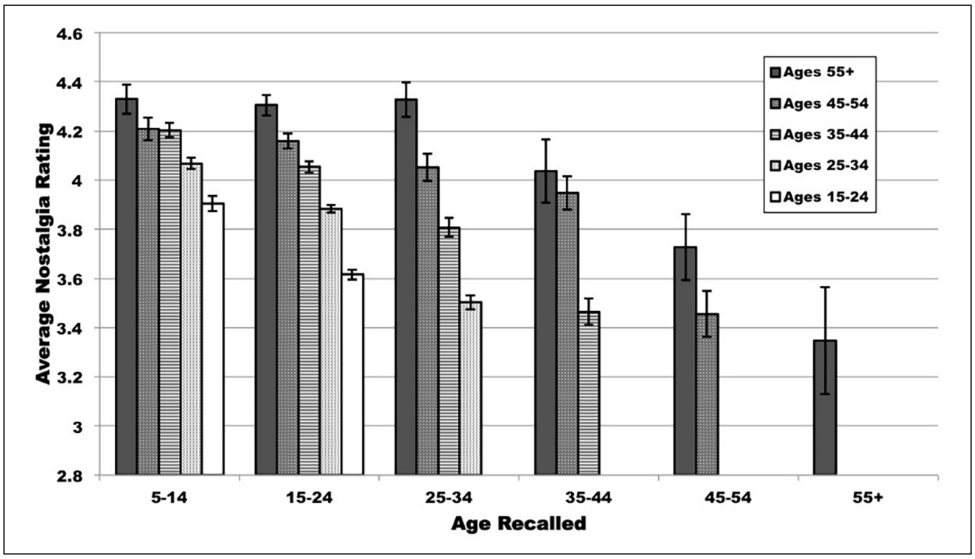

Figure 6. Nostalgia Ratings by Age Recalled.
Note. Participants divided into age groups.

Nostalgia

Participants were again sorted into 10-year age groups. For each group, the nostalgia ratings users gave to the recalled songs were also sorted into 10-year groups based on when the songs were first heard (see Figure 6). These nostalgia ratings were then averaged to give a single number for each age group and age first heard (e.g., participants aged 55+ had an average nostalgia rating of 4.33 for songs they first heard between the ages of 5 and 14). Overall, the nostalgia ratings were higher the older the age group. For example, participants aged 55+ had a considerably higher nostalgia rating (4.31) for songs recalled from their late teens and early 20s than participants aged 18–24 (3.62). In addition, nostalgia ratings decreased for each age group as the recalled songs approached the present. For example, users aged 45–54 had an average nostalgia rating of 4.21 for songs first heard between the ages of 5 and 14 and had an average nostalgia rating of 3.46 for songs first heard between the ages of 45 and 54.

Discussion

In this study, songs that were recalled by participants in an online musical-preferences survey were used to study the reminiscence bump phenomenon. Most recalled songs were first heard during the formative years (approximately aged 16–20). When the results were further analyzed by separating participants into groups by age, gender, and country as well as songs by musical genre, reminiscence bumps were still present.

When participants were separated into groups by age, the presence of a reminiscence bump continued to be significant. From ages 18–74, the age first heard for recalled songs consistently peaked between ages 16 and 20. This revealed that musical recollection, regardless of age, is extremely strong for the formative years and that songs that are a part of an individual's formative years will be important for the rest of their lives. This result replicates findings from recent

studies that show the reminiscence bump to be pervasive across generations (Jakubowski et al., 2020; Krumhansl, 2017; Schubert, 2016).

When participants were separated by gender, the results for both groups were similar with a reminiscence bump peaking between ages 16 and 20. The male participant group's reminiscence bump was more distinct than the female participant's bump, with less significance between the 11–15 and 16–20 bumps for the female data. The reasons for this difference are unclear. It could be intrinsic bias in the survey, a psychological or social difference between the sexes, or something else entirely. Many studies have not found any difference between the two groups (Fromholt & Larsen, 1991; Hyland & Ackerman, 1988; McCormack, 1979). Janssen et al. (2005) studied the difference in reminiscence bumps between male and female participants and found the female reminiscence bump to be earlier than the male. They attributed the earlier reminiscence bump to the earlier hormonal changes in adolescent females.

By separating participants by country, the reminiscence bump was shown to be a cross-cultural phenomenon. There are some small differences in the shapes of the bumps between different countries. The United States peak was skewed slightly toward the younger side, with more recalled songs from the ages of 12–18 and fewer recalled songs between ages 19 and 22 (i.e., an earlier reminiscence bump). Janssen et al. (2005) came to a similar conclusion about the cross-cultural bump when observing four groups of participants—Dutch women, Dutch men, American women, and American men. They found the reminiscence bump was present in all four groups. In addition, they found that Americans had an earlier reminiscence bump than the Dutch (Janssen et al., 2005). Other studies have found the same result with American participants. Benson et al. (1992) compared Japanese and American participants and their distribution of memories. They found that participants from the United States had a greater number of autobiographical memories from their teens and fewer in the 20s than the Japanese participants. Similarly, Conway et al. (2005) compared memory distributions of participants from Bangladesh, China, England, Japan, and the United States. They reported that they found a greater number of childhood memories in American participants than in the other groups (Conway et al., 2005).

The musical reminiscence bump was also found to be present across musical genres. For two genres—rock and metal—the reminiscence bump had much higher peaks and was on the younger side. Again, the reason for this difference is unclear. It is conceivable that it is related to the differences in genres presented in Woolhouse et al. (2014) and Woolhouse and Renwick (2016). These studies, using a music download database, looked at the mean year-of-release for popular songs across different genres and discovered that for pop and rap music the mean year-of-release was very recent (~2009) with a small standard deviation, while rock music had a mean year-of-release of about 2001 with a large standard deviation. Perhaps, the more historically informed listening of rock music is reflected in steeper and younger reminiscence bumps.

The presence of a distinction between reminiscence bumps and recency bias in all age groups except for participants between the ages of 18 and 24 replicates results from studies that show a reminiscence bump in participants younger than 40, such as Jansari and Parkin (1996) and Janssen et al. (2005). The difference between recency and reminiscence is only imperceptible in participants between the ages of 18 and 24 due to the closeness of age between both bumps. The recency data also show that in older age groups the recency bias becomes less prominent. This is in line with many studies that have noted that the reminiscence bump, as opposed to recency effect, becomes larger in older participants. For example, Schulkind et al. (1999) found a strong trend of participants between the ages of 65 and 70; these individuals appear to have more knowledge of and a stronger emotional response to music from their youth than any other music.

Results from Schulkind et al. (1999), showing the importance older participants place on the music of their youth, also relate strongly to our observations of nostalgia. Nostalgia rating for the 55+ age group was the highest of any age group for recalled music from the ages of 5 to 34. There was also a sharp decline as recalled music approached the age of 55. This highlights the importance of the reminiscence bump and music from youth as one gets older. This corresponds to the finding of Barrett et al. (2010) who proposed a deep connection between nostalgia and reminiscence bumps because triggers of nostalgia during musical episodes are actually the particular associations the participant has formed between a given piece of music and the past events.

Although the scale and scope of our study brings fresh insights to the field, a possible limitation could concern recalled versus *actual* age songs first heard. While we assumed that the age at which participants reported first hearing songs was accurate, it is possible that participants incorrectly recalled the age they first heard a song or were approximating the age. Some evidence of this can be found in the intermediate spikes in the data every 5 years—indicating that some participants are rounding their responses to some degree. Although song-recall prompt was intended to allow participants to freely recall song, the wording can potentially be understood as asking for each song to be a different period of life. This may have resulted in an underrepresentation of the reminiscence bumps as song-recall may have been distributed more evenly across some participants' lives than otherwise. Furthermore, this survey was susceptible to various issues that could affect the results, such as sampling bias and response bias. For example, while the study looked at participants across several countries, participants who did not speak English were unable to respond to the survey. This is most problematic for the results regarding specific nationalities, such as the Philippines, as English speakers from the Philippines do not necessarily have the same musical reminiscence as non-English speakers. In addition, it is possible that participants from different countries could interpret the survey differently. For example, the emotion labels could have different meanings depending on cultural associations.

In sum, this research provides key insight into the existence of a "musical" reminiscence bump by showing that it is present among different ages, musical tastes (genres), sexes, and cultures. While the presence of a musical reminiscence bump continues to be verified by studies, such as this, future research could look to expand the field in several ways. For example, while studies most often ask participants to report songs they recall, it remains unclear as to whether musical events, such as concerts can also be linked to reminiscence bumps. The bump's interaction with other forms of media could also be investigated (movies, television, books, etc.). Janssen et al. (2007), for example, point to the presence of a reminiscence bump when movies or books are recalled.

The apparent universality of this phenomena, as explored in this article, is consistent with research exploring the ubiquity of music across human populations (Merker, 2000). This is not to claim that reminiscence bumps account for the popularity and historical endurance of music, but it does suggest that the social and memory processes associated with song familiarization are common across the globe. A real-world implication of this research could relate to recommender systems that take into account not merely a user's playlist but also key demographic information.

Conclusion

The present study replicated the presence of a musical reminiscence bump found in earlier studies using a data set of unprecedented size and scope. Our findings continue to support the notion that there is a strong relationship between memory, important life events, and music.

The study also demonstrates the reminiscence bumps pervasiveness across several dimensions: age, gender, country, and musical genre. While previous studies have occasionally investigated these variables, this study is unique in the quantity of data and the diversity of respondents. The cross-cultural nature of this study is significant and demonstrates that the reminiscence bump is a phenomenon that is not unique to any one culture or geographic region.

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ORCID iDs

James Renwick https://orcid.org/0000-0001-8165-6308

Matthew H. Woolhouse https://orcid.org/0000-0002-4977-9460

Supplemental material

Supplemental material for this article is available online.

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