Music evokes vivid autobiographical memories

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(Received 7 November 2014; accepted 5 June 2015)

Music is strongly intertwined with memories—for example, hearing a song from the past can transport you back in time, triggering the sights, sounds, and feelings of a specific event. This association between music and vivid autobiographical memory is intuitively apparent, but the idea that music is intimately tied with memories, seemingly more so than other potent memory cues (e.g., familiar faces), has not been empirically tested. Here, we compared memories evoked by music to those evoked by famous faces, predicting that music-evoked autobiographical memories (MEAMs) would be more vivid. Participants listened to 30 songs, viewed 30 faces, and reported on memories that were evoked. Memories were transcribed and coded for vividness as in Levine, B., Svoboda, E., Hay, J. F., Winocur, G., & Moscovitch, M. [2002. Aging and autobiographical memory: Dissociating episodic from semantic retrieval. Psychology and Aging, 17, 677–689]. In support of our hypothesis, MEAMs were more vivid than autobiographical memories evoked by faces. MEAMs contained a greater proportion of internal details and a greater number of perceptual details, while face-evoked memories contained a greater number of external details. Additionally, we identified sex differences in memory vividness: for both stimulus categories, women retrieved more vivid memories than men. The results show that music not only effectively evokes autobiographical memories, but that these memories are more vivid than those evoked by famous faces.

Keywords: Music; autobiographical memory; episodic memory; sex differences; vividness

One of the most salient and evocative experiences associated with music is hearing a song that unexpectedly triggers a distant memory. A strain of “Knock Three Times”, for example, could prompt a vivid image of lying in bed on a hot summer night with the window open, listening to the local AM radio station in your home town when you were 13 years old. Strong associations between music and vivid autobiographical memories are obvious—music frequently reminds us of people, places, and specific events and experiences from our past. Nonetheless, it remains an empirical question as to whether memories evoked by music are more vivid than memories evoked by other cues. In other words, while the idea that music holds a particularly special connection to memories from our past is intuitively appealing, the scientific basis for this impression is minimal. While research suggests that music evokes autobiographical memories that are strongly emotional (Janata, Tomic, & Rakowski, 2007) and that persist even in persons with significant memory impairments (El Haj, Postal, & Allain, 2012), the idea that music evokes
memories that are more vivid than memories evoked by other stimuli has not yet been tested.

Music-evoked autobiographical memories (MEAMs) are often associated with strong emotions such as happiness, excitement, and nostalgia (Barrett et al., 2010; Janata et al., 2007; Schulkind, Hennis, & Rubin, 1999). Illustrating this, Janata et al. (2007) found that MEAMs in response to popular music were rated as significantly emotional and these emotions were experienced strongly. When songs evoked strong emotions, participants were more likely to describe an autobiographical memory. Neuroimaging studies have also indicated the emotional nature of MEAMs and the capacity for music to evoke memories of varying levels of specificity (Ford, Addis, & Giovanello, 2011; Janata, 2009). These studies suggest reasons why music is a salient memory cue and reliably evokes autobiographical memories.

Research focusing on clinical populations also suggests that autobiographical memory retrieval is facilitated by listening to music (El Haj, Postal, et al., 2012). Foster and Valentine (2001) showed that individuals with Alzheimer’s disease recalled more personal details after listening to music than after hearing white noise or silence. Irish et al. (2006) gave individuals with Alzheimer’s disease the Autobiographical Memory Interview (Kopelman, Wilson, & Baddeley, 1989) either while listening to a piece of music (Vivaldi’s Spring movement from the Four Seasons) or silence. They found that individuals with Alzheimer’s disease recalled more episodic details during music listening, indicating that these memories were more vivid. While these studies suggest that music evokes vivid memories even in individuals with severe memory disturbances, the music used in these experiments was played in the background and not as an explicit memory cue. Therefore, although these results suggest that music positively influences memory retrieval, they do not indicate whether music-evoked memories are distinct from memories evoked by other cues.

One novel way in which music is associated with autobiographical memories is its ability to evoke memories from multiple periods of time and be transmitted across generations. Krumhansl and Zupnick (2013) found that MEAMs exhibit multiple “cascading reminiscence bumps”. In this study, young adults listened to music that was popular during the previous five decades. Participants showed a typical “reminiscence bump” by retrieving more autobiographical memories in response to music from their childhood and adolescence. This standard reminiscence bump is the phenomenon whereby individuals recall disproportionately more autobiographical memories of events that occurred between the ages of 10 and 30, as opposed to other lifetime periods (Berntsen & Rubin, 2002; Rubin & Schulkind, 1997). In addition to the standard reminiscence bump for popular music, participants also displayed a second reminiscence bump for music that was popular when their parents were young adults. The authors suggest that this “cascading” reminiscence bump evoked by music from the parents’ generation is one characteristic that sets music apart from many other stimulus categories. While this experiment investigated the frequency with which music of varying time periods evoked memories, the vividness of memories was not indicated. In the present study, we sought to investigate whether MEAMs are more vivid than memories evoked from other stimuli. Although research suggests that MEAMs may be distinct from autobiographical memories evoked by other cues, no direct comparison between music and other memory cues has been conducted. Here, we aim to test the hypothesis that MEAMs are more vivid than autobiographical memories evoked by other cues. Instead of comparing memories evoked while listening to music to those from silence or noise, we sought to compare MEAMs to a similar stimulus. To this end, we compared MEAMs to memories evoked by photographs of famous faces. Famous faces are a compelling comparison for several reasons: famous people and famous songs are both specific, unique entities (Belfi & Tranel, 2014); they are each associated with a specific period of time; they are a part of popular culture, ubiquitously experienced, and highly familiar to the general population; and famous individuals can be associated with autobiographical memories (Westmacott & Moscovitch, 2003). We chose not to use a more common memory cue, such as cue-words, because they are not as comparable to popular songs in these ways.

An additional reason for using famous faces as a comparison is that pictures and music are both external sensory cues which can evoke involuntary autobiographical memories. Involuntary autobiographical memories are frequently retrieved in response to external stimuli, such as sensory experiences, persons, music, and other media content (Berntsen, 1996; El Haj, Fasotti, & Allain, 2012; McDonald, Sarge, Lin, Collier, & Potocki, 2015; Rasmussen, Johannessen, & Berntsen, 2014). Since there are significant differences between
voluntary and involuntary memories (Berntsen, 1998; Berntsen & Hall, 2004; Hall et al., 2014; Schlagman & Kvavilashvili, 2008), we selected pictures of famous faces as a comparable cue that would not require voluntary memory retrieval. This prevents a potential confound between cue type and level of retrieval effort and allows for a direct comparison between faces and music. We predicted that autobiographical memories evoked by music would be more vivid than those evoked by faces.

In addition to our main analysis, we were also interested in investigating potential sex differences in autobiographical memory retrieval in response to music and faces. Given previous research suggesting sex differences in autobiographical memory, we explicitly included sex as an independent variable in our analyses. For instance, it has been shown that women recall a greater number of autobiographical memories than men (Davis, 1999; Seidlitz & Diener, 1998) and these memories are often more specific (Pillemer, Wink, DiDonato, & Sanborn, 2003). Women report more vivid autobiographical memories than men when memories are evoked by visual, odour, and word cues (Goddard, Pring, & Felmingham, 2005). There has been some conflicting evidence on sex differences in autobiographical memory, such as whether or not there are sex differences in the temporal distribution of autobiographical memories (Janssen, Chessa, & Murre, 2005; Rubin, Schulkind, & Rahhal, 1999). However, even when behavioural differences are not seen, men and women show differing patterns of neural activity during autobiographical memory retrieval (Piefke, Weiss, Markowitsch, & Fink, 2005; St. Jacques, Conway, & Cabeza, 2011). Although previous research does not provide a strong basis for making specific predictions regarding possible directions of sex differences for our manipulations (i.e., how sex would influence face-evoked memories vs. MEAMs), we designed the experiments with the intent to analyse potential differences based on sex.

**METHODS**

**Participants**

Participants were recruited through advertisements in the local community and through a registry of research participants. Participants were healthy adults ($N = 30$; 15 female and 15 male) aged 30–72 years old ($M = 55.1$, $SD = 13.0$). Data were collected from one additional participant but excluded because there were no memories retrieved for any category of stimulus. Participants had an average of 16.4 years of education ($SD = 1.7$) and an average Full Scale IQ of 113.8 ($SD = 7.7$). Full Scale IQ was approximated using the Wechsler Test of Adult Reading (Wechsler, 2001). This study was approved by the Institutional Review Board and all participants gave informed consent in accordance with the requirements of the Human Subjects Committee.

Our target sample size of 30 was determined by conducting a power analysis based on data from a similar study comparing memory vividness during music and silence (El Haj, Clément, Fasotti, & Allain, 2013). While our main analysis was to investigate within-subjects differences in memory vividness between music and face conditions, we wanted a sample size with adequate power to investigate potential interactions between sex and condition. Therefore, we based our estimated effect sizes on a study that investigated MEAMs using a similar mixed design (El Haj et al., 2013). The authors of this study reported effect sizes for significant effects of group ($\eta^2 = .64$) and condition ($\eta^2 = .29$), and a significant interaction ($\eta^2 = .18$). We used G*Power software (Faul, Erdfelder, Lang, & Buchner, 2007) to conduct a power analysis using the effect size from this interaction. This resulted in a projected sample size of nine individuals in each group. Thus, our sample size of 30 is adequate for the main objective of this study and should allow for sufficient power to investigate our additional interest in sex differences.

**Stimulus selection**

Music was chosen from the Billboard Hot 100 year-end charts between the years 1950 and 2013. A song database was created to include the top 20 songs from each of these years. We selected only the top 20 songs from each year to increase the likelihood that participants would be familiar with the songs. Songs were randomly selected from this database for each participant based on the years when the participant was between the ages of 15 and 30 years old. For example, a 35-year-old participant would hear songs from the years 1993 to 2008, such as “The Macarena” and “Hey Ya”. This age range was selected because it corresponds roughly to the standard reminiscence bump (Berntsen & Rubin, 2002; Rubin &
Schulkind, 1997), and to maximise the likelihood that participants would be highly familiar with the songs. For example, a person’s favourite movies, books, musical albums, and songs are often those they were exposed to during this period of their life (Holbrook & Schindler, 1989; Janssen, Chessa, & Murre, 2007). Each song clip was 15-seconds long and contained the chorus or other highly recognisable parts of the song, as determined by the audio sample provided for each song on the iTunes music store (as in Barrett et al., 2010; Janata, 2009; Janata, Tomic, & Haberman, 2012).

Faces were chosen from the Iowa Famous Faces test, which has been used extensively in previous research and has substantial normative data (Damasio, Grabowski, Tranel, Hichwa, & Damasio, 1996; Damasio, Tranel, Grabowski, Adolphs, & Damasio, 2004; Grabowski et al., 2001; Tranel, 2009). The faces from this test include individuals with various occupations (athletes, politicians, actors, etc.) who were popular during a variety of time periods. In a sample of 90 healthy adults, these faces were correctly named 85% of the time, indicating high familiarity (Tranel, 2006). Each famous face was assigned to particular years during which they were most popular (e.g., when they were actively playing professional sports or holding political office, when they had their top box-office grossing films, etc.). For example, Bob Hope was assigned to the 1940s and 1950s. Faces were selected in the same way as the music—based on when the participant was between the ages of 15 and 30 years old. For example, a 35-year-old participant would see faces that were popular during the years 1993–2008, such as Derek Jeter and Jennifer Aniston. Each face appeared on the screen for 5 seconds.

Procedure

Participants listened to 30 songs and viewed 30 faces in a counterbalanced design. After each stimulus, participants rated their autobiographical association with the stimulus. An autobiographical association was defined as the strength to which the stimulus evoked autobiographical memories. Participants rated their autobiographical association on a three-point scale: no autobiographical association, somewhat autobiographical, and strongly autobiographical. Participants were instructed to select “somewhat” or “strongly autobiographical” only if the stimulus evoked an autobiographical association with something they personally experienced during their life. If the participant selected “no association”, they continued on to the next stimulus.

If the participant selected “somewhat autobiographical” or “strongly autobiographical”, they then verbally described the memory that was evoked. At the start of the experiment, participants were instructed to provide as many details as possible during the memory descriptions. After each stimulus, however, participants were simply asked to “describe the memory”, and were given an unlimited amount of time to provide their memory descriptions. After the participants completed their memory descriptions, the experimenter provided a general probe (Levine, Svboda, Hay, Winocur, & Moscovitch, 2002). This general probe served to provide the participant with additional time, if needed, to think of more details to add to their memory description. As in Levine et al. (2002), data from the initial retrieval and from the general probe were combined. To preserve the involuntary nature of these memories, participants were not given specific probes. Memory descriptions were audio recorded using a Sony Digital Voice Recorder, model ICD-UX533.

Response coding

The recordings of the memory descriptions were transcribed and coded (as in Levine et al., 2002). Each memory was segmented into details (single pieces of information) that were coded as either internal or external. Internal details pertain to the central memory and reflect episodic reexperiencing. Internal details were each categorised into one of the following five mutually exclusive categories: (1) events (e.g., happenings, actions taken), (2) places (e.g., room, building, city), (3) times (e.g., year, month, semester), (4) perceptions (e.g., smells, sights, sounds), and (5) emotions/thoughts (e.g., happiness, sadness) directly related to the memory. External details do not directly pertain to the memory and were each categorised into one of the following four mutually exclusive categories: (1) semantic statements (e.g., general knowledge or facts), (2) repetitions (repeating previously stated information), (3) external events (e.g., information about an event not related to the present memory), or (4) other details not related to the memory (e.g., metacognitive statements).
After coding each detail, internal and external composite scores were created by tallying the total number of internal and external details for each condition within each participant. These composite scores were then used to calculate a ratio of internal/total details. This ratio provides a measure of episodic detail that is unbiased by the total number of details (Levine et al., 2002). We then performed an arcsine transformation on the internal/total ratio for each participant. This procedure normalises the distribution to allow analysis using paired-samples t-tests on the data (Freeman & Tukey, 1950). This ratio is the main variable of interest in the present study and was one of two ways that was used to operationalise memory vividness. A higher ratio of internal to total details reflects a more vivid memory, or, a memory that contains a greater proportion of information that directly pertains to the memory itself.

The second way that we operationalised memory vividness was the number of perceptual details. We calculated a composite score for perceptual details by tallying the total number of perceptual details for each condition within each participant. We focused specifically on this subtype of internal details because perceptual details reflect sensory experiences such as sights, sounds, and smells. A greater number of perceptual details therefore indicate a more vivid memory.

Memories were coded by three trained raters. Each memory was coded by only one rater. Memories from two pilot participants were coded by all three raters and intraclass correlation was performed (using a two-way mixed effects model) to assess interrater reliability. This amount of interrater reliability data is similar to that used in previous studies (Levine et al., 2002). Intraclass correlation was performed on the internal and external composite scores. The correlation coefficient for internal composite was .93 and for external composite was .88. These values reflect high agreement among the three raters.

**RESULTS**

Out of the 30 faces and 30 musical clips presented to each participant, approximately 30% of these stimuli evoked memories, although faces evoked a significantly greater number of memories ($M = 12.33$, SEM $= 1.33$; 95% CI: [11.25, 13.40]) than music ($M = 8.6$, SEM $= 0.84$; 95% CI: [7.52, 9.67]), $t(29) = -3.02$, $p = .005$, $d = -.55$ 95% CI [.16, .93]. We then analysed the ratings of autobiographical strength. Participants rated each memory as “somewhat autobiographical” or “strongly autobiographical”. There were more memories rated as “somewhat autobiographical” in the face ($M = 9.4$, SEM $= 1.01$, 95% CI: [8.59, 10.20]) than the music ($M = 6.6$, SEM $= 0.69$, 95% CI: [5.79, 7.40]) conditions, $t(29) = -2.41$, $p = .02$, $d = .44$, 95% CI: [0.06, 0.81]. There were no differences in the number of memories rated “strongly autobiographical” between the face ($M = 3.0$, SEM $= 0.81$) and music ($M = 2.4$, SEM $= 0.55$) conditions.

**Memory vividness—ratio of internal to total details**

Supporting our hypothesis, there was a significantly greater ratio of internal/total details in the music ($M = 0.84$, SEM $= 0.03$; 95% CI: [0.78, 0.89]) than the face ($M = 0.64$, SEM $= 0.05$; 95% CI: [0.58, 0.69]) condition. MEAMs had a significantly higher ratio of internal to total details than face-evoked memories $t(29) = 4.9$, $p < .001$, $d = .89$, 95% CI [.46, 1.37] (Figure 1).

**Internal and external composite scores**

As a follow-up analysis, we looked at the composite scores for internal and external details. There were no significant differences between the total number of internal details for the music

![Figure 1. Increased memory vividness for MEAMs. Memories evoked by music showed a significantly larger ratio of internal to total details. Error bars represent 95% within-subject confidence intervals (Baguley, 2012; Loftus & Masson, 1994).](image-url)
(M = 27.8, SEM = 4.48) and face (M = 26.0, SEM = 4.21) conditions. There was a significant difference between the total number of external details for the music (M = 23.53, SEM = 4.16, 95% CI: [12.55, 34.50]) and face (M = 61.63, SEM = 11.81, 95% CI: [50.65, 72.60]) conditions. There was a significantly greater number of external details in the face condition, t(29) = −4.28, p < .001, d = .78, 95% CI [.36, 1.18] (Figure 2).

Memory vividness—number of perceptual details

Although there were no differences between faces and music in the total number of internal details, we were interested in the type of details reported in each condition. If MEAMs are more vivid than face-evoked memories, we would expect MEAMs to contain a greater number of perceptual or sensory details. We found that there were significantly more perceptual details in the music (M = 1.66, SEM = 0.53, 95% CI: [1.40, 1.91]) than the face (M = 0.76, SEM = 0.23, 95% CI: [0.50, 1.01]) conditions, t(29) = 1.99, p = .05, d = .36, 95% CI [0.01, .73] (Figure 3).

Sex differences

Lastly, we investigated sex differences in autobiographical memory retrieval. We conducted a mixed-design analysis of variance (ANOVA) to investigate a potential sex effect on our main dependent variable of interest, the ratio of internal to total details. A mixed-design ANOVA with sex as a between-subjects factor and condition as a within-subjects factor revealed a significant main effect of sex, F(1,28) = 9.91, p = .004, η² = .26, 95% CI [0.03, .47]. The interaction between sex and condition was not significant (Figure 4).

DISCUSSION

In this study we investigated differences in autobiographical memories evoked by famous faces and popular music. The total number of memories evoked by these stimuli was near 30%, which is consistent with previous research (Janata et al., 2007). However, we found that faces evoked a significantly greater number of memories than music. It may be the case that the faces used in the present study were simply more familiar than the musical cues, and therefore triggered memories more often. Though familiarity and autobiographical
salience are somewhat correlated for memories evoked by musical cues, familiarity with a song does not necessarily mean that song will evoke a memory. In addition, unfamiliar songs can at times evoke autobiographical memories (Janata et al., 2007). One possible explanation for our findings that faces evoked a greater number of memories could be that familiarity and autobiographical salience are more correlated in faces than musical cues. Alternatively, faces could be more likely to be associated with a particular context, for example, watching Johnny Carson on TV in the living room each night. While individuals may be highly familiar with musical cues, the cues may be less likely to be associated with a particular time and place and therefore less likely to evoke a memory.

In addition to investigating the number of memories evoked by music and faces, we assessed aspects of the memories retrieved. We tested the hypothesis that MEAMs are more vivid than autobiographical memories evoked by famous faces. We assessed vividness in two ways: (1) by calculating the ratio of internal details over total details and (2) the number of perceptual details. We chose to assess vividness in these ways, as opposed to directly asking participants to rate the vividness of their memories (e.g., Janssen, Rubin, & St Jacques, 2011), in order to assess the qualities of the memories themselves as opposed to the participants’ perceptions of their memories. A rating of memory vividness would not provide the detailed information about the qualities and characteristics of the memories evoked by faces and music. In addition, self-reported ratings of vividness may not accurately capture the amount of episodic information and detail contained in the memories. An interesting question for future research is to investigate the relationship between self-reported ratings of memory vividness and composition of internal and external details in memory descriptions.

Supporting our hypothesis, we found that MEAMs were more vivid than face-evoked memories in that they contained a greater proportion of internal to total details as well as a greater number of perceptual details. One explanation why MEAMs are more vivid is that music may elicit stronger emotional responses than faces. There is an abundance of research indicating that music evokes strong emotions (Juslin & Sloboda, 2010) and these emotions can often be extremely pleasurable (Harrison & Loui, 2014). Therefore, it is possible that the music in the present experiment evoked strong emotional responses comparable to those experienced during the original event. Music may therefore evoke the emotions felt during the time of the event, resulting in greater feelings of reexperiencing and increased memory vividness. Future studies could examine emotional responses during MEAMs to determine whether strength of emotional response is correlated with memory vividness. Music is well known to elicit highly pleasurable emotions that are correlated with physiological responses such as heart rate and skin conductance (Salimpoor, Benovoy, Longo, Cooperstock, & Zatorre, 2009). If emotion is central to the mechanism underlying MEAMs, we would expect that degree of physiological response would be related to memory vividness.

Additionally, functional neuroimaging research has indicated that listening to pleasurable music activates similar brain regions as other highly rewarding stimuli (Blood & Zatorre, 2001; Salimpoor et al., 2013; Salimpoor, Benovoy, Larcher, Dagher, & Zatorre, 2011). These regions, including the striatum, are also involved in associative-learning processes such as encoding the reward value of a stimulus. For example, activity in the striatum is associated with higher rates of associative learning (Williams & Eskandar, 2006). Music is typically a highly rewarding stimulus and therefore may be preferentially associated with events from one’s lifetime. In contrast, famous faces may be less inherently rewarding than music and therefore less likely to be associated with autobiographical memories. This strong association between music and an event may consequently facilitate autobiographical recall when later hearing the same music.

While memories evoked by music were more vivid than those evoked by faces, there were no differences between conditions in the total number of internal details. There was, however, a significant difference between conditions in the total number of external details. Face-evoked memories contained significantly more external details than MEAMs. Face-evoked memories typically contained substantial semantic information about the person pictured such as his or her occupation or activities. Despite being instructed to retrieve autobiographical information, participants routinely focused their autobiographical memories around semantic information regarding these faces. For an example of this and an example of a characteristic MEAM, see Appendix.
One potential reason why face-evoked memories contain more external details is that faces may evoke more general memories. Autobiographical knowledge typically falls into three levels of specificity ranging from event-specific knowledge, to general event knowledge, and to knowledge of broad lifetime periods (Conway & Pleydell-Pearce, 2000). Music seems to evoke memories from all three levels with equal frequency (Ford et al., 2011). Here, faces may have evoked a greater proportion of general or lifetime period memories than musical cues. This could explain why face-evoked memories contained more external details than music-evoked memories. In the present study, participants rated their memories as either “somewhat” or “strongly autobiographical”. While these ratings do not directly map on to levels of memory specificity, our findings indicate that faces evoked a greater number of memories that were rated “somewhat” autobiographical than musical cues. This may suggest that memories evoked by faces are more likely to refer to general events or lifetime periods than memories evoked by music. A question for future research would be to investigate differences in levels of autobiographical memory specificity evoked by various memory cues.

In addition to our main findings that MEAMs are more vivid than face-evoked memories, we also identified sex differences in autobiographical memory retrieval. Regardless of the condition under which memories were evoked, women described more vivid autobiographical memories than men. This is consistent with previous findings showing that overall, women report more autobiographical memories than men and these memories contain more specific episodes (Pillemer et al., 2003). Previous research has also shown that women recall more events than men and use significantly more words to describe these events (Seidlitz & Diener, 1998). The authors suggest that men and women use different cognitive styles to encode memories, with women encoding them in more detail. Piefke et al. (2005) also suggest that men and women use different cognitive strategies during autobiographical memory retrieval. Our findings confirm sex differences in autobiographical memory retrieval and enrich previous findings by demonstrating that women not only produce more memories than men, but that these memories are more vivid. Whether this is due to differences in encoding or retrieval strategies, however, is unclear.

An additional demographic variable that may affect vividness of autobiographical memories is age. For example, older adults report less specific memories, memories with a lower proportion of episodic details, and less autonoetic consciousness than younger adults (Levine et al., 2002; Piolino et al., 2006). A limitation of the current study is that, while participants covered a relatively large age range, overall the group was fairly homogeneously middle-aged (only two participants under 40 years old and three above 70 years old). This coincides with an additional limitation of the study, which is a relatively small sample size. An interesting question for future research will be to investigate the effects of age on autobiographical memories evoked by various cues. To investigate the issue of age in the current sample, we split our group (using a median split) into older and younger groups. There were no significant differences between these two groups on any of our dependent variables. To assess age as a continuous variable, we conducted correlations between age and all of our outcome variables, and found no significant correlations. Therefore, while age is an important variable to consider in studies of autobiographical memory, our current sample does not provide enough variability in the age range to find significant age-related differences.

Alternatively, previous research has indicated that involuntary autobiographical memories may not show typical age-related changes. For example, while voluntary autobiographical memories are less specific in older adults, there is no age-related decrease in specificity for involuntary memories (Schlagman, Kliegel, Schulz, & Kvavilashvili, 2009). Furthermore, age-related differences in autobiographical memory specificity may be a function of task instructions. When instructed to retrieve specific memories, older adults produced fewer specific memories than younger adults. However, there were no age-related differences in memory specificity when participants were not given explicit instructions to retrieve specific events (Ford, Rubin, & Giovanello, 2014). In the present study, participants were instructed to report memories that spontaneously arose in response to the stimuli, and were not given explicit instructions as to the specificity of these memories. Therefore, these memories were likely to be involuntary and may not be as susceptible to showing age-related differences.

Our study is the first to compare autobiographical memories evoked by music to those evoked by other cues. Our results indicate that memories evoked by music are more vivid than those evoked by pictures of famous persons, and that face-
evoked memories contain more information not relevant to the central memory. This lends support to the prevalent belief that music is especially suited to evoke vivid autobiographical memories.

**ACKNOWLEDGEMENT**

We thank Brett Schneider, Amanda Owens, Jonathan Schacherer, Jonah Hesjke, and Erin Evans for their research assistance.

**DISCLOSURE STATEMENT**

No potential conflict of interest was reported by the authors.

**FUNDING**

This work was supported by the generous donations of 56 donors using Experiment, an online research crowd funding platform.

**REFERENCES**


### Appendix

**Characteristic MEAM:** I saw him in concert in Cedar Falls. And it was so cold that night that there was snow on the roof of the dome. And the heat inside cause the snow to melt and it rained inside the
auditorium dome or whatever. And I just remembered
that I loved it and it was great. Someone gave me the
tickets, and I remember Mick Jagger coming out on
the walkway over the crowd and just yelling. I liked it.

Characteristic face-evoked memory: Seeing Dennis
Rodman, I love basketball, he played basketball. He
played for the Bulls which I really enjoyed watching
the Bulls, and he was part of three championships with
them, so I have pretty fond memories of that time.
Before that he played for the Pistons and I hated his
guts and I thought he was horrible. But it just reminds
me of, you know, when I was younger, and watching bas-
ketball. And it was a good time to watch basketball
when the Bulls were actually a really good team.