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The tracks of my years: Personal significance contributes to the reminiscence bump

Clare J. Rathbone[1], Akira R. O'Connor[2] & Chris J.A. Moulin[3]

[1]Department of Psychology, Oxford Brookes University, Oxford, UK

[2]School of Psychology and Neuroscience, University of St Andrews, UK

[3] LPNC, CNRS UMR 5015, Université Grenoble Alpes, Grenoble, France

Word count: 8,272

Acknowledgements:

This work was supported by the Economic and Social Research Council (ES/K000918/1) and data collection was carried out at the University of Leeds, UK. We are grateful for the comments of David Rubin and one anonymous reviewer on a previous draft of this manuscript.

Address for Correspondence:

Clare J. Rathbone

Department of Psychology

Oxford Brookes University

Gipsy Lane

Oxford

OX3 0BP

United Kingdom

Tel. +44 (0)1865 483772 Email: crathbone@brookes.ac.uk

Two studies investigated the role of the self in the reminiscence bump (heightened retrieval for events from young adulthood). Participants over the age of 40 were presented with top-grossing films and songs, and were asked to select the five that were most personally significant. Study 1 produced reminiscence bumps for personally significant songs, when measured by both participants' age at release (AaR) and age when songs were reported as most important (AaI). This effect was not shown for films. In Study 2, participants again selected their personally significant songs but also rated all songs for whether they were known, remembered (e.g., associated with an episodic memory), or not known. Personally significant songs were significantly more likely to be associated with episodic memories, compared to personally non-significant songs. Again, only personally significant songs formed a reminiscence bump. Findings underline a critical role of personal significance in the reminiscence bump, which we argue is consistent with the formation of identity in this lifetime period.

Keywords: Autobiographical memory; Self; Identity; Episodic Memory; Remember/Know

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What influences the things we remember in later life, and from which time period do we remember best? A predominant contemporary view is that our preferences and memories are accessed via a cognitive structure which can be described as the self (Conway, 2005). There are several illustrations of the influence of self in memory (such as the self-reference effect; Rogers, Kuiper & Kirker, 1977) but one interesting extension of the idea that the self is a cognitive structure is that we may see meaningful patterns in the distribution of preferences for films and songs (for example) across the lifespan. That is, our preferences are determined by the things we are exposed to at a critical time in our personal development: the reminiscence bump.

The reminiscence bump is a robust phenomenon whereby events and information encountered in late adolescence and early adulthood tend to be remembered better than those from any other period in life (Rubin, Rahaal & Poon, 1998; Rubin, Wetzler & Nebes, 1986). The reminiscence bump is formed between the ages of 15 and 30, and has been demonstrated across a range of domains, including episodic autobiographical memory (Rubin, Wetzler & Nebes, 1986), semantic autobiographical memory (Rybash & Monaghan, 1999), public events (Janssen, Murre & Meeter, 2008; Koppel, 2013), and flashbulb memories (Denver, Lane & Cherry, 2010), as well as in the distributions of favourite films, books and songs (e.g. Holbrook & Schindler, 1989; 1996; Janssen, Chessa & Murre, 2007; Schulkind et al., 1999; Sehulster, 1996; Smith, 1994). Self-based theories of the reminiscence bump propose that this period of the lifespan is remembered best because these years are central to the formation of an enduring adult identity, and preferential accessibility of this time-period promotes a stable sense of self later in life (e.g. Conway, 2005; Fitzgerald, 1988; Rathbone, Moulin & Conway, 2008).

Several different, non-self explanations for the reminiscence bump have also been proposed (for a detailed review, see Rubin, Rahhal & Poon, 1998). One possibility is that events from this time are remembered best due to a peak in neurobiological processes (e.g. a biological account). This account is supported by studies that have shown similar reminiscence bump patterns across participants from a range of different cultures and nationalities (Conway et al., 2005). The novelty account proposes that this period of life typically involves many new events and first-time experiences (e.g. first job, first relationship, moving away from home) and so memories from this time are encoded at a deeper level (e.g. Robinson, 1992). An alternative explanation is that the bump reflects typically occurring events. The life script hypothesis (Berntsen & Rubin, 2004) is supported by studies showing that reminiscence bump memories tend to consist of positive rather than negative events (Rubin & Berntsen, 2003) and that people structure their life stories around culturally normative events from the bump period such as graduation and weddings (Berntsen & Rubin, 2004).

These different accounts are not necessarily mutually exclusive (Rubin et al., 1998; Janssen, Rubin, & Conway, 2012). Recent studies have sought to pinpoint specific mechanisms in the formation of the reminiscence bump. For example, Janssen, Rubin and St. Jacques (2011) investigated participants' ratings of re-living and vividness and found that memories from the reminiscence bump period did not differ in these features compared to memories from other periods in the lifespan. They suggested that such phenomenological features are not responsible for the formation of the reminiscence bump. Such a finding does not fall in favour of any one of the proposed accounts above. More recently, Koppel and Berntsen (2015) have shown that according to the types of cues used to generate autobiographical memories and the retrieval processes used, there are differences in the reminiscence bumps produced. Rubin (2015, p.87) states "Such differences in the location of the peak cannot be explained purely in terms of encoding, which is one class of explanation we have suggested (Rubin et al., 1986, 1998) and the main theoretical mechanism in many other theories

especially those that view adolescence and early adulthood as times of identity formation or increased cognitive ability."

Our previous work (Rathbone, Moulin and Conway, 2008) has shown that memories that are particularly self-defining (cued by participant-generated self-images) tend to cluster around periods of identity formation. Whilst this provides some support for the idea that periods of life that involve change in the self are associated with more accessible autobiographical memories (the core of the self account of the reminiscence bump), there was no 'non-self' control condition in our study. It therefore seems to us that to test the self account of the reminiscence bump, one needs to compare the distributions of self-relevant compared to non-self-relevant material. We should expect that self-relevant (i.e. personally significant) materials should show a reminiscence bump, whereas non self-relevant materials should not. For instance, for the biological account to hold, we should expect all information encoded in the reminiscence period to be better retained, regardless of how self-relevant it was.

Thus, the present two studies were designed to investigate the relationship between the self and the reminiscence bump, by exploring the distributions of personally significant and personally non-significant films and songs. At a broader level, the self (or identity) is conceptualised as a multifaceted and complex set of self-related processes and schema (e.g., Conway, 2005; Markus, 1977; McAdams, 2003; Power, 2007). The study of the self has roots in personality theory, as well as aspects of social, clinical and cognitive psychology. Our specific interest is in the role that self-related processes may play in shaping our understanding of memory (e.g. Conway, 2005). Thus, in this paper we have operationalised the self by asking participants to consider the personal significance of particular songs and films and examined the distributions of these items across the lifespan. Of relevance, Janssen and Murre (2008) previously examined ratings of importance (which we assume measure personal significance) for autobiographical memories from across the lifespan. They found reminiscence bumps for unimportant as well as important events, suggesting that the reminiscence

bump is not necessarily shaped by distributions of personally significant events. A number of previous studies have found reminiscence bumps in the lifespan distributions of favourite songs and films (e.g. Holbrook & Schindler, 1989; 1996; Janssen, Chessa & Murre, 2007; Schulkind et al., 1999; Sehulster, 1996; Smith, 1994). Recent work by Krumhansl and Zupnick (2013) even revealed the presence of "cascading" reminiscence bumps for music that was popular during participants' parents' early adulthood. In line with the self function of the reminiscence bump, several researchers have proposed that our musical preferences and music-related memories bolster a sense of personal identity (Lonsdale & North, 2009; Rentfrow & Gosling, 2003, 2006; Sloboda & O'Neill, 2001; Smith 1994). Previous studies have also demonstrated the links between emotional memories and specific items of music (e.g. Baumgartner, 1992; Janata, Tomic & Rakowski, 2007; Schulkind, Hennis & Rubin, 1999; Sloboda & O'Neill, 2001), and show that people can readily identify particular films that 'define their era' (Sehulster, 1996).

Studies that examine lifespan distributions of remembered films and songs typically take one of two methodological approaches. In the first approach (what we will call "self-generated cue studies"), participants are asked to generate their own personally significant films or songs, and are then asked to rate them for details such as age when encountered, number of times encountered, and details of the memories evoked, such as vividness and imagery specificity (e.g. Baumgartner, 1992; Janssen et al., 2007; Sehulster, 1996). For example, Baumgartner (1992) asked participants to give examples of specific pieces of music that were associated with episodic autobiographical memories. The memories generated were high in self-relevance, typically associated with past or present boy/girlfriends, or events involving family and friends. Furthermore, these memories tended to be rated as highly emotional and containing vivid imagery, and there was a strong bias towards remembering positive events. Using similar self-generated cues, Sehulster (1996) asked participants to list five or more favourite films, and five or more era-defining films, and date the age at which they first saw each film generated. In addition, participants gave a range of ages that they felt

"defined their era". Participants' era-defining films tended to have been watched during their early 20s (mean age 21.85) and their favourite films during their late 20s (mean age 27.6) – both within the boundaries of the reminiscence bump range of 10 to 30 (Rubin, Wetzler & Nebes, 1986). These results indicate that people *recall* encountering favourite films during the reminiscence bump period, but they cannot speak to the issue of whether this reflects a self-related process. To argue that high accessibility in memory reflects high self-relevance is circular. Thus, in order to examine the effects of the self, one needs to compare items with high self-relevance with items of low self-relevance. This is better suited to tasks based on recognition, rather than recall, paradigms.

An alternative methodological approach is based on experimenter-generated cues, which is akin to a recognition paradigm. In these studies, ratings are collected for songs or films that have been pre-selected by the experimenter (e.g. Bartlett & Snelus, 1980; Holbrook & Schindler, 1989, 1996; Janata et al., 2007; Schulkind et al., 1999). The advantage of using a pre-selected list is that one can control for factors such as year of release and popularity. For example, Janata, Tomic and Rakowski (2007) used extracts of songs selected from the Billboard pop and R&B charts that were released during participants' childhood years, and examined whether memories elicited were event-specific (e.g. episodic) or general (e.g. semantic) in nature. Results showed that both episodic and semantic memories were generated by music from adolescence and childhood. Similarly, Janssen, Rubin & Conway (2012) designed an elegant experiment that demonstrated a reminiscence bump in the distribution of participants' favourite football players. Janssen and colleagues presented participants with a list of the 190 best football players in the world, and asked them to select the five they considered to be the best of all time. The players were all associated with a concrete date (the mid-point of their career), much like the release date of a film or song. When these footballer dates (for the five selected players) were plotted relative to the age of the participants they showed a clear reminiscence bump. Thus, football players who were at the mid-point of their career when

participants were adolescents tended to be those who were considered the best of all time; the age at which you encountered the player determined your preference.

In designing the present study we took advantage of the fact that reminiscence bumps are produced even when reporting preferences and not merely for retrieval from memory (e.g., Janssen et al., 2012; Janata et al., 2007; Schulkind et al., 1999). Use of experimenter-selected cues overcomes the circularity raised above. By adopting a recognition paradigm with experimenter-generated cues, research has shown that reminiscence bumps in distributions of favourite items are not easily explained merely by raised accessibility; something else causes participants to preferentially select items from young adulthood (e.g. Sehuslter, 1996).

Our aim then, was to compare the reminiscence bumps of items that were and were not rated as personally significant. If the reminiscence bump is driven by personal significance, we should see it for items rated as personally significant, but not for the other items. To do this, we examined the distributions of selected films and songs based on their release dates. Most reminiscence bump studies are based on participant-generated memory dates (i.e. participants report their age at the recalled event). However, we directly compared the temporal distributions of age at release (AaR: participant age in the year of release for films and songs – like the mid-point of the players' career, discussed above) and age at importance (AaI: the participant-generated age when a particular film or song was most personally significant). The use of these objective (AaR) dates is critical for our main aim: we cannot measure the AaI for a song or film that someone has forgotten, and so we cannot plot a reminiscence bump. The use of objective release (AaR) dates as compared to participant-generated dates was one of the main issues we address in Study 1. It addressed this question by presenting participants with an experimenter-generated list of the top hit songs and Best Picture Oscar winning films from the last 55 years, and asking them to select those that were most personally significant. We tested whether such release dates still produce the reminiscence bump for films and songs (thereby extending Janssen et al.'s [2012] method for the mid-points of

footballers' careers) chosen for their personal significance. We also compared the distributions of AaR dates for songs and films that were and were not selected as personally significant. In Study 2, this paradigm was developed further to examine the specific memory processes that might underlie these choices. We were interested in whether the reminiscence bump effect was driven by associations between particular songs and rich, event-specific episodic memories, by using the widely used remember/know (R/K) paradigm. The R/K paradigm assesses recollective experience: the subjective state that characterises episodic 'remembering' as opposed to semantic 'knowing' (Tulving, 1985). Previous studies using this task have suggested that autobiographically significant famous names may be more likely to be associated with recollective experience (i.e. rated as remembered rather than known) compared to less autobiographically significant famous names (Westmacott et al., 2003). Thus, Study 2 adopted the R/K paradigm to enable a more detailed exploration of the relationship between recollective experience and personal significance.

Study 1

The first aim of Study 1 was to compare the distributions of AaR dates for personally significant songs and films, with the AaI – dates when these significant songs and films were most important to the participant. Our prediction was that both distributions would form reminiscence bumps, as previous studies have shown bump effects for non-participant generated dates (e.g. Janssen et al., 2012) and participant-generated dates (e.g. Sehulster, 1996). To our knowledge this study is the first to compare these two types of distribution directly. More importantly, establishing whether AaR dates formed reminiscence bumps in this task laid the foundations for us to investigate our second, more novel aim: to examine whether personally significant films and songs would form more pronounced reminiscence bumps than non-selected (personally non-significant) items. We assessed this by plotting the distributions of AaR dates for selected compared to non-selected films and songs. We predicted that personally significant films and songs would show a reminiscence bump, in contrast to personally non-significant films and songs, which would show a flatter distribution.

Method

Participants. The online questionnaire was active between 2007 and 2010, and was accessed 2979 times[1]. Participants were only included in the analysis if they had complied with instructions and provided their date of birth and selected 5 films, 5 songs, and given AaI for each selected song and film. This left a group of 1,538. As standard for reminiscence bump research we excluded participants aged under 40 in order to examine lifespan distributions of past events (e.g. Elnick, Margrett, Fitzgerald, & Labouvie-Vief, 1999; Rathbone et al., 2008). This left a sample of 172 participants (Mean age = 49.97, SD = 8.92, Range 40 to 80).

Materials and Procedure. Participants were presented with a pseudo-randomised list of the 56 movie titles that won an Oscar for Best Picture at the Academy Awards each year from 1950 to 2005 inclusive. Their instructions were to select the five films that "you most identify with, e.g. those you find most personally important, and that you might feel played a significant part in your life." They were then presented with a pseudo-randomised list of the song title and artist for the 56 most successful singles (measured by number of weeks at number one) from the UK music charts for each year from 1950 to 2005 inclusive, and asked to choose their five most personally significant using the same instruction wording as for films. Participants were then re-presented with their five film choices, and asked to report the approximate calendar year when they most vividly remember watching that film. They were told that if they had seen a particular film many times, they should write down the year in which they felt the film was most significant to them personally. After they had generated these five AaI dates, they were asked to repeat the process for their five selected songs. Finally, participants were asked for their own year of birth and thanked for their participation.

Results and Discussion

[1] Thanks to the following sites for hosting a link to the questionnaire: www.socialpsychology.org/expts.htm and http://psych.hanover.edu/research/exponnet.html

All participants selected five films and five songs and generated AaI dates for each selection, thus the results below are based on data for 860 song-related and 860 film-related data points. For each film/song selected, we were able to analyse by AaI (e.g. the year that the film/song was personally significant to the participant) or by AaR. Both AaR and AaI dates were reformulated relative to the participants' ages. For example, if a participant born in 1960 selected 'Gladiator' (released in 2000) as one of their significant films, and generated the year 2004 as their AaI date, the AaI would be reformulated as 44 (AaI date minus year of birth, e.g., 2004 – 1960) and the AaR date would be reformulated as 40 (release date minus year of birth, e.g., 2000 – 1960). Using these reformulated dates, we were able to plot the distributions of both AaR and AaI according to participant age. Figure 1 shows these frequency distributions for personally significant films. The data plotted are normalised proportions. To ensure the reminiscence bump was not an artefact of age, the frequency data for each year were normalised according to the age of the sample, since someone born in 1950 would not be able to have a memory for seeing a film from before 1950, for instance. Normalisation was carried out by identifying the possible range for each participant and restricting the frequency of values for each year accordingly: if only 10 people could contribute data about songs from 15 years before their birth, the denominator for the proportion became 10, for instance.

(Insert Figure 1 about here)

There is no clear reminiscence bump for films, in either AaI or AaR distributions. Given the mean age of the sample, of fifty years old, these results look more like a recency effect; people tend to select films as personally significant that were released when the participant was between 35 and 45 years old. For AaI there is a suggestion that the maximal frequency is earlier, and within the reminiscence bump period (age 25-19), but the data to not produce a very defined reminiscence bump. The same distributions were plotted for frequencies of personally significant songs (see Figure 2). The song distributions show a more pronounced reminiscence bump. For both AaR and AaI, the highest frequency of personally significant songs were encountered (or released) in participants' teenage

years. Also, in contrast to the data for films, there was less distance between the peak dates of AaI and AaR for personally significant songs. Whilst the peak in distributions for films' AaI generally came a decade or more after the release date, for songs the AaI data were distributed in a more similar pattern to AaR. This suggests that songs became personally significant for participants at, or soon after, the time of their release. We analyse this possibility in an ANOVA, below.

(Insert Figure 2 about here)

Having established that the distribution of release dates for personally significant songs form a reminiscence bump, we were able to compare the distributions of AaR dates for personally significant (i.e. selected) items compared to personally non-significant (i.e. unselected) items. Figure 3 shows this data for films (3A; upper panel) and songs (3B; lower panel).

(Insert Figure 3 here)

For Figures 3 and 5, 95% confidence intervals (CIs) were estimated using Monte-Carlo case-resampling bootstrapping procedures (see Mooney & Duval, 1993). Participants' complete datasets were sampled with replacement until the number of participants in the original experiment was reached. This was repeated for 10,000 simulated experiments, and the lower and upper CIs were estimated based on the distributions of items falling in each of the 5-year bins plotted in the figures. The data show more pronounced reminiscence bumps for personally significant (compared to personally non-significant) films and songs. These results, on which we expand in Study 2, suggest that personal significance plays an important role in shaping the reminiscence bump.

(Insert Table 1 here)

To confirm statistically the pattern shown in Figures 1-3, we examined the temporal distribution using within-subject ANOVAs. In this study, participants selected five songs or films. For each participant we thus calculated the mean and median ages for these five selections. A 2 (film versus

song) x 2 (AaR versus AaI) repeated measures ANOVA on the mean ages of participants showed a main effect of media type ($F[1,171] = 46.79$, $p<.001$, partial $\eta^2 = .21$), with the songs (M=23.58) having been from a period approximately four years before the films (M=27.56). There was also a main effect of age type, with the AaR (M=21.56) ages being significantly earlier than the AaI ages (M=29.54) ($F[1,171] = 283.89$, $p<.001$, partial $\eta^2 = .62$). There was also a significant interaction ($F[1,174] = 16.76$, $p<.001$, partial $\eta^2 = .09$). The means show that the temporal distance between the two ages (AaR and AaI) was greater for the films than for the songs. A parallel analysis was carried out but using the median of the five ages given, which gave exactly the same pattern: A main effect of media type ($F[1,171] = 39.35$, $p<.001$, partial $\eta^2 = .19$), a main effect of age type ($F[1,171] = 198.07$, $p<.001$, partial $\eta^2 = .54$) and a significant interaction ($F[1,171] = 35.43$, $p<.001$, partial $\eta^2 = .10$). Again the means of the participants' medians indicated that songs were encountered earlier than films, that AaI was later than AaR and that there was a larger difference between AaI and AaR for films than for songs. In short, the within subject analyses confirm that there exist systematic differences between AaI and AaR values and songs and films, and that a typical age to encounter personally significant songs and films is in one's twenties.

Study 1 showed that lifespan distributions of personally significant songs produce reminiscence bumps regardless of whether data is plotted as participant-generated AaI memory dates or objective AaR dates. This result, in line with our predictions, is further support for the idea that the reminiscence bump itself is not an artefact of other more general memory factors; a bump is produced even when simply plotting the release dates of personally significant songs.

In support of our second prediction, the figures show that items selected as personally significant demonstrated a more pronounced reminiscence bump than non-selected items. However, we did not know how many of the songs and films that were not selected as personally significant were actually known to each participant. It is thus problematic to compare directly personally significant

items with non-selected items. To allow for this comparison in Study 2, we asked all participants to rate each item for whether it was known, remembered (e.g. associated with an episodic event) or not known. This allowed us to compare personally significant items with those that were known to the participant but not rated as personally significant. It also allowed us to examine the recollective experience ratings for personally significant compared to personally non-significant items.

There were a number of unexpected differences between distributions of films and songs. First, both the AaR and AaI data show less pronounced bumps for films compared to songs. This finding contrasts with previous work showing clear reminiscence bumps for favourite films (e.g. Janssen, Chessa, & Murre; 2007; Sehulster, 1996). Second, the peak for AaI lags several years behind the peak for AaR – a pattern that was more marked for films than songs (shown graphically, but also in the means in Table 1). Of course, the fact that participants could not hear songs or watch films released before their birth goes some way to explaining this lag, but as this would apply to both songs and films it is interesting that we found a greater lag for films compared to songs. People seem to identify with films such that their memories of first watching these films tend to peak a after their release. Thus it is not simply a case of encoding whatever films are released during young adulthood as being self-defining and personally significant – there is a difference between distributions of AaI and AaR data.

The difference between AaI and AaR for films and songs is possibly related to the ways we encounter films and pieces of music (cf. Janssen et al., 2007). A Number 1 hit song typically involves frequent broadcasts which are clustered during the period that the song features in the charts. As music can be a background activity, it is understandable that certain songs will become associated with events that unfolded during the period of that song's release and airing (e.g. Baumgartner, 1992). Films are encountered in a different manner, with less repetition, and may be watched on DVD or television several years after release. This greater lag between film release and viewing, compared to between song release and listening, may explain the greater difference between AaR and AaI found for films

compared to songs. As such, the release date of a film is not an ideal objective measure to be compared to a subjective AaI measure, as it may be irrelevant if the participant did not see the film until television release. However, the benefit of examining AaR dates is that one can compare distributions of items that are and are not recognised by participants in a way that would be impossible for standard free-recall memory paradigms.

The fact we find different distributions using different cueing methods reflects recent developments in the reminiscence bump literature. Koppel and Berntsen's (2015) review compared temporal peaks for memory distributions cued by most important memories and word-cued memories. They found that the shape and dates of the reminiscence bump were affected by the type of memory task employed, for example, the bump is earlier for word-cued memories than for important memories. The comparison of personally important and personally less important songs and films in the present study is, in some ways, similar to the comparison of personally important and word-cued (i.e. personally less important) memories in the studies reviewed by Koppel and Berntsen. It is interesting then, that the word-cued memory studies reviewed by Koppel and Berntsen consistently produce a reminiscence bump, while the equivalent less personally significant items in the present study did not. One explanation for this difference is the nature of the cues and dating process used in the present study. Whilst word-cued studies involve the free recall of participant-dated memories, the present study used a recognition paradigm and, instead of participant dating, used age at song/film release (AaR) to plot temporal distributions. Thus, the cognitive processes that may underlie the organisation of memories cued by words are less likely to be evident when examining the distributions of release dates for items that were personally non-significant (i.e. not selected) in the present study. Moreover, the Koppel and Bernsten conclusion is derived from comparisons across studies using different methodologies rather than the experimental manipulation of controlled stimuli within subjects, as we report here. Here we show that the bump is clearly demonstrated

(both in AaR and AaI) when you ask participants for their most significant songs, but we do not see it so clearly when plotting participants' most significant films.

Study 2

In Study 1 participants generated a year in which each of their selected films and songs were of most personal significance. Study 2 aimed to explore the memory mechanisms that underlie this dating process. The key questions were: (1) whether only songs rated as personally significant would show a reminiscence bump, in contrast to recognised songs that were not rated as personally significant; (2) whether feelings of personal significance were associated with episodic re-experiencing (e.g. a Proustian moment of recollection, in which a song triggers a feeling of the self in the past, e.g. Wheeler et al., 1997; Tulving, 1985). To address these questions we adopted a Remember/Know (RK) paradigm (e.g. Gardiner, 1988; Gardiner, Ramponi, & Richardson-Klavehn, 1998; 2002).

One might consider that certain films or songs become personally significant by virtue of their association with particularly salient autobiographical memories. The idea that some songs and films might hold particular "autobiographical significance" was proposed by Westmacott and Moscovitch (2003; Westmacott et al., 2003). They showed that famous names rated as high in autobiographical significance were remembered better, and responded to faster, compared to those rated as low in autobiographical significance. Famous names were assigned ratings of high or low autobiographical significance based on participants' R (remember) and K (know) responses using an R/K task (e.g. Gardiner et al., 2002). In their study, Westmacott et al., presented participants with famous names and, for each name, asked them to give an R response if they could recall a specific event linked with that name, and a K response if the name was familiar but not associated with any specific events in the participant's life. Westmacott et al. proposed that the names associated with R responses were likely to be higher in autobiographical significance as they evoked personal memories, and suggested that autobiographical significance helped to organise long term memory for both semantic and

episodic information. This conceptualisation of autobiographical significance informed the development of the present studies. By Westmacott et al.'s view, it is possible that the personal significance ratings in Study 1 are achieved by the participant considering access to autobiographical memories for the given film or song, that is, the reminiscence bump is due to the recollection of items on our list.

However, previous work has shown that the reminiscence bump consists of memories for both episodic and semantic information. Rybash and Monaghan (1999) asked participants to date AMs generated using a standard cue-word task, and then to rate whether the memories were known (K) or remembered (R). When memories were plotted across the lifespan, results showed that reminiscence bumps were present for both R and K memories, showing that both semantic and episodic information is preferentially accessible from the reminiscence bump period.

Finally, by asking participants to generate R/K ratings in Study 2, we were able to examine the memory status of items that were not selected as personally significant. In Study 1, we did not know whether the selection of personally significant items was driven by a lack of knowledge of songs from outside of the reminiscence bump period. If people only recognise music from young adulthood, we would find a reminiscence bump regardless of any effects of personal significance. Study 2 therefore enabled us to establish whether participants had knowledge of songs released in periods beyond the reminiscence bump, ruling out the possibility that the personal significance effect was driven by selective recognition for items from young adulthood.

As songs showed the clearest reminiscence bump pattern in Study 1, we opted to only use the list of 56 song titles for Study 2. First, in line with self-based accounts of the reminiscence bump (e.g. Fitzgerald, 1988; Conway & Haque, 1999; Rathbone et al., 2008) and in replication of Study 1, we predicted that the reminiscence bump would be more pronounced for personally significant songs compared to those not selected as personally significant. Second, following the work of Westmacott

and Moscovitch (2003), we predicted that songs selected as personally significant would be more likely to be rated as associated with specific episodic events (e.g. rated 'R'). Third, we investigated the distributions of personally significant songs associated with R compared to K memories. Previous studies based on recollection paradigms have shown similar temporal distributions for semantic and episodic autobiographical memories (e.g. Rathbone, Moulin & Conway, 2009; Rybash & Monaghan, 1999). For the first time here, we explored the lifespan distributions of personally significant songs assigned R and K ratings.

Method

Participants. The online questionnaire was active between 2008 and 2010, and was accessed 2,733 times. As in Study 1, we only included data from participants who completed the questionnaire and were aged 40 or above. The sample comprised 151 participants (30 male) aged 40 to 65 (mean age 46.98, *SD* =5.73).

Materials and Procedure. Study 2 had two sections. The first consisted of a replication of Study 1, in which participants had to select their five most personally significant songs from a list and then generate dates of personal significance (i.e. AaI). The song list was identical to that used in Study 1, however, in order to reduce questionnaire length, participants saw one of two versions of the task, each only listing 28 of the 56 song titles (Version 1 consisted of all even year song titles, e.g. 1950, 1952; whilst Version 2 used odd year song titles). As in Study 1, all song titles were presented pseudo-randomly. Participants were then asked for year of birth and gender. In section 2, participants were told that this part of the study was about two different ways of thinking about memory: remembering and knowing. They were re-presented with the 28 song titles shown in section 1 (including the five they had rated as personally significant) and asked to make an R/K judgement for each song. Participants were instructed to select Remember if "you can re-experience a particular memory in which you watched, listened to, or heard about this song, or if reading about

the title of this song triggers some other specific personal memory"; Know if "you know of this song but cannot recall a specific memory involving this song"; or N if "you do not recognise this song title at all." Instructions were based on Westmacott and Moscovitch (2003), with the word 'episode' replaced with 'memory'. The order of sections 1 and 2 were counterbalanced, so that half of the participants completed the R/K task (e.g. Section 2) first, and half completed it second.

Results and Discussion

Every participant selected five personally significant songs and generated dates of personal significance for each. This totalled 755 AaI (ages of personal significance) and 755 AaR (ages at year of song release). As in Study 1, all song dates were reformulated relative to participants' ages, thus a song released in 1990 would be reformulated as 20 for a participant born in 1970 (and again, for this graph, the results were normalised for age). First we replicated the findings in Study 1 by demonstrating a reminiscence bump in late childhood/early adulthood for both AaR and AaI for songs (shown in Figure 4).

(Insert Figure 4 about here)

As in Study 1, because all 56 songs were associated with a release date, we were able to compare the distributions of personally significant songs (e.g. the five selected by each participant) with songs that were not selected as personally significant. Figure 5 shows the lifespan distribution of AaR dates for personally significant songs compared to those not selected as personally significant. As the number of songs in each group was not equal (five personally significant songs compared with up to 23 personally non-significant songs per participant) all data were converted into proportions. For a better-matched comparison, we excluded personally non-significant songs that had been marked as 'not known' from this dataset. Thus, each participant's set of personally non-significant songs reflect the release dates of songs that were known by the participant (either rated as R or K) but not selected as personally significant.

(Insert Figure 5 about here)

A pattern similar to a reminiscence bump is demonstrated for personally significant song release dates, with a peak in participants' early teenage years. This relatively early peak (between ages 10-14 years) is in line with a number of studies reviewed by Koppel and Berntsen (2015) that show early bumps, particularly for word-cued memories. A broader and flatter distribution is shown for songs that were not selected as personally significant, with a peak that extends from 10 years before birth to age 39. This key finding, replicating Study 1, suggests that personal significance may play a role in shaping the reminiscence bump.

As with the previous previous study we sought to confirm the pattern of results shown in the aggregate lifespan retrieval curves using repeated measures ANOVAs on participants' mean and median AaIs and AaRs. For the mean ages, there was a significant difference between AaI and AaR ($F[1,150] = 116.05$, $p<.001$, partial $\eta^2 = .436$), with the AaR being significantly earlier (M=17.11) than the AaI (M=22.35). Likewise, the median values yielded the same significant effect ($F[1,150] = 75.19$, $p<.001$, partial $\eta^2 = .33$). In this study the participants' ages given were in the late teens and the early twenties.

We were interested in whether participants' judgements of recollective experience differed for personally significant compared to personally non-significant songs. Each participant had 5 personally significant songs and 23 songs that were not selected as personally significant. All 28 songs were assigned an R, K or N judgement. For each participant we calculated the proportion of personally significant songs that were assigned an R, K and N (R and K proportions were calculated from the total of R and K responses – excluding number of N responses – whilst N was calculated from the total of R, K and N responses). Participants' proportional scores were then averaged, as shown in Table 2.

(Insert Table 2 about here)

Table 2 shows that personally significant songs were associated with a far higher proportion of Remember responses (78%) than Know responses (22%). This pattern was reversed for personally non-significant songs, where only 35% of songs were rated as R, and K ratings accounted for the majority of responses (65%). Table 2 also shows a very small proportion of responses (1%) were N for personally significant songs, whilst over half of personally non-significant songs were rated N. The proportional data for R and K responses for personally significant and personally non-significant songs were entered into a repeated measures 2 (personal significance) x 2 (judgement type) ANOVA. As proportions of R and K totalled 1, main effects of personal significance were not calculated, however, there was a significant main effect of judgement type (F [1,150] = 13.12, $p < .0001$, partial $\eta^2 = .08$) and a highly significant interaction between judgement type and personal significance (F [1,150] = 203.69, $p < .0001$, partial $\eta^2 = .58$). These results suggest that participants were significantly more likely to associate specific episodic memories with personally significant songs, compared to personally non-significant songs. Furthermore, because the design of this study involved counterbalancing the order of presentation for (a) selection of personally significant songs, and (b) judgements of recollective experience, this pattern is not simply a result of order effects.

Finally, we examined the lifespan distribution of both R and K memories associated with personally significant songs. Because this set of personally significant songs demonstrated a pronounced reminiscence bump (e.g. Figure 5) we did not expect to see great differences between R and K memories, however it was possible that R-rated memories (which accounted for 78% of this set of memories) were responsible for driving the shape of the distribution. To test this, we analysed all the AaI for personally significant songs, and grouped them on whether they were rated R or K. As there were many more R song dates (n = 568) than K (n = 160), these data were converted into proportions to allow them to be compared directly (see Figure 6).

(Insert Figure 6 about here)

Figure 6 demonstrates that songs that are associated with remembered events (R) are distributed in a similar pattern to songs that are not associated with specific memories. We also examined the mean and median AaR using within subjects ANOVAs in order to compare the different ages for R and K responses for the 5 significant songs. As suggested by Figure 6, there was no difference in the mean ($F<1$) or median ($F<1$) ages for R and K values – the songs which we experienced as R and F did not have a different distribution across the lifespan.

In Study 2, we examined the relationship between ratings of personal significance and the reminiscence bump. We replicated the effect in Study 1, showing reminiscence bumps in the distribution of songs measured by both AaI and AaR. Furthermore, we showed again that only personally significant songs formed a reminiscence bump, with songs that were not personally significant (but still known to the participant) organised in a flatter distribution across the lifespan. Results also indicated that personally significant songs were significantly more likely to be associated with specific episodic events (e.g. rated as remembered), compared to songs that were known but not selected as personally significant. Finally, replicating previous work by Rybash and Monaghan (1999), we showed that distributions of personally significant songs rated as both remembered and known exhibited reminiscence bumps. These findings lend support to self-based accounts of the reminiscence bump (e.g. Conway, 2005; Fitzgerald, 1988; Rathbone et al., 2008) and suggest several avenues for future research.

General Discussion

In two studies, participants selected and dated their most personally significant films (Study 1) and songs (Studies 1 and 2). In Study 2 they also rated songs for whether they were simply known, associated with a sense of recollective experience, or not known. In line with our predictions, distributions of personally significant songs formed reminiscence bumps, with most significant songs released and recalled in participants' teenage years and early twenties. In contrast, personally

significant films did not form a reminiscence bump pattern; instead they showed recency effects. Across both studies we showed that only personally significant items formed a reminiscence bump. Finally, Study 2 found that personally significant songs were more likely to be associated with episodic recollection compared to personally non-significant songs.

These findings move the field of reminiscence bump research forward in several key ways. We have shown for the first time that items in memory that are more connected to the self (in this case, songs rated as high in personal significance) are organised in a reminiscence bump distribution, in contrast to items in memory that are recognised but not connected to the self. This finding supports the idea that the self plays an important role in the formation of the reminiscence bump (Conway, 2005; Fitzgerald, 1988; Rathbone et al., 2008). Furthermore, the highly significant relationship between personal significance and ratings of recollective experience suggests that increased self-relevance is associated with greater episodic re-experiencing. Our findings support the work of Westmacott and Moscovitch (2003; Westmacott et al., 2003), who suggested that items (in their case, famous people) can develop heightened significance through their association with salient episodic memories. The idea that particular songs can trigger specific memories has been shown in previous studies (e.g. Baumgartner, 1992; Janata, Tomic & Rakowski, 2007; Schulkind, Hennis & Rubin, 1999; Sloboda & O'Neill, 2001) and is probably a familiar sensation for all. Music can be a particularly evocative direct retrieval cue (Conway, 2005), such that the first few chords of a certain song can transplant the self back to a previous time and place – the hallmarks of episodic recollection (Wheeler, Stuss &Tulving, 1997). However, the present research is (to our knowledge) the first to demonstrate that personally significant songs (compared to other known songs) are far more likely to be associated with episodic recollection.

At first glance this seems to contradict the work of Janssen et al. (2011), who suggested that the reminiscence bump did not feature memories that were particularly unique in terms of episodic richness. Janssen and colleagues analysed ratings of vividness and re-experiencing in memories

within and outside of the reminiscence bump period, and found no significant differences. However, our findings did not involve this comparison. We were motivated by an interest in the comparison of distributions for different types of memories (e.g. those associated with AaI versus AaR, and those associated with personally significant and personally non-significant songs). Our findings suggest that personally significant songs are associated with episodic recollection, and that the reminiscence bump is strongest for songs that are personally significant, but it does not indicate that only episodically rich events feature in the bump period. In fact, personally significant songs associated with both R and K ratings formed reminiscence bumps (as in Rybash & Monaghan, 1999), although a far higher proportion of personally significant songs were associated with R ratings.

Although personally significant songs were associated with higher ratings of recollective experience, it would be interesting to know more about the features of the memories associated with these songs. Westmacott and Moscovitch (2003) suggested that the preferential retrieval of personally significant over non-significant items might be a result of several factors, including emotional salience, specific temporal-spatial context and a form of self-reference effect, in that information associated with the self tends to be remembered best (Rogers, Kuiper & Kirker, 1977). Future studies could therefore include a wider range of measures for all songs presented to participants, allowing examination of the relationship between personal significance, dating (i.e. AaI), emotionality and temporal-spatial context.

We found that participants rated the memories associated with personally significant songs as more episodic than those associated with personally non-significant songs. This raises the question of circularity, as we cannot ascertain whether songs were selected as personally significant because they were associated with specific memories, or whether high personal significance of a given song makes one more likely to associate it with specific events from the time of hearing it. Thus, even though both studies used a recognition paradigm, it is still possible that recollection processes played a role in the selection and dating of personally significant films and songs. This complex

casual relationship reflects the bi-directionality that is central to models of memory and the self (e.g. the Self Memory System; Conway & Pleydell-Pearce, 2000). Ultimately, it seems clear that personal significance plays a role in shaping the reminiscence bump. Whether this personal significance is driven by recollection, or causes it, we find for the first time that only songs that are personally significant form a reminiscence bump.

Finally, although our results support the self-account of the reminiscence bump, they do not necessarily contradict other accounts. For example, we cannot rule out the possibility that personally significant songs were associated with memories for cultural life script events (e.g. Rubin & Berntsen, 2003) such as relationships, moving house, or starting university. One interesting possibility in future work might be to compare what is of significance to the individual with what is significant culturally to whole cohorts of people. Indeed, our data cannot discriminate between personal identity as reflected in personal film and song choices, and a 'culture wide importance'. It is also possible that the memories triggered by songs were of particularly novel events. Our results do suggest, however, that the biological account is not an adequate explanation for the reminiscence bump. If age-related optimal encoding was the only mechanism at play, one would not expect personally significant items to form a more robust reminiscence bump than personally non-significant items. Fundamentally, the reminiscence bump is an empirical observation of human behaviour and as such one might expect it to have multiple causes at different levels. Thus, although the self may play a role in shaping the bump, this identity mechanism could be associated with more basic cognitive processes. For example, rehearsal has been suggested to help shape the reminiscence bump (e.g. Janssen, Chessa & Murre, 2007) and this may, in part, explain self-related effects as people tend to share and rehearse memories that are personally meaningful (e.g. Singer & Salovey, 1993). Cognitive accounts based on novelty and lack of proactive interference have also been proposed to explain the bump (e.g., Schrauf & Rubin, 1998). Such explanations may underlie self-related effects, as development of the self (argued to play a role in organising autobiographical

memory e.g., Conway, 2005; Rathbone et al., 2008) often involves periods of rapid change as opposed to periods of stability. Finally, we cannot rule out the possibility that neural development combines with other factors, such as a cultural bias to focus on events from young adulthood (e.g., Koppel and Berntsen, 2014), to play a role in shaping the bump. Koppel and Berntsen (2015) show that different shapes of reminiscence bump are produced according to how the memory system is interrogated, emphasising that retrieval mechanisms are critical in producing the reminiscence bump, and suggesting that the reminiscence bump is caused by a fixed period in which events which are encoded are preferentially retrieved later. We agree that given the effects of factors at retrieval on the distribution of memories across the lifespan, we should begin to think of how retrieval operations which are constrained or modified by access to personally significant or self-relevant information influence the reminiscence bump. Future research into the specific features of memories cued by personally significant songs will enable us to start unravelling and comparing these theoretical explanations.

Conclusions

Our studies support the growing body of work showing that items and events with the most personal significance tend to be encountered in young adulthood. We found that the songs encountered during the period of young adulthood in each generation are those that retain a lasting personal significance. As recently suggested by Koppel and Berntsen (2014) there seems to be a "youth bias" for events and experiences in early adulthood. Our findings suggest that this bias may be driven by the increased personal significance that is associated with encounters from this period of life.

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Tables

Table 1. Means (and standard deviations) for the mean and median Age at Release (AaR) and Age at Importance (AaI) for the participants' selected films and songs, Studies 1 and 2

	Mean Age		Median Age	
	AaR	AaI	AaR	AaI
Study 1				
Films	22.87 (9.91)	32.25 (9.75)	23.17 (11.61)	33.12 (11.63)
Songs	20.25 (9.14)	26.90 (9.50)	20.19 (10.37)	26.23 (11.07)
Study 2				
Songs	17.11 (7.31)	22.36 (6.51)	17.02 (8.52)	21.65 (7.63)

Table 2: Mean proportions (and standard deviations) of R/K/N judgements for personally significant and personally non-significant songs - Study 2

	Remember (R)	Know (K)	Not recognised (N)
Personally significant	0.78 (0.30)	0.22 (0.30)	0.01 (0.04)
Personally non-significant	0.35 (0.28)	0.65 (0.28)	0.54 (0.20)

Nb. R and K proportions are calculated from total number of R and K responses, while N proportions are calculated from total number of R, K and N responses.

Figure Captions

Figure 1: Age at which personally significant films were released (AaR) and dated as personally significant (AaI) – Study 1. The y-axis shows age-normalised proportions.

Figure 2: Age at which personally significant songs were released (AaR) and dated as personally significant (AaI) – Study 1. Shaded area marks cut-off for minimum age of participants in cohort. The y-axis shows age-normalised proportions.

Figure 3: Lifespan distribution of AaR dates for personally significant (i.e. selected) and personally non-significant (i.e. non-selected) films (upper panel; A) and songs (lower panel; B) – Study 1. Bounded areas (grey lines) around central lines represent bootstrapped 95% CIs. Non overlapping areas can be considered as significantly different.

Figure 4: Age at which personally significant songs were released (AaR) and dated as personally significant (AaI) – Study 2. The y-axis shows age-normalised proportions.

Figure 5: Lifespan distribution of release dates for personally significant (i.e. selected) and personally non-significant (i.e. non-selected) songs – Study 2. Bounded areas (grey lines) around central lines represent bootstrapped 95% CIs. Non overlapping areas can be considered as significantly different.

Figure 6: Lifespan distribution of AaI for personally significant R and K rated songs – Study 2. Bounded areas (grey lines) around central lines represent bootstrapped 95% CIs. Non overlapping areas can be considered as significantly different.

Figure 1

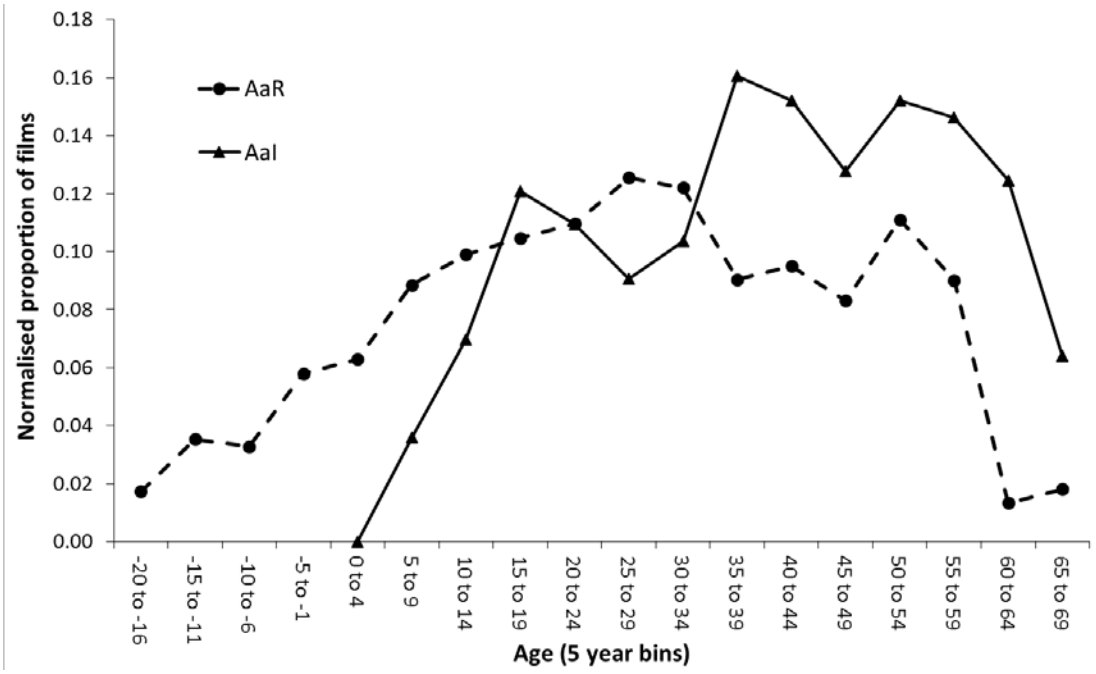


Figure 2

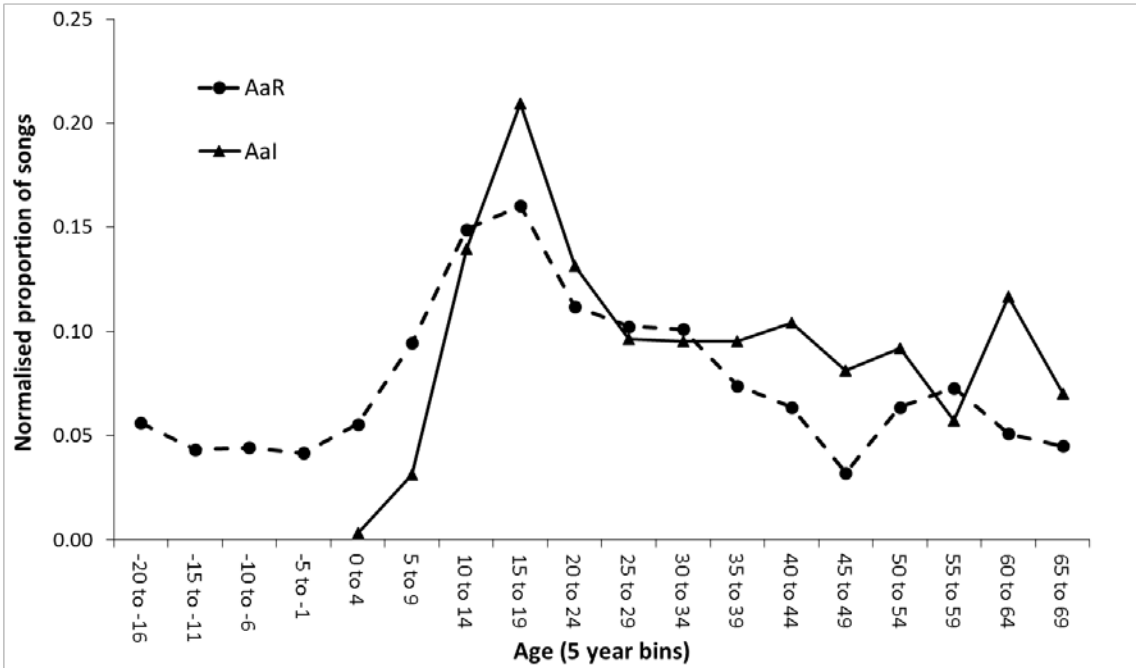
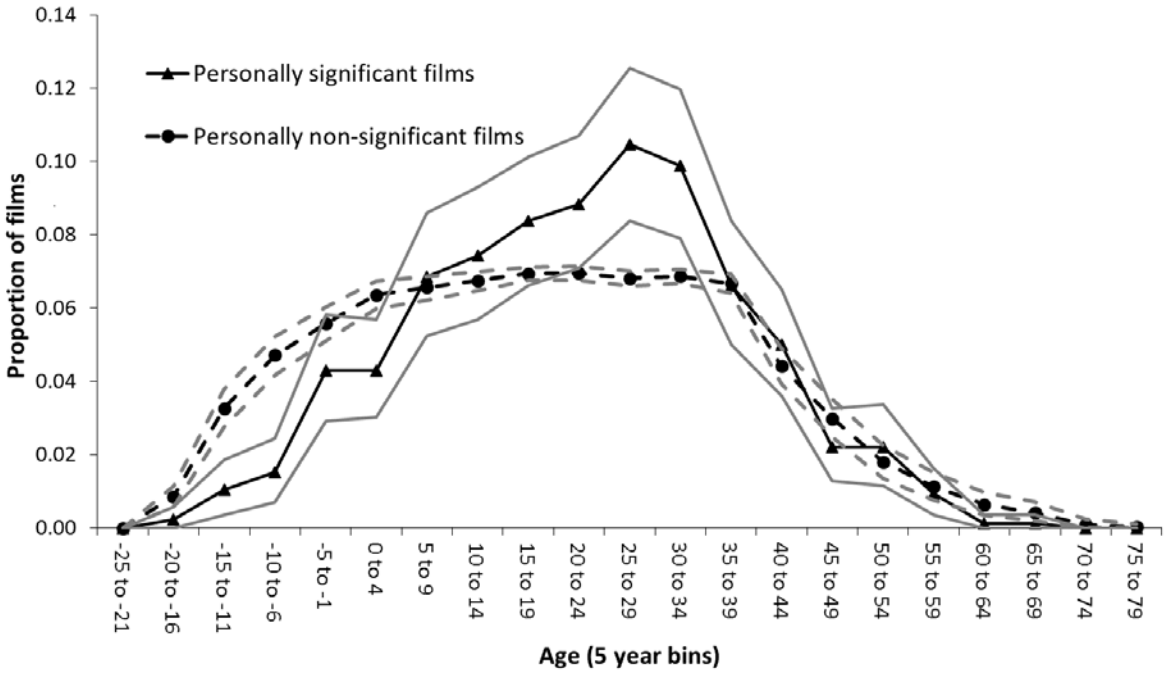


Figure 3

A)


Personally significant films
Personally non-significant films
Proportion of films
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-25 to -21
-20 to -16
-15 to -11
-10 to -6
-5 to -1
0 to 4
5 to 9
10 to 14
15 to 19
20 to 24
25 to 29
30 to 34
35 to 39
40 to 44
45 to 49
50 to 54
55 to 59
60 to 64
65 to 69
70 to 74
75 to 79
Age (5 year bins)

B)

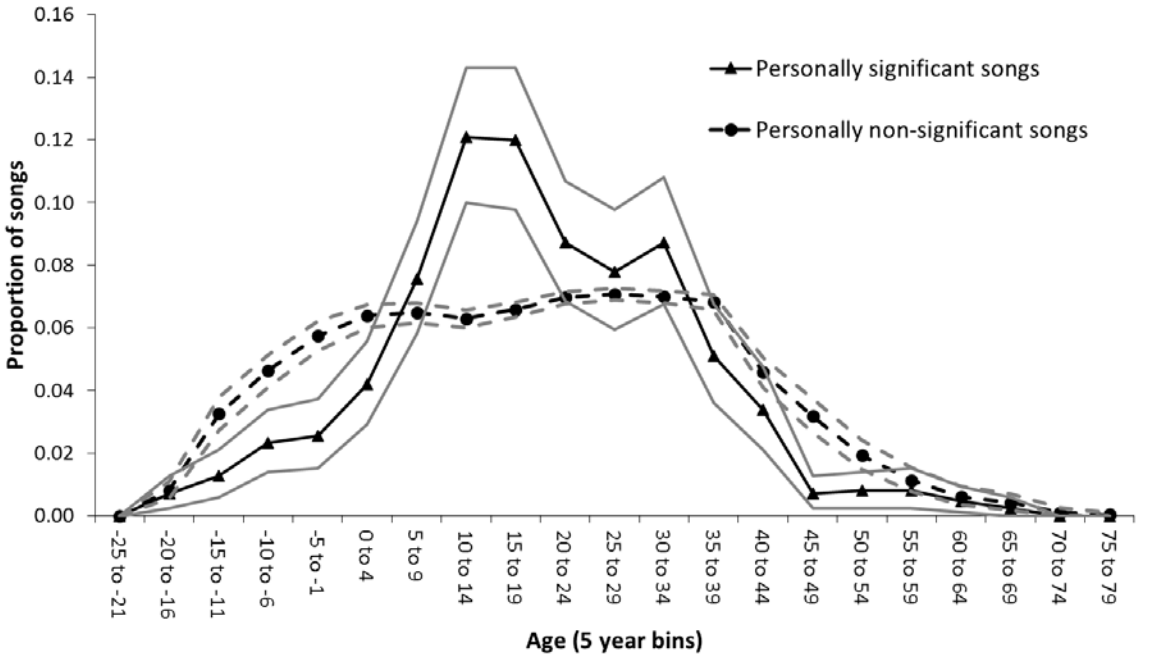

Personally significant songs
Personally non-significant songs
Proportion of songs
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-25 to -21
-20 to -16
-15 to -11
-10 to -6
-5 to -1
0 to 4
5 to 9
10 to 14
15 to 19
20 to 24
25 to 29
30 to 34
35 to 39
40 to 44
45 to 49
50 to 54
55 to 59
60 to 64
65 to 69
70 to 74
75 to 79
Age (5 year bins)

Figure 4

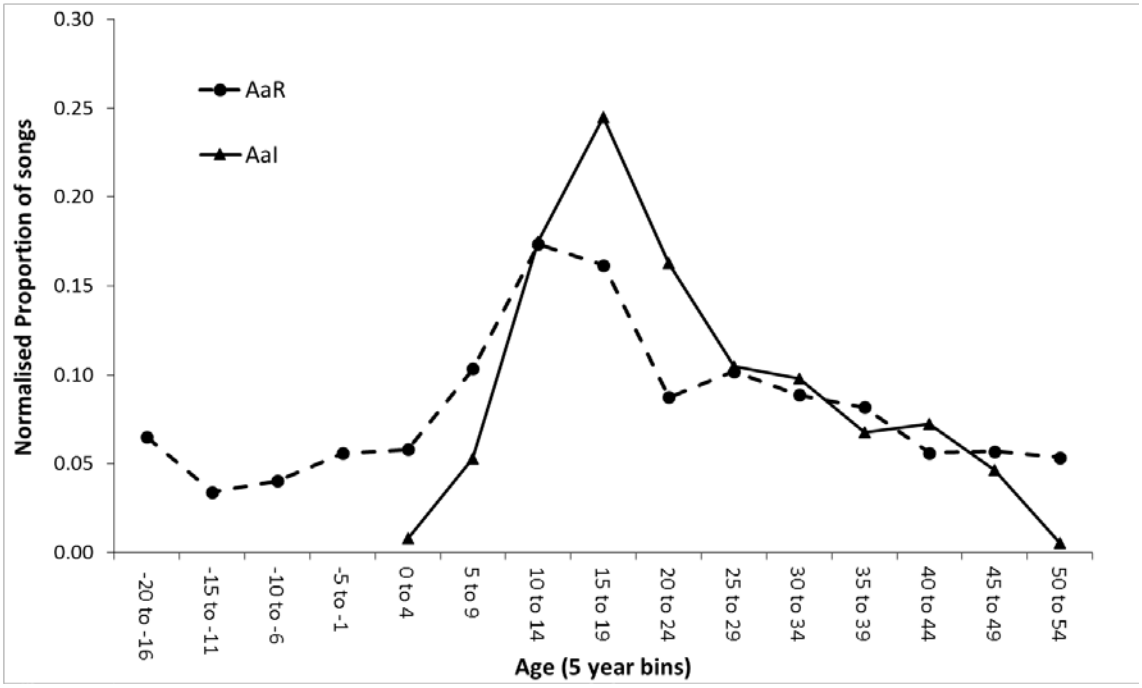


Figure 5

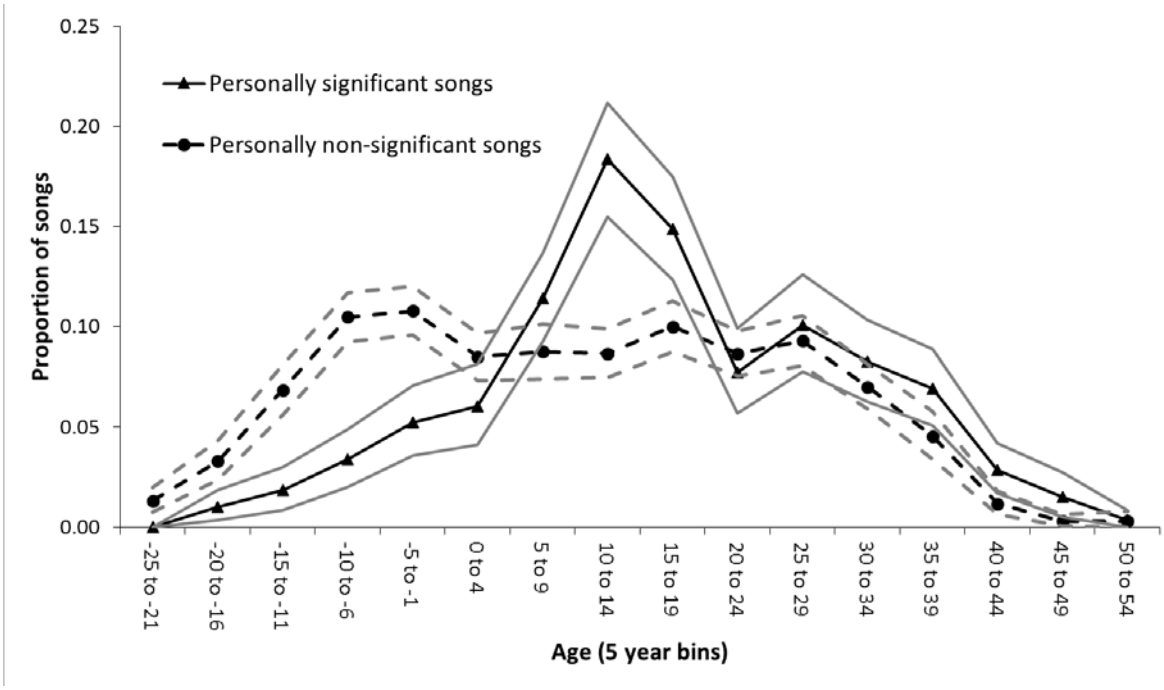
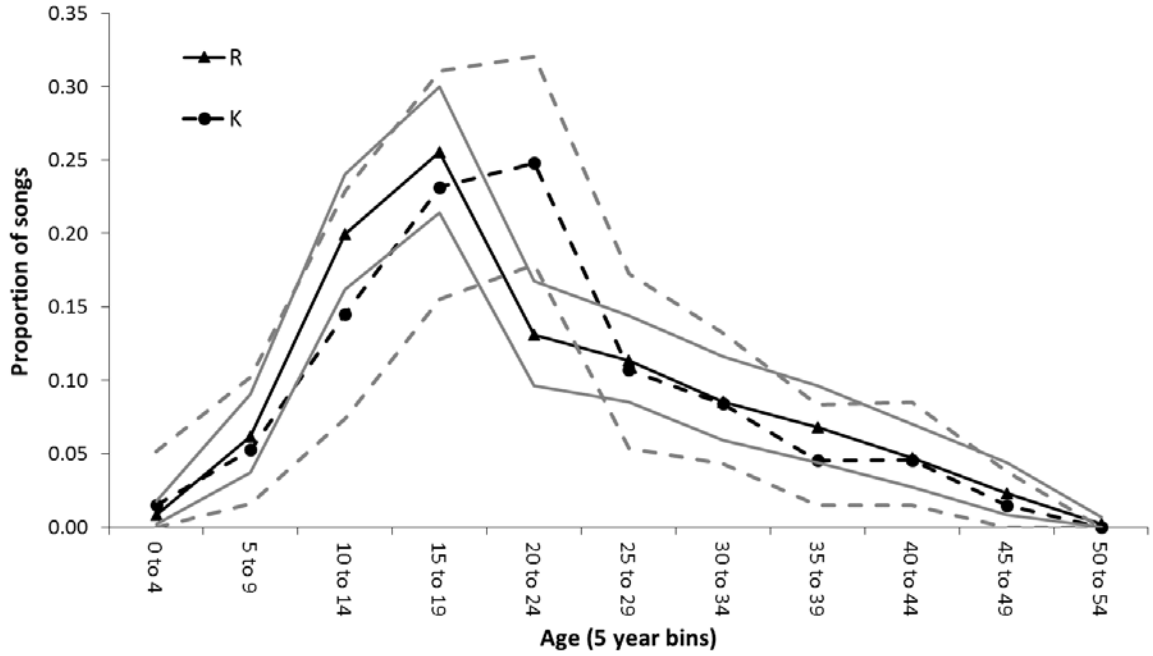


Figure 6


0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Proportion of songs
R
K
0 to 4
5 to 9
10 to 14
15 to 19
20 to 24
25 to 29
30 to 34
35 to 39
40 to 44
45 to 49
50 to 54
Age (5 year bins)