Mental Imagery in Music-Evoked Autobiographical Memories

Kelly Jakubowski

Durham University

kelly.jakubowski@durham.ac.uk

https://orcid.org/0000-0002-4954-7117

The experience of being mentally transported back to a previous event or time period from one's life when listening to music is a familiar one to many people. Such music-evoked autobiographical memories (MEAMs) are typically vivid and emotionally positive (Belfi, Karlan, & Tranel, 2016; Janata, Tomic, & Rakowski, 2007), and tend to occur around once per day (Jakubowski & Ghosh, 2019). MEAMs often come to mind involuntarily, with no intentional effort made to retrieve a memory (El Haj, Fasotti, & Allain, 2012a; Jakubowski & Ghosh, 2019), and can vary in their level of specificity (Janata et al., 2007; Kristen-Antonow, 2019)—from semantic information or facts about one's life, to generic memories of entire life periods or recurring events, to specific, episodic details about single events (see Conway & Pleydell-Pearce, 2000, for one influential model of the levels of organisation of autobiographical knowledge). The main autobiographical memories of interest for the present chapter are those that contain at least some episodic content, meaning that these memories are characterised by a sense of recollection and 'reliving' of past experiences, which is made possible via mental imagery. In this chapter, I will first provide a brief overview of research on mental imagery in autobiographical memory in general, followed by a review of relevant findings on mental imagery in MEAMs, and suggestions for future research.

Mental Imagery in Autobiographical Memories

In research on autobiographical memory more broadly, the role of mental imagery in recollective experiences has been explored in some detail. Mental imagery will be defined in this chapter as a perception-like experience that can occur even in the absence of perceptual input. Experiences of mental imagery inevitably rely on memory processes (e.g. 'imagine the face/voice of your mother'), but can also recombine previously perceived stimuli in novel or creative ways (e.g. 'imagine your mother speaking in your father's voice'). This possibility for recombination in mental imagery bears many parallels to discussions of the reconstructive nature of autobiographical memory (i.e. memories are not an exact record of the past, but can change over time and are influenced by various biases and errors; Hyman & Loftus, 1998). Mental imagery can exist in a single modality (visual, auditory, haptic, olfactory, etc.), but can also be multimodal. Studies of mental imagery in autobiographical memories to date have focused predominantly on the visual modality, with some taxonomies of autobiographical memory including visual imagery as one of the defining features by which episodic autobiographical memories can be distinguished from semantic autobiographical facts (e.g. being able to mentally visualise your 6th birthday party at a particular playground, versus simply knowing that your 6th birthday party happened at that playground; Brewer, 1986).

Indeed, subsequent research has indicated that visual imagery is a strong predictor of ratings of the strength of recollection in autobiographical memories, although it is clear that these memories can also be accompanied by mental imagery across several different sensory modalities (e.g. auditory and olfactory imagery; Rubin, 2005). Rubin, Schrauf, and Greenberg (2003) studied autobiographical memories recalled by undergraduate students in response to word cues, such as 'tree' and 'doctor' (following Crovitz & Schiffmann, 1974). The researchers analysed the extent to which participant ratings of reliving, remembering an

event (rather than just knowing it happened), and mental time travel were predicted by component properties of the memory. Ratings of visual imagery and, to a lesser extent, auditory imagery were both significant predictors of these measures of the recollective nature of the memories. In addition, memories that were reported as highly relived were almost always (98% of the time) accompanied by strong visual images. These results provide compelling evidence that mental imagery, particularly in the visual domain, may be a necessary component for the recollection of autobiographical events. This account has been supported by a series of experiments demonstrating that an absence of visual input at encoding (e.g. by blindfolding participants or presenting video recordings in audio-only versions) significantly reduced ratings of recollection of events at retrieval (Rubin, Burt, & Fifield, 2003). Individual differences in visual imagery abilities have also been found to be predictive of the level of sensory-perceptual detail and specificity of autobiographical memories (Aydin, 2018), as well as the way in which event and spatial details are remembered (Sheldon, Amaral, & Levine, 2017). Finally, damage to brain regions necessary for visual memory has been found to be accompanied by profound impairments in autobiographical recall, whereas linguistic and auditory impairments are much less associated with autobiographical memory deficits (Greenberg & Rubin, 2003).

Subsequent work has highlighted that episodic memory recall activates highly similar brain networks to several other cognitive activities, including thinking about the future, imagining fictitious experiences, navigation, and mind wandering (Hassabis & Maguire, 2007). [1] Hassabis and Maguire (2007) have thus proposed 'scene construction' as a crucial component process underlying all these cognitive functions. Scene construction is defined as 'the process of mentally generating and maintaining a complex and coherent scene or event'

[1] See also the work of Kubit and Janata (2018), who found that music-evoked autobiographical memories elicited activity in the default mode network, a network of brain regions typically implicated in introspection and mind wandering.

(p. 299), involving retrieval and integration of multi-modal sensory information into a spatial context that may subsequently be manipulated or transformed (Hassabis & Maguire, 2007). Scene construction provides a quite parsimonious explanation for the striking similarities between a seemingly diverse set of cognitive functions, all of which implicate the generation and manipulation of multimodal imagery. Thus, it appears that the component processes underlying autobiographical memories may overlap substantially with other cognitive activities outlined in this book, including mind wandering, imagination, and mental simulation, with autobiographical memories being differentiated primarily on the basis of their evocation of a sense of mental time travel (a key component of 'autonoetic consciousness'; Tulving, 1985), past-focused temporal orientation, and connection to the self.

Mental Imagery in Music-Evoked Autobiographical Memories

More recently, researchers have become interested in the specific experience of autobiographical memories cued by music, in particular as music appears to be an effective means for spontaneously eliciting positive and significant lifetime memories (El Haj et al., 2012a; Janata et al., 2007). MEAMs are a topic of great theoretical interest in terms of understanding the links between music, emotions, and identity, and practical interest in terms of exploring the potential for using music to elicit memories in people with dementia and other memory impairments. Although there is still much to be discovered regarding the mechanisms that underlie the coupling of music to autobiographical memories, several studies have revealed initial insights regarding mental imagery in MEAMs, and in particular, how MEAMs might differ from other autobiographical memories in terms of imagery experiences.

The Content of Mental Imagery in Music-Evoked Autobiographical Memories

In a seminal study, Janata et al. (2007) elicited MEAMs by playing a wide range of chart-topping pop songs to undergraduate students. Their work presents a detailed characterisation of the MEAM experience, including some first indications of their imaginal content. On average, over 40% of the songs that were played elicited memories of people—most typically friends and significant others—and for 83% of participants at least one song elicited a memory of a person. Fewer songs evoked memories of places (less than 20% of songs on average). Written descriptions of the memory contents were analysed using Linguistic Inquiry and Word Count (LIWC; Pennebaker, Francis, & Booth, 2003), a software that performs automated categorisation of words into themes using large dictionaries of conceptually related words. The most highly represented word categories were the 'Social' and 'Leisure' categories, and the most commonly used words were 'school', 'friend(s)', 'danc(e/es/ing)', and 'car/driving'.

Jakubowski and Ghosh (2019) subsequently investigated the content and features of naturally-occurring MEAMs, using a week-long diary method. MEAM descriptions were classified using LIWC and were again characterised by a relatively high degree of 'Social' and 'Leisure' category words, and the most commonly used words bore strong similarities to those found by Janata et al. (2007). MEAMs also exhibited a relatively high percentage of words in the 'Hear' LIWC category (a subcategory of 'Perceptual processes'); this seemed to be mainly due to a high usage of words such as 'song', 'listen', and 'radio', in which memory descriptions often referred to previous instances of listening to the same song. However, on average only around 1% of words from each MEAM description fell into the 'See' category from LIWC. It is yet to be determined whether this result indicates a relatively low degree of visual imagery within MEAMs, or whether the LIWC dictionary simply does not capture linguistic descriptions in a way that can be meaningfully interpreted as evidence of visual

imagery. In addition, although these studies provide some initial overview and agreement in terms of the typical content of MEAMs, further research is needed to test whether such memories actually evoke mental imagery (e.g. whether music brings to mind an image of your schoolfriend Jill, or simply reminds you that you had a schoolfriend named Jill) and, if so, what modality such mental imagery might take (e.g. do you simply remember Jill's face, or the sound of her voice and the smell of her perfume?).

Comparing Mental Imagery in Music-Evoked Autobiographical Memories to Other Autobiographical Memories

Several studies have compared the phenomenological characteristics or content of MEAMs to autobiographical memories evoked via other cues. Belfi et al. (2016) compared MEAMs cued by pop songs to autobiographical memories evoked by photographs of famous faces. Memory descriptions were coded using the procedures of Levine, Svoboda, Hay, Winocur, and Moscovitch (2002), and it was found that MEAMs contained a greater proportion of episodic and perceptual details than memories evoked via famous faces, indicating that MEAMs were characterised by more vivid and detailed reliving of the remembered events. A subsequent study replicated these findings, and also revealed that MEAMs were significantly less episodically rich in patients with damage to the medial prefrontal cortex (mPFC) in comparison to healthy controls (Belfi, Karlan, & Tranel, 2018). The patients did not differ from the controls in terms of the episodic richness of memories evoked by famous faces, suggesting a specific role for the mPFC in integrating musical cues with episodic memory details.

Zator and Katz (2017) compared memories cued by popular music to memories evoked via two types of word cues, which referred to either a life period or a specific event. They used LIWC to analyse the written memory descriptions and found that the event-

specific word cues elicited significantly more words from the ‘See’ LIWC category, while musical cues elicited a significantly higher proportion of words in the ‘Hear’ category, indicating potential differences in the modality of mental imagery implicated in these two memory types. MEAM descriptions also contained significantly more motor and spatial terms (indexed by the ‘Relativity’, ‘Motion’, and ‘Space’ LIWC categories) than the other two memory types, suggesting that music cued memories that were more embodied and perhaps accompanied by increased visuospatial and motor imagery.

Jakubowski, Belfi, and Eerola (2021) compared MEAMs to autobiographical memories evoked by watching television (TV) in an online survey of a representative sample of UK adults. MEAMs were rated significantly higher in vividness and reliving and contained more perceptual and social details (as coded using LIWC) than TV-evoked memories; these differences were also consistent across three age groups (young, middle-aged, and older adults). These results occurred despite the fact that the MEAMs and TV-evoked memories did not differ in terms of how recently they had been recalled, and the music and TV programmes also did not differ in terms of how much they were liked by the participants. However, the music was rated as significantly more familiar than the TV programmes, suggesting that the association between a piece of music and its corresponding autobiographical memory may have been more frequently rehearsed, leading to increases in the amount of episodic detail recalled.

These studies provide some initial evidence on how the imaginal contents of MEAMs differ from other autobiographical memories. The language used in memory descriptions has indicated that MEAMs differ from other memories in terms of their increased embodied nature and social content (Jakubowski et al., 2021; Zator & Katz, 2017). In addition, MEAM descriptions have been found to comprise a greater proportion of perceptual details than

memories cued by photographs of famous faces and TV programmes (Belfi et al., 2016; Jakubowski et al., 2021).

One question that remains is *why* music is able to bring back more episodically detailed memories than other common memory cues. As mentioned above, pieces of music are often listened to over and over for many years, which may strengthen the association between the music and an autobiographical memory. Although the cue overload principle (Berntsen, 2009) suggests that hearing the same piece of music in the context of many different life events can also *blur* the association between the musical cue and a particular memory, this may be partially counteracted by the fact that some instances of music listening are coupled with life events that are highly emotional and can be seen as milestones or 'turning points' (i.e. music is often heard at weddings, funerals, initiations, etc.). These particularly salient and important memories are less likely to be susceptible to cue overload, especially if future instances of exposure to the associated piece of music occur in relatively mundane, non-emotional contexts. The relationship between the emotional properties of a musical retrieval cue and the emotional reaction to the associated memory also merits further exploration, in terms of how emotional features of the cue itself might enhance recall of certain episodic details (see initial exploration of these ideas in Schulkind & Woldorf, 2005 and Sheldon & Donahue, 2017).

In addition, several studies have highlighted the involuntary nature of MEAMs. Involuntary memories are retrieved in a direct and spontaneous manner, rather than via an intentional and effortful search process. Self-selected music appears to be particularly effective for eliciting involuntary autobiographical memories (El Haj et al., 2012a); this parallels results on other types of autobiographical memories, in which personal/self-selected cues elicited more directly retrieved memories than experimenter-selected cues (e.g. Uzer & Brown, 2017). Some studies (e.g. Cuddy, Sikka, Silveira, Bai, & Vanstone, 2017) have even

defined MEAMs as a specific type of involuntary memory, although other research indicates that the majority of MEAMs are involuntary, but voluntary MEAMs can also occur in everyday life (Jakubowski & Ghosh, 2019).[2] Research on involuntary autobiographical memories has revealed that such memories are generally characterised by greater reliving, including heightened emotional impact, than voluntarily retrieved autobiographical memories (Berntsen & Hall, 2004). This work also indicates that involuntary retrieval is more effective for accessing memories of specific episodes, whereas voluntary retrieval tends to favour more generic memories. Interestingly, however, Jakubowski et al. (2021) did not find a significant different in ratings of the involuntary nature of MEAMs versus TV-evoked memories, despite increased ratings of reliving and vividness in MEAMs. Thus, it seems that involuntary retrieval may be only part of the explanation for differences in recall of episodic detail.

Conclusions and Future Research

Although research on autobiographical memory has broadly examined the role of mental imagery (especially visual imagery) in recollective experiences, the imaginal processes implicated in MEAMs have only recently been explored. Initial empirical findings have indicated that MEAMs of healthy adults may be relived in greater episodic detail than autobiographical memories evoked via other pop cultural cues (Belfi et al., 2016, 2018; Jakubowski et al., 2021). However, the underlying mechanisms that might explain such differences (e.g. encoding conditions, retrieval method, rehearsal frequency, emotional factors) are still poorly understood.

Several studies have also provided indications of the content of mental imagery in MEAMs. MEAMs often comprise social themes, including memories of people such as

[2] Clarification in future studies is essential, since most previous studies have not differentiated between voluntary and involuntary MEAMs, and the extent to which retrieval intentionality might impact on the memory properties.

friends and significant others (Jakubowski & Ghosh, 2019; Jakubowski et al., 2021; Janata et al., 2007). This finding speaks to the prominent role music can play in developing and maintaining social bonds, including group formation on the basis of shared personal preferences and values (e.g. Rentfrow & Gosling, 2006). Descriptions of MEAMs were also characterised by a relatively high proportion of motor and spatial language (Zator & Katz, 2017), which relates to the embodied nature of music listening. This fits with theories emphasising the close coupling of perception and action systems during music listening (Maes, Leman, Palmer, & Wanderley, 2014), including the common urge to move along with music (Janata, Tomic, & Haberman, 2012). It may be that this drive to action could actually serve as an additional cue for remembering a previous experience involving moving to music; indeed, words such as 'dance' and 'sing' were particularly prevalent in the studies of both Janata et al. (2007) and Jakubowski and Ghosh (2019). One potential avenue for subsequent research could be to explore whether music that is high in groove ("the urge to move in response to music, combined with the positive affect associated with the coupling of sensory and motor processes", Janata et al., 2012, p. 54) elicits more embodied and vivid autobiographical memories than low-groove music.

The studies reviewed above have typically drawn inferences about the imaginal contents of MEAMs based on the language used by participants to describe their memories; they therefore provide somewhat indirect evidence of the underlying mental imagery processes. Future research should more explicitly ask participants to report on their imagery experiences during MEAMs, including details on the modality of such imagery. More covert measures may also provide new insights, for instance by examining the activation of visual imagery-related brain areas during MEAMs or by attempting to suppress visual imagery during MEAMs to test the effects of such a manipulation on the quality of the recollective experience. Studies of mental imagery in modalities other than the visual domain are

relatively rare in autobiographical memory research, but will also be important for providing a more complete understanding of these everyday mental experiences.

One prominent theoretical framework for explaining emotional responses to music posits *episodic memory* and *visual imagery* as separate mechanisms by which music induces emotions (Juslin, 2013). However, it is clear from previous research on MEAMs and episodic memory in general that there is much overlap between these two mechanisms. Indeed, it may be that *episodic memory* is more logically classified as a subcategory of *visual imagery,* if it is found to be the case that MEAMs always comprise some component of visual imagery. Similarly, future studies of the *visual imagery* mechanism should explore how often music-evoked visual imagery comprises scenes that could be classed as episodic memories (rather than, for instance, abstract shapes or imaginary scenes).

Another important topic in this field is memory decline, as a result of both healthy ageing and disease or brain damage. Some research has revealed a decline in both autobiographical memory retrieval and visual imagery in Alzheimer's disease (AD; El Haj, Kapogiannis, & Antoine, 2016). However, several studies have provided evidence of relatively spared retrieval of autobiographical memories in AD when cued by music as compared to memories evoked in silence or via visual cues (e.g. Baird, Brancatisano, Gelding, & Thompson, 2018; El Haj, Postal, & Allain, 2012b). Of particular relevance to the present focus, El Haj et al. (2012a, 2012b) found that MEAMs of people with AD were more specific (scored via the TEMPau test; Piolino et al., 2006) and had greater emotional impact than autobiographical memories generated in silence, although these MEAMs were still less specific than those of healthy control participants. Subsequent research is needed which further probes the particular content and features of the mental imagery underlying MEAMs in people with AD and other memory disorders. In addition, Belfi et al. (2018) have identified the mPFC as a crucial brain structure for vivid reliving of MEAMs, and Janata

(2009) and Kubit and Janata (2018) have investigated the brain networks underlying MEAMs of healthy young adults. However, further exploration of the neurological underpinnings of MEAMs in people with memory impairments is needed to fully understand the conditions under which particular features of these memories may be spared.

In conclusion, mental imagery is a crucial component of autobiographical memory, which allows the rememberer to relive the sights, sounds, and other feelings of past experiences. Autobiographical memories evoked by music appear to be particularly vivid in several of these regards, which may be related to the remarkable frequency and diversity of ways with which people engage with music, and the particular value placed on music in developing and maintaining one's personal and social identity.

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