Music, Memory and Imagination

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Abstract

This paper argues that the capacity of music to reliably cue both autobiographical memories and fictional imaginings can be leveraged to better understand the relationship and interdependence between memory and imagination more generally. The multiple levels involved in musical engagement provide a rich forum for investigating how emotional, semantic, and contextual associations with musical cues influence both memories and imaginings. Moreover, musical excerpts are extended in time, and can influence the trajectory of a memory or imagining dynamically as it develops, allowing for a more precise manipulation of the implied semantic space. Because music's uses and contextual associations are culturally constrained, and culture can be shared, autobiographical memories and fictional imaginings cued by music can show surprising similarities among individuals from the same culture. This article surveys the research on music-evoked autobiographical memories and music-evoked fictional imaginings, proposing a framework for bringing these separate strands of work together to shed light on larger questions about shared underlying mechanisms.

Keywords

Music, autobiographical memory, imagination

Introduction

Memory and imagination can be construed as distinct or even opposing capacities, with memory documenting true things that really happened, and imagination conjuring up novel scenarios full of fiction and fantasy. But over the past fifteen years, research has increasingly shown that memories and imaginings should be considered within a unified framework. Remembering the past and imagining the future both activate the same core brain network, known as the default mode because it comes online when attention is not focused on an external task (Addis et al., 2007; Szpunar et al., 2007). Individual differences in relevant dimensions such as the capacity for visual imagery affect remembering the past and imagining the future similarly (D'Argembeau & Van der Linden, 2006). The mutual dependence of memory and imagining extends to the generation of fictional scenarios; a case study of a severely amnesic individual, KC, revealed that he lacked not only the capacity for episodic memory or future simulation, but also the capacity for constructing fictional narratives (Rosenbaum et al., 2009). Memory is a reconstructive rather than replicative process that is shaped by knowledge and experience beyond the discrete event being recalled (e.g. Hyman & Loftus, 1998). Imagining depends on remembering, and remembering depends on imagining.

To make sense of these connections, some accounts emphasize the role of semantic memory, which provides a wellspring of information that is generalizable to different contexts and useful in constructing novel imaginings (Abraham & Bubic, 2015). Semantic memory undergirds the capacity to construct coherent remembered and fictional scenes (Hassabis & Maguire, 2009), allowing a person, for example, to either remember a dinner they really experienced at a neighbourhood restaurant with friends,

or to imagine a fictional dinner at a restaurant in the clouds, enjoyed with a cast of characters from their favorite novels. Other accounts emphasize the role of episodic simulation, wherein “the cognitive raw materials of imagined future experiences are bits and bobs of episodic memories” (Gaesser, 2013)—people create imaginings out of pieces of memories of things that really happened to them. This notion, known as the constructive episodic simulation hypothesis (Schacter & Addis, 2007), makes it unsurprising that the confabulation of fact and fiction can lead to false autobiographical memories (Mazzoni & Memon, 2003). Overall, research paints a blurrier picture of the line between memories and imaginings than might initially be assumed; memories are never exact replicas of past events, and imaginings are constrained by our previous experiences.

We argue here that music, which has been shown in separate strands of research to reliably cue a range of both memories and imaginings, can serve as an essential laboratory for discovery about the *interrelationship* between these capacities. Music can cue autobiographical memories that are especially vivid when compared to other memory-evoking stimuli like faces (Belfi, Karlan & Tranel, 2016). It can also cue absorbing fictional stories (Margulis et al. 2019). For example, a song might trigger powerful memories of the actual breakup of a person’s real previous relationship, but it might just as well trigger an imagining of a fictional person experiencing a devastating end to a relationship that never really occurred. Below, we outline key reasons that music can offer important new insights into the component processes of generating autobiographical memories and fictional stories. We then propose a conceptual model, considering the potential shared mechanisms that influence how music evokes them.

Music is a reliable and ecological cue for both autobiographical memories and fictional stories

Both autobiographical memories and fictional imaginings are common everyday responses to listening to music, even when that music is unfamiliar (Margulis, 2017; Jakubowski & Francini, 2022, Sheldon & Donahue, 2017). In diary studies of both young and older adults, music-evoked autobiographical memories were reported an average of 1-2 times per day, with the majority of these rated as being spontaneously retrieved (Jakubowski & Ghosh, 2021; Jakubowski et al., 2023). In a survey study, 77% of respondents reported that they had experienced visual imagery in response to music (Küssner & Eerola, 2019). In a laboratory-based study, respondents from multiple cultures found that excerpts of instrumental music easily and intuitively prompted imagined stories, with over half of excerpts eliciting a fictional imagining (Margulis et al., 2019). People don't need to be specially coaxed to remember or imagine in response to music; they do so as a matter of course. In fact, music-evoked memory and music-evoked imagery are two of the principal mechanisms through which music elicits emotional responses (Juslin & Västfjäll, 2008).

Music provides a rich medium for investigating how emotional, semantic, and contextual associations influence the generation of both autobiographical memories and fictional stories

Music is a multifaceted stimulus that can be engaged with in diverse ways (Tuuri & Eerola, 2012), including as an object of contemplation, a tool for mood regulation, and a signifier of identity, among many others. Despite this complex array of possible modes for interacting with it, research has reliably demonstrated that even music's highly experience-dependent aspects, such as its emotional and cultural associations, can be systematically manipulated to test their effect on autobiographical memories and fictional imaginings. Because music allows for the manipulation of experiential context, it can serve as an important testing ground for the study of the way that complex, real-world factors shape memory and imagination.

To take one example, studies on music-evoked autobiographical memories have manipulated the emotional valence and arousal of musical excerpts and revealed emotional congruency effects. People retrieve more positive autobiographical memories in response to more positively valenced music, and more energetic memories in response to higher arousal music (Jakubowski & Francini, 2022, Sheldon & Donahue, 2017). Aesthetic evaluations of music have also been documented to play a role: more liked or enjoyed music evokes both autobiographical memories and fictional stories more readily (Jakubowski & Francini, 2022; Margulis, 2017).

More broadly, features of music have been shown to elicit cross-modal associations with visual or spatial concepts, such as size, shape or distance—high notes being perceived as small and low notes as large, for example (Eitan & Timmers, 2010). These associations show similarities in listeners from the same culture, but do not consistently extend across cultures. Semantic priming effects have also been found,

with particular musical excerpts reliably priming concepts like “king,” “river,” or “wideness” (Koelsch et al., 2004). These findings provide a roadmap for how future studies could manipulate particular features of music, such as pitch height, tempo, or timbre, to test how these features causally impact the contents of music-evoked autobiographical memories and fictional stories (McAuley et al., 2021).

Finally, people are often acutely aware of music’s typical contexts; this capacity is termed “source sensitivity” (Thompson, Bullot & Margulis, 2022), and could account for how listening to seemingly abstract sounds can actually cue a range of real-world associations. For example, people can frequently name a title or genre after hearing just a few hundred milliseconds of a song (Krumhansl, 2010), and can quickly identify whether it would be most likely encountered in a downtown club or in a romantic movie scene. Comparing an excerpt’s typical contexts with the contents of the spontaneous imaginings and memories it cues can reveal the extent to which source sensitivity, including semantic knowledge about where music is from and who made it, as well as episodic memory about where you might have heard it before, plays a role in shaping those contents.

Music facilitates the investigation of culture-dependent intersubjectivity in both autobiographical memories and fictional stories

Because most psychological work considering the relationship between memory and imagination doesn’t use a temporally extended, shared cue like music, the powerful intersubjectivity or shared content that can characterize these responses has been

underappreciated. When listeners with broadly similar cultural backgrounds (college students in Arkansas and Michigan) were asked to freely describe the fictional stories they imagined in response to excerpts of instrumental music, tools from natural language processing (cosine similarity of feature vectors for stories generated in response to specific excerpts) revealed that they imagined strikingly similar narratives, even though they had never previously heard the specific excerpts and even though the task was highly unconstrained (Margulis et al., 2022c). For example, one excerpt reliably cued stories about a sunrise over a meadow where tiny creatures started to frolic; another cued stories about a romantic pursuit on the streets of a 1920s city. People imagine vivid shared stories even to music in highly unfamiliar styles (Loui et al., in press), suggesting that the generation of specific stories can't rely straightforwardly on associations learned through mass media exposure. Intersubjectivity did not arise, however, in the absence of a broadly shared cultural background (for example, when stories from these US college students were compared with stories from residents of a rural Dong village in China). Thus, both cultural environment and musical features seem to shape music-evoked imaginings.

Similarly, even excerpts of music that are completely unfamiliar seem to elicit broadly similar autobiographical memories; in young adult listeners from the UK, upbeat music often prompts memories that feature dancing, singing, and social events, whereas sad music often prompts memories that feature solitary settings, such as funerals and breakups (Jakubowski & Francini, 2022). Familiar music may cue memories that share even more specific characteristics. For example, music played at Princess Diana's funeral triggered memories of that event in multiple UK listeners;

Everywhere by Fleetwood Mac triggered memories of dancing at weddings for multiple participants (Jakubowski & Ghosh, 2021).

Music is a temporal stimulus, allowing investigation of dynamic, causal changes in both autobiographical memories and fictional stories

Because musical features, such as pitch and loudness, and their emotional connotations vary over time, music provides an ideal medium for investigating how changes in stimulus properties dynamically shape the contents of ongoing memories and imaginings. Music's temporal aspect presents a novel opportunity for researching the shared processes underpinning memory and imagining; most previous studies on the topic have used static cues such as single words. Using music as a cue has revealed how temporal changes in the musical structure can elicit temporal changes in what's being imagined; for example, repeated events within a musical excerpt tend to prompt repeated actions within an imagined fictional narrative (Margulis et al., 2022a). What's more, the timepoints at which people imagine new events in their ongoing fictional story also tend to converge around discrete timepoints associated with specific musical features—the beginning of a romantic pursuit, for example, tended to be imagined in response to the moment when a sweeping violin melody took over from the clarinets in one excerpt (Margulis et al., 2022b). These were the same moments that, in a separate task whose instructions mentioned nothing about stories, people marked as the ones where changes in the musical tension occurred, reinforcing the notion that

specific musical features drove the event imaginings, rather than some endogenous retrieval process associated with the unfolding of the story itself.

The openness of fictional imaginings may make them more susceptible to dynamic shaping over time, with ongoing musical cues prompting sequences of imagined events. Autobiographical memories have their own temporal structure determined by what took place in the past that may or may not link to what's happening dynamically as the music progresses; however, changes in musical features may shift the focus to different perspectives on or aspects of the recalled event. Research that expressly compares the feature-dependency, especially as it links to changes in musical content as excerpts progress, could illuminate the degree to which the constructive aspects of memory and imagination are shared.

Mechanisms and conceptual model

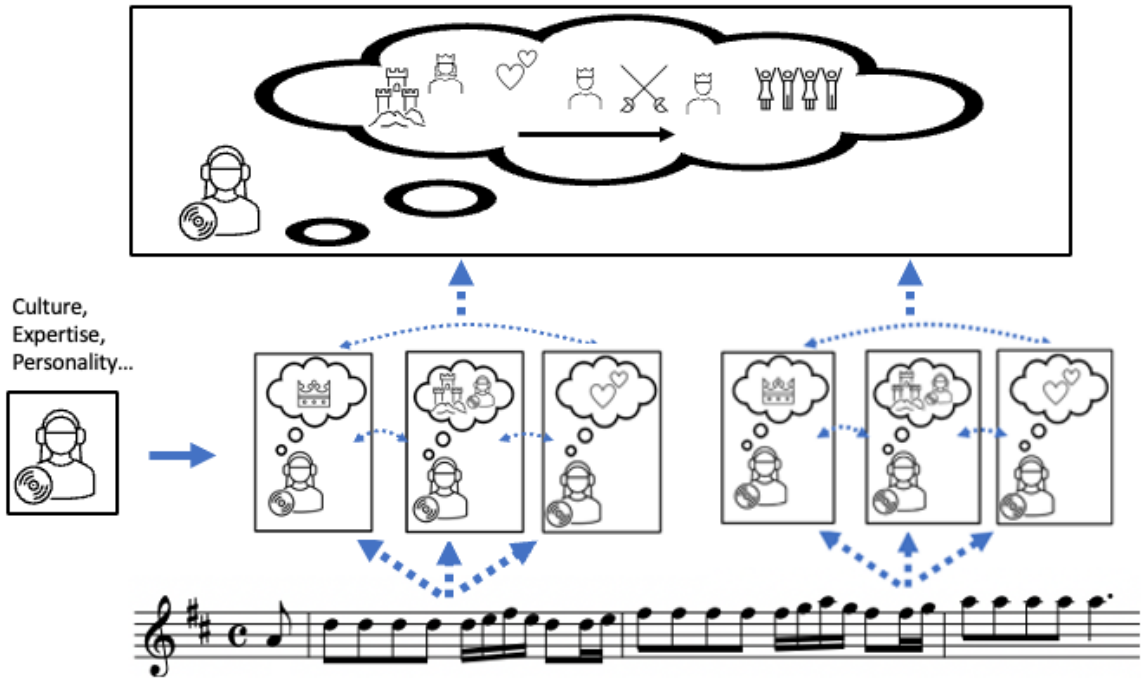

Figure 1. Listening to a fragment of music can elicit semantic, contextual, and/or emotional associations, which may interact with one another. These associations are influenced by an individual listeners' previous experience, incluing their cultural upbringing, musical expertise, and personality, among other factors. These semantic, contextual, and/or emotional associations evolve over time with the music, and thus serve as dynamic cues for the generation of memories and imaginings. Dotted arrows signify that not all music will elicit all associative pathways, and not all associative pathways will interact or lead to more complex memories/imaginings.

To effectively bring together the separate strands of research on music-evoked autobiographical memory and music-evoked fictional stories will require a conceptual model. Figure 1 depicts one such possibility, including the primary factors posited to underlie the generation of both memories and imaginings evoked by music. In this model, an individual comes to the music listening episode with their own personal background, including cultural experience and musical expertise, which will inevitably impact how they engage with the music and what associations it evokes (e.g, some listeners will be more prone to memory/imagination evocation in general). This also means listeners with similar backgrounds will show more similarities (greater intersubjectivity) in their memories and imaginings. Upon hearing a fragment of music, semantic memory associations (e.g., the concept of “royalty”), contextual associations from the episodic memory store (e.g., “that time I went to a castle”), and or/emotional associations (e.g., “love”) may emerge. These may also impact one another (e.g., remembering being at a castle evokes a particular emotion, or an emotion conjures up an associated object). These semantic, contextual, and/or emotional associations then feed into the construction of a more complex and detailed memory or imagining (e.g., situated in time and place, with discrete characters and events). The temporal nature of music means these associations are also updated over time, which then impacts the unfolding narrative of the memory or imagining.

This framework provides a range of possible avenues for future research aiming to elucidate how music impacts the generative and recombinant nature of memories and imagination. For example, an excerpt of music could be presented to separate groups of participants who are asked to describe either a concept, context, or emotion

associated with the excerpt. In a subsequent experiment, the mostly commonly reported concepts, contexts, and emotions from the previous study, as well as *the music excerpt itself*, could be presented to new participant groups as cues for fictional stories. Examining the degree of semantic similarity between the stories generated by these four groups would allow one to test whether music-evoked imaginings are shaped more by conceptual, contextual, or emotional associations. By subsequently using these same materials as cues for autobiographical memories, one could disentangle whether similar associative mechanisms drive the generation of both memories and imaginings elicited by the same music. Efforts of this sort should also be replicated across a large range of music excerpts, as it likely that some types of music, depending on their typical uses, activate certain associative paths more than others (e.g., conceptual vs. contextual). Experiments that compare reaction times for the different associative tasks could also reveal new information about the most frequent causal paths between these associations (e.g., whether emotional associations more often precede semantic ones or vice versa, c.f. Day & Thompson, 2019).

Such work allows investigation of the degree to which music-evoked memories and imaginings are underpinned by the same mechanisms, or whether different associative paths more commonly lead to music-evoked memories versus imaginings. Previous research has often focused on the similarities/differences between memories and imaginings once they have been generated, including their phenomenological properties and associated brain networks (Schacter at el., 2012). By focusing here more on the associative mechanisms that lead to music-evoked memories and imaginings,

we shift attention to how and why these thoughts are generated, introducing a causal framework that can be adapted to different cues beyond music.

If differences are found in the typical associative pathways underpinning music-evoked memories versus imaginings, this also has implications for creative and therapeutic uses of music; for example, by harnessing a particular associative pathway (e.g., directing a listener's attention to the contextual or emotion associations elicited by the music) a practitioner may be able to bias listeners toward more autobiographical or fictional modes of thinking. Moreover, since in people with early-stage Alzheimer's disease, music has been shown to evoke autobiographical memories that are more specific, emotional, and self-defining than those retrieved in silence (El Haj et al., 2012, 2015), uncovering more about the mechanisms that allow music to cue memories and imaginings could set the stage for new clinical interventions.

Music's capacity to cue a wide range of vivid, absorbing autobiographical memories and fictional imaginings makes it an opportunity that's hiding in plain sight, capable of shedding new light on some of the oldest questions about cognition: what is the relationship between memory and imagination? To what degree is subjective experience shared among individuals? As with so many questions of similar heft, the trick will be connecting lines of research that have historically been carried out independently.

Recommended Readings

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Investigates the ways in which the content of music-evoked imaginings can be shared among individuals, dependent on culture

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