DURMS
Durham Undergraduate
Research in Music & Science

The Influence of Perceived Groove on Autobiographical Memory

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ABSTRACT

The report presents an online study assessing potential correlations between perceived groove and the frequency/vividness/descriptions of music-evoked autobiographical memories (MEAMs). Familiarity was also considered as a mediating factor. The study involved 33 participants aged 55-65. Participants were asked to listen to 30 seconds of 12 songs and rate perceived grooved, familiarity, and their emotional response to each song, as well as detail any evoked autobiographical memories. The results showed strong correlations between perceived groove and frequency/vividness of MEAMs, but even stronger correlations between familiarity and frequency/vividness of MEAMs. Four songs with significantly lower perceived groove ratings were also less familiar. Total emotional response was more strongly correlated with familiarity than perceived groove. MEAM descriptions revealed a contrast in content; high groove songs reflected group settings, but low groove/high familiarity songs evoked personal memories of significant individuals. Overall, the study identifies strong correlations between perceived groove and frequency/vividness of MEAMs, but further research must determine the impact of familiarity and provide causal, rather than correlative, relationships between independent and dependent variables.

1. INTRODUCTION

Music is heard '37-38% of time in everyday life' (Blais-Rochette & Miranda, 2016: 27) as well as in socially and culturally significant events (e.g., ceremonies; Gregory, 1997: 123). This makes it likely for certain music to resonate and evoke autobiographical memories: long-term memories which relate to one's identity and include specific times and places (Blais-Rochette & Miranda, 2016: 26).

Music-evoked autobiographical memories (MEAMs) evoke emotions, fitting within Juslin and Västfjäll's (2008) multiple mechanisms theory. One significant mechanism is 'episodic memory': 'a process whereby an emotion is induced in a listener because the music evokes a memory of a particular event in the listener's life' (Juslin & Västfjäll, 2008: 567). Intense emotion is usually evoked alongside the memory (Juslin & Västfjäll, 2008) because past music may relate to self-defining moments which contribute to one's identity. As a result, episodic memory acts as a powerful cue for MEAMs and can induce 'all possible emotions, though especially nostalgia' (Juslin & Västfjäll, 2008: 571). If emotion is evoked, it is usually clear to the participant that it is associated with a memory, distinguishing the mechanism from others within the framework. Episodic memory also has the capacity to induce emotions beyond the ones that are said to be basic emotions (Ekman, 1992): fear, anger, sadness, happiness, surprise, and disgust. Consequently, this mechanism is a sophisticated concept to consider when researching MEAMs, despite the subjectivity of a participant's response.

A key study by Janata et al. (2007) reported on the characterisation of MEAMs evoked by popular music in laboratory and online settings. Three hundred and twenty-nine undergraduate students aged 18-29 years old took part. Results showed that 30% of the excerpts provoked autobiographical memories and found the third most common emotion [evoked] was nostalgia (Janata et al., 2007). The study focused on describing the characteristics of MEAMs, rather than the content of memories. Songs were randomly selected from 1500 excerpts of music taken from the Billboard Top 100 Pop and R&B lists. The material's position in music charts and subsequent presence on the radio allowed the researchers to assess a song's familiarity. However, the study could not show the potential evocation of autobiographical memory from genres other than Pop and R&B and restricted its findings by using a younger participant age bracket with less lived experiences. The research aimed to control the surrounding environment through laboratory and online settings, yet this does not consider the realistic impact an environment has when listening to music in everyday life.

In contrast, Jakubowski and Ghosh (2021) recognised the influence of our environment and conducted the experiment naturalistically; participants recorded MEAMs in a diary for 7 days. Thirty-one participants with an age range of 18-72 years took part (mean age = 35.8). The study found that people experience a MEAM once a day and these were cued listening to music during menial tasks. MEAMs were vivid and accompanied by emotion, especially in older participants (Jakubowski & Ghosh, 2021). This demonstrates how music in our earlier life contributes to our self-identity and consequently leads to the creation of long-term memories. The study produced results that were similar to Janata et al. (2007) but differed in methodology. Naturalistic data collection meant music listening was considered in context with the surrounding environment and acknowledged a wide range of musical genres. Nevertheless, participants often recorded MEAMs that were provoked by current songs on the charts due to their presence in everyday life. The results also found that 65% of MEAMs were recalled more involuntarily than deliberately (Jakubowski & Ghosh, 2021); therefore, MEAMs had to be recorded quickly before they were forgotten.

Significantly, these studies utilising both experimental (Janata et al., 2007) and naturalistic (Jakubowski & Ghosh, 2021) sampling found that dancing was a prominent activity described in many of the participants' autobiographical memories. The influence of bodily movement while listening

to music is indicated in previous research. Katz and Zator (2017) found greater use of motor and spatial words in MEAMs than in autobiographical memories cued by prompts. Maes et al. (2014) revealed how actions and social interactions with the external environment influenced cognitive processes and vice versa. Altogether, previous research has shown how the degree of one's physical immersion with music influences cognitive processes and the listening experience, subsequently evoking autobiographical memories. This is due to the positive feelings associated with dance which compels someone to move.

This research regards the phenomenon of 'groove', 'the urge to move in response to music, combined with positive affect' (Janata et al., 2011: 54). Janata et al.'s (2011) paper is central to this research as it uncovers how 'groove' provides pleasure, influences cognitive processes, and compels us to behave differently. Study 1 in Janata et al.'s (2011) paper was titled 'Perceived Groove as Function of Genre, Tempo, and Familiarity'. This was a quantitative study where 19 undergraduate students listened to music from a sample of 215 excerpts and were asked to rate perceived groove, enjoyment, and familiarity through scale ratings. Results showed that Soul/R&B had the most groove, followed by jazz, rock and folk. Apart from songs in the Soul/R&B genre, faster tempos had a higher groove. Perceived groove ratings had strong, positive correlations with enjoyment and familiarity (r = .82 and r = .57 respectively, Janata et al., 2011). Overall, these findings revealed that enjoyment, tempo, and genre had a more significant impact on perceived groove than familiarity. Furthermore, this could imply that musical characteristics have a greater impact on perceived groove than individual musical tastes.

Overall, previous research has indicated possible links between physical immersion, cognitive processes, and emotional response. However, this has not been explicitly extended to include autobiographical memory. Investigating this link is the aim of this study. In addition, studies on MEAMs have included younger rather than older participants (Janata et al., 2007; Jakubowski & Ghosh, 2021). This is significant when researching autobiographical memory due to a phenomenon called the 'reminiscence bump' where older adults have an increased recollection of memories from their adolescence and early adulthood (approximately 10-30 years old). It is at this age when most people establish their identities. Therefore, a tailored approach towards an older age bracket is required when researching MEAMs.

The study aims to expand on previous research and establish whether perceived groove is influential in the evocation of MEAMs. Two objectives will help establish this:

1) Determining how the level of perceived groove impacts a) the frequency, b) the vividness of MEAMs, and c) MEAM descriptions.

2) Determining how the level of familiarity impacts the frequency/vividness/descriptions of MEAMs.

Previous research has indicated the potential of physical immersion in provoking MEAMs and positive emotion alongside. Therefore, I hypothesise that there will be a strong positive correlation between perceived groove and the frequency/vividness of MEAMs. It is also likely that songs with high groove ratings will evoke MEAMs that describe social settings and interactions. However, familiarity must be considered and treated as an influential independent variable because a musical appetite for a favourite genre becomes frequent and fixed over time.

2. METHOD

Design. This study is an online quantitative experiment with elements of qualitative data collection. The independent variables are the levels of perceived groove and familiarity with stimuli. The dependent variables are the frequency, vividness, and descriptions of MEAMs and the participant's total emotional response. The study was designed for participants aged 55-65 because an increased age means more potential exposure to songs and life experiences. The age bracket also considers the 'reminiscence bump' phenomenon.

Participants. Thirty-three participants completed the study and were recruited online through the spread of an email link and a Facebook post. The respondents consisted of 17 females (51.5%) and 16 males (48.5%). Responses revealed a broad range of musical ability and experience: 19 out of 33 described themselves as music loving non-musicians (57.6%), eight as amateur musicians (24.2%), four as non-musicians (12.1%), and two as professional musicians (6.1%). The average age was 60 with an age range of 55-65.

Materials/Stimuli. Qualtrics was used to create the online survey. Stimuli were taken from SoundCloud and YouTube. Stimuli consisted of 13 songs: 12 for the main study and one song to be used in a practice trial. Data collected from the practice trial was not used for the main study. Songs were selected according to Study 1 in Janata et al. (2011). The participants in Janata's study rated each song's perceived groove which gave an estimation of the perceived groove for this study. The researcher selected three songs from each genre used in Janata's study: Soul/R&B, Jazz, Rock, and Folk, acknowledging that some genres have higher perceived groove levels than others (Janata et al., 2011). Familiarity was increased where possible to elicit more MEAMs; however, it was acknowledged that songs in certain genres are heard more often than others due to their presence in the UK Official charts. The release dates of songs ranged from 1957 to 2005; this considers the 'reminiscence bump' of every participant plus ten years on either side for leeway. Participants did not require any materials other than a quiet space to complete the study.

Procedure. Participants were asked to listen to 30 seconds of each song (the location in the song was indicated in each question and was determined by the presence of lyrics). This time period allowed participants to get into the music and perceive an impulse to move to it. After listening to each extract, participants answered questions assessing the following variables with a rating scale from 5 (*incredibly high*) to 1 (*incredibly low*): impulse to move to the music (i.e., perceived groove), enjoyment, and familiarity. Participants were then asked whether they experienced any autobiographical memories and selected either 'Yes' or 'No'.

Those who did experience autobiographical memories were invited to provide a short description about these memories and were encouraged to be as specific as possible. Those participants rated the vividness of MEAMs from the same scale of 1-5. All participants were then asked to rate from 1-5 the intensity of each emotion listed in the Geneva Emotional Music Scale (GEMS; Zentner et al., 2008): wonder, transcendence, tenderness, nostalgia, sadness, peacefulness, power, joyful activation, and tension. The GEMS is used in the methodology to reflect on the concept of 'episodic memory' being able to convey more complex emotions. Participants could add any further comments at the end of each set of questions.

3. RESULTS

Tables 1 and 2 summarise the results from the independent and the dependent variables, respectively. Total Emotional Response (TER) represents an overall average and includes the means of each emotion on the GEMS, plus mean enjoyment.

Table 1. Results of Independent Variables (Perceived Groove and Familiarity)

Song	Mean (Standard Deviation)	
	Perceived Groove	Familiarity
Superstition	4.15 (1.00)	4.55 (1.00)
Lady Marmalade	3.97 (1.10)	4.12 (1.27)
Come fly with me	3.30 (1.19)	4.30 (1.13)
We are more	2.88 (1.39)	1.12 (0.70)
Don't stop me now	4.36 (0.99)	4.88 (0.33)
Start me up	3.97 (1.33)	4.21 (1.47)
Summertime	2.97 (1.42)	4.73 (0.63)
TFS	2.58 (1.32)	1.42 (0.87)
What a wonderful world	3.45 (1.46)	4.85 (0.71)
Mud	2.55 (1.15)	1.24 (0.66)
Space Oddity	3.24 (1.30)	4.73 (0.84)
Dawn Star	1.70 (0.92)	1.18 (0.73)

Table 2. Results of Dependent Variables (Frequency/Vividness of MEAMs and TER)

Song	No. of MEAMs	Mean (Standard Deviation)	
		MEAM Vividness	TER
Superstition	19	4.05 (1.03)	2.74 (0.85)
Lady Marmalade	16	4.19 (0.75)	2.45 (0.71)
Come fly with me	15	4.33 (0.82)	2.64 (0.81)
We are more	0	N/A	1.81 (0.72)
Don't stop me now	27	4.37 (0.88)	3.13 (0.74)
Start me up	20	4.30 (0.73)	2.47 (0.93)
Summertime	17	4.18 (0.81)	3.22 (0.91)
TFS	1	4.00 (N/A)	1.58 (0.61)
What a wonderful world	23	4.48 (0.67)	3.45 (0.84)
Mud	2	4.00 (0.00)	1.97 (0.77)
Space Oddity	21	4.52 (0.68)	3.04 (0.85)
Dawn Star	4	4.00 (0.82)	2.12 (0.80)

Frequency of MEAMs. Figure 1 shows a strong positive correlation between perceived groove and the number of autobiographical memories elicited (r = .90), thereby proving my hypothesis. In particular, the song 'Don't stop me now' had the highest perceived groove rating (M = 4.36) and the highest number of recorded MEAMs (27). This is supported by a low standard deviation (SD = 0.99), which shows consistency in the result. However, 10/12 songs have a standard deviation higher than 1 which reflects varying opinions (see Table 1).

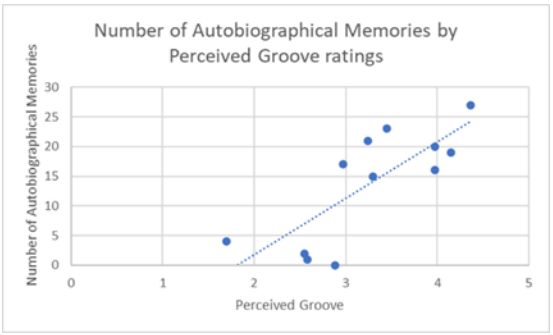

Figure 1. Correlation between perceived groove and no. of MEAMs

Vividness of MEAMs. Figure 2 shows a nearly strong positive correlation (r = .49) between perceived groove and vividness of MEAMs. These results range from 4 – 4.52, reflecting Jakubowski and Ghosh's (2021) study where older participants experienced more vivid MEAMs than younger participants. Standard deviation results in Table 2 reflect consistency as all songs that evoked MEAMs, apart from 'Superstition', had a value below 1.

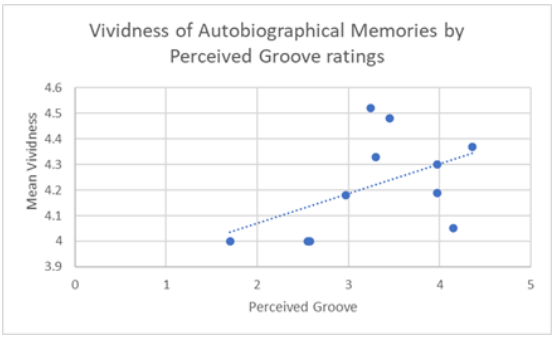

Figure 2. Correlation between perceived groove and vividness of MEAMs

Familiarity. Despite the strong positive correlations between perceived groove and frequency/vividness of MEAMs, correlations with familiarity were stronger. Figure 3 reveals a nearly perfect, positive correlation (r = .96) between familiarity and frequency of MEAMs. Figure 4 reveals another strong positive correlation between familiarity and vividness of MEAMs (r = .76). Two results in particular stood out; 'What a Wonderful World' had the 5th highest perceived mean groove rating (M = 3.45) yet elicited 23

MEAMs; 'Space Oddity' was rated the 7th highest in perceived groove (M = 3.24) yet elicited 21 MEAMs (see Table 2). In addition, these two songs have standard deviation values of 0.71 and 0.84 respectively for familiarity but higher values of 1.46 and 1.3 respectively for perceived groove. This suggests that the results for familiarity may be more dependable than perceived groove.

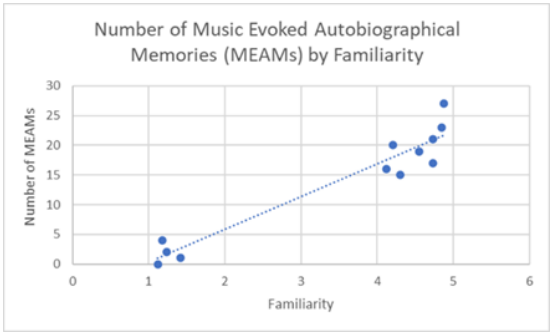

Figure 3. Correlation between familiarity and no. of MEAMs

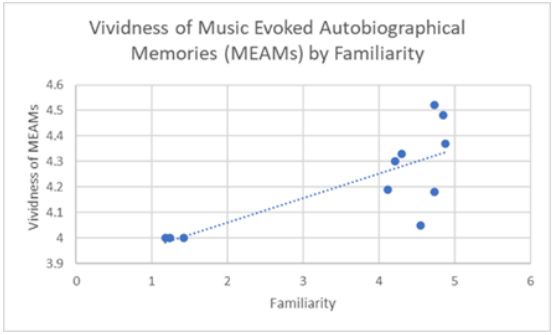

Figure 4. Correlation between familiarity and MEAM vividness

Figures 3 and 4 show two distinct clusters of results, in contrast to Figures 1 and 2, where the results are spread across the trendline. Four songs with low familiarity had lower frequency/vividness levels, while eight songs had higher ratings of familiarity, frequency, and vividness of MEAMs. This is supported by Figures 5 and 6 which reflect correlations between TER and perceived groove or familiarity. Figure 5 shows a small positive correlation (r = .22); Figure 6 reflects a strong positive correlation (r = .90).

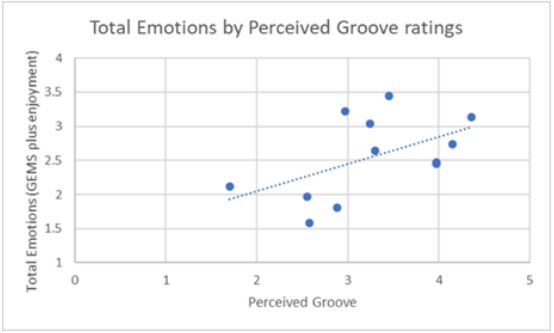

Figure 5. Correlation between perceived groove and TER

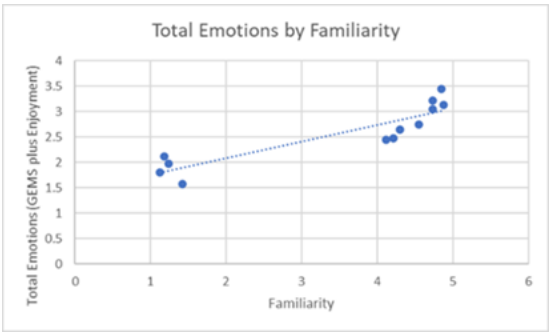

Figure 6. Correlation between familiarity and TER

Figure 6, along with the low Standard Deviation (SD) results from Table 2, reveals that familiarity had the stronger influence on TER. Considering that emotional response almost always accompanies autobiographical memory through Juslin and Västfjäll's (2008) framework of 'episodic memory', it can be assumed that familiarity had the stronger impact on the elicitation of MEAMs.

MEAM descriptions. MEAM descriptions were analysed in NVivo by filing reoccurring words and phrases under 'node' names (shown in brackets) which were subsequently grouped into themes. Figures 7 to 10 and accompanying quotes present word clouds with the most frequent terms used to describe MEAMs in relation to different songs. In 'Superstition', 31.58% of references contained physical movement (dancing, discos), 36.84% people (friends, partner), 26.32% being a student (school, college), 15.79% social activities (parties and drinking), 21.05% the music/artist, and 21.05% first time listening. For 'Don't stop me now', 33.33% of references contained social groups/activities (friends, parties, partner, pub), 29.63% referenced the band (including live concerts, 29.63% recreation (bedroom, car, holiday), 7.41% dancing (dance performance, disco), and 7.41% being a student. In addition, 22.22% of nodes referenced singing along to the track and 50% of these experiences were in social settings.

Figure 7. MEAM descriptions 'Superstition'

Participant 9: 'Can remember parties in the late 70s.'

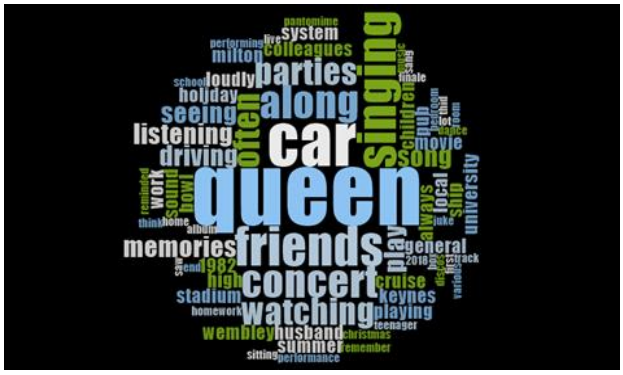

Figure 8. MEAM descriptions 'Don't stop me now'

Participant 13: 'Watching Queen in concert at Wembley stadium.'

Highly familiar songs with lower groove ratings showed reflection on important individuals and personal memories. In 'What a Wonderful World', 52.17% of participants referenced family members, 21.74% home life (home, kitchen, radio), 13.04% other close attachments (loved one, friend), dance 13.04% (dancing, disco), funerals 8.7%, buying the single 4.35%, and reflecting by a lake 4.35%. In 'Space Oddity', 57.14% referenced the music/artist, 33.33% being a student, 23.81% private listening, and 14.29% self-discovery (artistic expression, drugs, psychedelics). 38.1% references contained various social occasions (disco, family, friends, party), activities 19.05% (car, work), and children and home each represented 4.76% of references.

Figure 9. MEAM descriptions 'What a Wonderful World'

Participant 18: 'I recall being in the Isle of Man at my grandparent's home. My grandmother loved it. Also was played at a friend's funeral.'

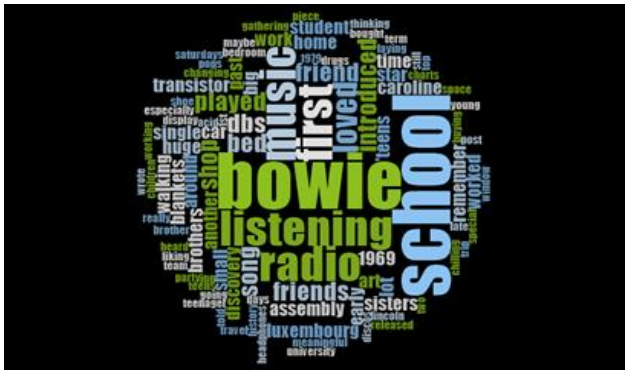

Figure 10. MEAM descriptions 'Space Oddity'

Participant 22: 'I remember buying the single and feeling that I was very cool!'

4. DISCUSSION

Outwardly, the results revealed strong correlations between perceived groove and MEAM frequency and vividness. In addition, MEAM descriptions of songs with higher perceived groove ratings described social gatherings. This reflects Maes et al.'s (2014) study, which demonstrated how external environments influence cognitive processes, suggesting that physical immersion while listening to a song influences memory content. However, familiarity proved to have stronger correlations with MEAM frequency/vividness; this conflicts with Janata et al. (2011), who found out that familiarity had less of an impact than enjoyment, tempo, and genre. This difference may derive from using an older age bracket because increased repetition of songs over long time periods leads to increased memorisation (Blum, 2013). Other results found that familiar songs had a potentially greater emotional impact than perceived groove, confirming previous research on MEAMs and their relationship to 'episodic memory' (Juslin & Västfjäll, 2008). MEAM descriptions of songs with high familiarity showed an emphasis on individuals (family, friends, or icons like David Bowie) and personal recreation through private listening and self-discovery, which may link to the development of one's identity.

Overall, the study ran smoothly but there are several limitations to be considered. The most significant limitation was the number of familiar songs which had potentially overridden the effects of perceived groove, despite strong correlations. For example, four songs with significantly lower perceived groove ratings were also less familiar. Familiarity was measured as an important mediating variable because someone's preferred music becomes frequent and therefore fixed over time. If this study is replicated, a broad range of familiar and less familiar stimuli should be used. Future studies could find a potential correlation between the independent variables to determine whether familiarity increases perceived groove. Janata et al.'s (2011) paper stated that some unfamiliar excerpts were rated highly in groove (2011), indicating these two dimensions are

somewhat independent, yet this study says differently. Therefore, more explicit ways of measuring familiarity are needed. For example, Jagiello et al. (2018) used electroencephalography (EEG) to measure the brain's temporal signals which differentiated familiar, unfamiliar, and enjoyable music.

Another limitation is the lack of inferential statistics; the continuous rating scales for the independent variables meant the study was based entirely on correlation which only infers how variables are related. In the future, logistic regression should be used to predict MEAMs based on perceived groove and familiarity ratings and consequently provide a causal relationship between the two. Lastly, the study relied on subjective opinions on "perceived" groove rather than "felt" groove. Face-to-face clinical settings would allow observation and physiological arousal tests to be conducted, such as heart and respiration rates, which along with EEG, would provide more concrete results.

Once limitations are considered within in-person experiments on healthy participants, further research regarding clinical disorders could be conducted. Entrainment of 'groovy' rhythms that are often heard in social settings could benefit cognitively, emotionally, and socially for those with dementia (Baird et al., 2020: 24). Using songs with varying groove ratings could help manage mood regulation: "high groove" songs uplift emotion and act as an effective diversion; the reflective nature of low groove songs may encourage emotional disclosure (Jagiello et al., 2018: 293).

Previous research has focused on MEAMs and groove as individual fields, but the two have never been combined. The novelty in this study lies in this combination, following evidence that music impacts our cognitive processes. In addition, using an older age range contrasts to previous studies and worked effectively by exploiting the 'reminiscence bump' and maximising data collection. To summarise, there were strong and medium correlations between perceived groove and the frequency and vividness of MEAMs, respectively. MEAMs displayed differing descriptions of group settings and individuals, due to high perceived groove or low perceived groove/high familiarity, respectively. However, the results remain inconclusive, and further research is required to examine the impact of familiarity, which overshadowed perceived groove in this study. Nevertheless, the strong correlations between perceived groove and MEAMs show potential for future research.

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APPENDIX

Appendix 1. Sample set of questions for one song

Listen to the **first 30 seconds** of this extract.

1) Please rate your impulse to move to the extract (5 – incredibly high, 1 – incredibly low).
2) How much did you enjoy listening to the extra? (5 – I enjoyed it a lot, 1 – I did not enjoy it at all)
3) How familiar are you with the extract? (5 – I know it very well, 1 – I don't know it)
4) Did you experience any autobiographical memories while listening to the extract? (Answer 'Yes', or 'No').
5) If yes and you feel comfortable, briefly describe your memories, including time and place, maximum 50 words.
6) How vivid were the MEAMs? (5 – incredibly vivid, 1 – not vivid at all)
7) Please rate the intensity you felt each emotion listed below (5 – incredibly high emotional response, 1 – no emotional response).
    - Wonder
    - Transcendence
    - Tenderness
    - Nostalgia
    - Sadness
    - Peacefulness
    - Power
    - Joy
    - Tension
8) Any comments on your emotional response to the extract?

Appendix 2. Stimuli information

Song title and artist	**Year Release**	**Genre**	**Janata et al.'s 2011 study Perceived groove ratings**
Word Up – Cameo (Practice trail)	1986	Soul	85.9
Superstition – Stevie Wonder	1972	Soul	108.7
Lady Marmalade – LaBelle	1975	Soul	102.5
Come fly with me – John Stevens	2005	Jazz	86.0
We are more – Erin McKeown	2005	Folk	73.1
Don't Stop me now - Queen	1977	Rock	72.5
Start me up – The Rolling Stones	1981	Rock	71.0
Summertime – Ella Fitzgerald and Louis Armstrong	1957	Jazz	67.9
TFS – Herbie Hancock	1983	Soul	67.8
What a Wonderful World – Louis Armstrong	1957	Jazz	66.4
Mud – Greg Brown	2002	Folk	50.5
Space Oddity – David Bowie	1969	Rock	38.7
Dawn Star – Dean Margraw	1997	Folk	34.8