The Second International Conference
Psychology and Music – Interdisciplinary Encounters
(PAM-IE Belgrade 2022)

Main Conference Program, October 26–29, 2022

Parallel Conference Program, October 27, 2022

Main Organizer
Faculty of Music, University of Arts in Belgrade

Co-organizers
Institute of Psychology, Faculty of Philosophy, University of Belgrade
Psychology of Music Section, Serbian Psychological Society
Regional Network Psychology and Music (RNPaM)

Proceedings of the Second International Conference
Psychology and Music – Interdisciplinary Encounters, Belgrade 2022

Editors
Blanka Bogunović, Sanela Nikolić, and Dejana Mutavdžin

Publisher
Faculty of Music, University of Arts in Belgrade, Kralja Milana 50, Belgrade

For publisher
Faculty of Music
Ljiljana Nestorovska

Editor-in-Chief of the Faculty of Music Publications
Gordana Karan

Cover design
Stefan Ignjatović

Technical Editor and Pre-Press
Dušan Ćasić

THE SECOND INTERNATIONAL CONFERENCE

Psychology and Music – Interdisciplinary Encounters

PROCEEDINGS

Editors
Blanka Bogunović, Sanela Nikolić, and Dejana Mutavdžin

Faculty of Music, University of Arts in Belgrade, 2023

Age-Related Motor Speed and Music of the World's Best-Selling Recording Artists

Geoff Luck

Centre of Excellence in Music, Mind, Body and Brain, Department of Music, Art and Culture Studies, University of Jyväskylä, Finland

geoff.luck@jyu.fi

Abstract

Typical movement speed, often measured by spontaneous motor tempo (SMT), has been shown to follow a downward trajectory across the lifespan. It is also well established that body movement and musical activity are intimately intertwined, especially in terms of timing-related factors. It might not seem unreasonable, therefore, to expect the tempo of music we create to slow as we age. This was investigated by examining tempo of songs released by top-tier recording artists over their decades-long careers. Three hypotheses were formulated. H1: Artists will exhibit a downward trend in mean album tempo (MAT) across their careers. H2: Artist-specific variations will be observed due to other likely tempo-related influences. H3: By nesting tempo within-artist, it will be possible to construct a robust model in which artists' age predicts tempo. Catalogs of the 10 all-time best-selling solo artists (top 5 male, top 5 female) with careers spanning at least 2 decades were selected for study (Eminem, Elvis Presley, Michael Jackson, Elton John, Lil Wayne, Mariah Carey, Madonna, Whitney Houston, Céline Dion, Shania Twain). The resulting corpus comprised 134 albums and 1497 tracks. The basic beat-level tempo was obtained manually for each track via a tapping task and then averaged by album. Linear regression analyses revealed that all 10 artists exhibited a downward trend in MAT across their careers (supporting H1), with age explaining up to 91% of the variance in tempo. There was also noticeable individual variation in tempo evolution across time (supporting H2). Nesting MAT within-artist and regressing all tempi against artist age yielded a robust linear relationship, $F(1, 26) = 13.35$, $R^2 = 0.34$, $p < .05$ (supporting H3), with MAT decreasing by almost one and a half standard deviations from artists' early twenties to their late fifties. This study thus offers evidence for an intimate connection between body movement and musical creativity.

Introduction

Tempo is an essential characteristic of music, with different musical tempi being used to express specific emotions (Eerola & Vuoskoski, 2013), suggest particular musical styles (Li & Chan, 2011), and build or release tension (Goodchild et al., 2016). Musical tempo is also known to influence listeners' perception of emotion (Webster & Weir, 2005), level of arousal (Lundqvist et al., 2009), and music-induced body movement (Burger et al., 2014). Body movement and music are, in fact, intimately intertwined, especially in terms of timing-related factors (Luck & Toiviainen, 2012). For example, body movement is not only induced by music but is required to understand it (Leman & Maes, 2014) and to create it in the first place (Palmer, 1997). The typical speed of body movement, known as spontaneous motor tempo or SMT, is known to decrease across the lifespan (McAuley et al., 2006), likely a result of decreased muscle activation speed and a slowdown of nerve conduction velocities (Chase et al., 1992). Simply put, the older we get, the slower we move. Taken together, our general age-related slowdown and the intimate relationship between body movement and musical activity raises the question of whether the tempo of music we create slows as we age?

One way of investigating this might be to carry out an empirical study in which participants of different ages compose and perform new music, the tempo of which is then regressed against age. Another, more accessible and ecologically valid approach – especially at this exploratory stage – would be to examine the tempi of songs recorded and released by established recording artists over their decades-long careers.

Aim and Hypotheses

Here, then, the aim was to investigate the extent to which typical age-driven decline in SMT might have impacted the tempo of commercial recordings, with a focus on music released by the biggest recording artists of the popular music era. Three hypotheses were formulated. H1: Each artist will exhibit a downward trend in mean album tempo (MAT) across their career. H2: Artist-specific variations will be observed in this overall downward trend due to other likely tempo-related influences, such as different producers, musicians, label executives, genres, musical trends, etc. H3: Nonetheless, by nesting tempo within-artist, it will be possible to construct a robust overall model in which artists' age predicts the tempo of musical output.

Method

Catalogues of the 10 all-time best-selling solo artists (top 5 male, top 5 female) with careers spanning at least 2 decades were selected for study. A lower limit of 2 decades was applied to increase likelihood of identifying a decline in SMT, known to taper-off gradually across the lifespan. Data concerning album sales were obtained from the official Recording Industry Association of America (RIAA) certification database. According to these criteria, the artists selected for study were Eminem, Elvis Presley, Michael Jackson, Elton John, Lil Wayne, Mariah Carey, Madonna, Whitney Houston, Céline Dion, and Shania Twain. Between them, these artists have sold almost 2 billion albums spanning a range of genres including Hip hop, Rock and roll, Pop, Rockabilly, Country, Gospel, R&B, Blues, Soul, Funk, Rock, Disco, Post-disco, Dance-pop, New jack swing, Pop rock, Glam rock, Soft rock, Pop, Electronica, Dance, Chanson, and Country pop.

Initially, the complete catalogue of each artist was considered. However, in order to reduce extra-artist influences as much as possible, the following types of albums were excluded from analysis: Albums recorded before the artist reached adulthood (defined as 18 years of age), compilation albums, live albums, soundtrack albums, cover albums (those containing 50% or more non-original tracks), Christmas albums,

Table 1. Certified album sales, genres, album span, and other pertinent information for each artist.

Artist	Certified Album Sales (Millions)	Genres	Alum Span (Years)	No. Albums	No. Tracks
Eminem	321	Hip hop	21	10	106
Elves Presley	231	Rock and roll, Pop, Rockabilly, Country, Gospel, R&B, Blues	21	21	232
Michael Jackson	148	Pop, Soul, Funk, R&B, Rock, Disco, Post-disco, Dance-pop, New jack swing	22	6	104
Elton John	204	Pop, Pop rock, Glam rock, Soft rock	47	30	311
Lil Wayne	165	Hip hop	20	11	120
Marian Carey	196	R&B, Soul, Hip hop, Pop	28	12	118
Madonna	181	Pop, Electronica, Dance	36	14	141
Whitney Houston	155	R&B, Pop, Soul, Gospel, Dance	24	9	55
Céline Dion	137	Pop, Chanson, Soft rock	32	19	239
Shania Twain	81	Country, Pop, Country pop	24	5	71
TOTAL	1919		275	134	1 497
AVERAGE	191.90		27.50	13.40	149.70
SD	65.85		8.62	7.92	82.92

posthumous albums, remix albums, and mix-tapes. These produced a corpus of 134 studio albums containing 1866 tracks. From this corpus, the following types of tracks were excluded from analysis: bonus tracks that did not appear on the original release, skits (spoken-word tracks without musical accompaniment), tracks with ambiguous tempi, and tracks with featured artists.

The final corpus comprised 1497 tracks spanning 65 years of popular music. Table 1 shows certified album sales, genres, career/album span length, and other pertinent information for each artist. The number of years from the first to the most recent album (album span) ranged from 21 (Eminem, Elvis Presley) to 47 (Elton John). The average number of albums per artist = 13 (range = 5 [Shania Twain] to 30 [Elton John]). The average number of tracks per artist = 150 (range = 55 [Whitney Houston] to 311 [Elton John]).

Figure 1 shows the span and relative timing of each artist's career, revealing an unbroken timeline of musical output from 1955 to 2021. It's not perfect – not all decades are equally represented, for example – but it's a good place to start.

Due to challenges arising from automated computational tempo extraction, the basic beat-level tempo was obtained manually for each track via a tapping task. Five annotators worked remotely, listening individually to assigned playlists of tracks. Tracks were presented in a quasi-randomized order to help mask potential age-related tempo effects. Each annotator tapped the tempo of each track using a mobile application and entered it into a database in beats per minute (bpm). Subsequently, each track having a tempo provided by at least 3 annotators was assigned a value in bpm based upon the mean of all tapped tempi. Tracks with tapped tempi deviating from the mean by more than 2 bpm were excluded from the analysis.

Results

A series of simple linear regression analyses revealed that all 10 artists exhibited a downward trend in MAT across their careers (supporting H1), with noticeable artists' variations in the evolution of MAT (supporting H2). Four trends were statistically significant – those for Eminem, Elvis Presley, Michael Jackson, and Lil Wayne. Overall, the variance in tempo explained by age ranged from 3% to 91%.

Given the limited statistical power arising from a relatively small amount of data per artist (as few as 5 albums/data points for Shania Twain, for example), MAT was standardized within-artist, combined, and regressed against artists' age. This yielded a robust linear relationship between MAT and artists' age, $F(1, 26) = 13.35$, $R^2 = 0.34$, $p < .005$ (H3). The evolution of tempo over time across all artists is shown in Figure 2. As can be seen, MAT decreased by almost one and a half standard deviations from artists' early twenties to their late fifties.

Figure 1. Span and relative timing of artists' careers show an unbroken musical output timeline from 1955 to 2021.
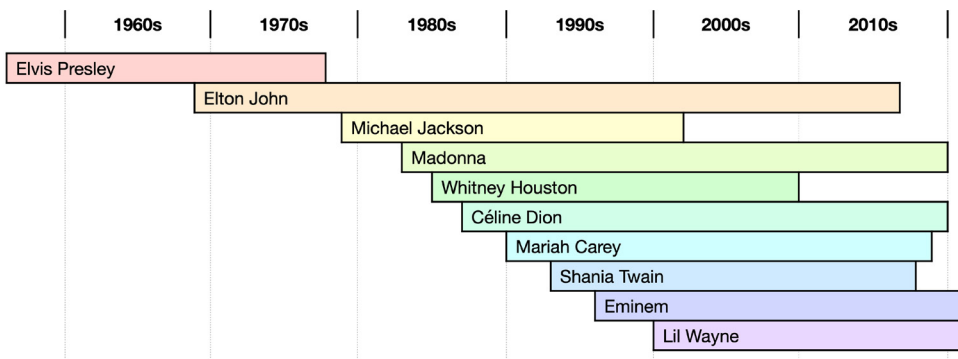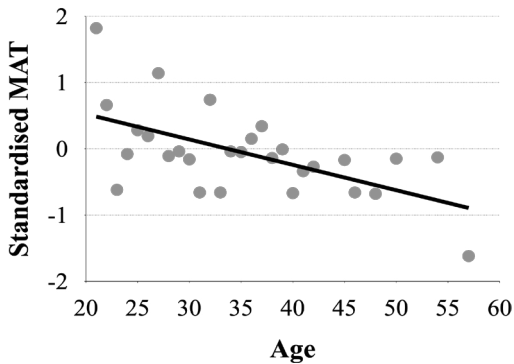
Figure 2. The plot of tempo * age across all artists.

Discussion

All 3 hypotheses were confirmed. Chronological age was found to be a statistically significant predictor of the tempo of music released by the world's most successful recording artists of the past 60 years. The fact that this effect held despite the presence of different songwriters, producers, label executives, collaborators, and other factors made it all the more remarkable. Furthermore, it demonstrated that commercial recordings, millions of which are instantly accessible via a range of streaming platforms, can offer profound insights into a fundamental and understudied aspect of human functioning across the lifespan.

While this work offers support for a connection between age or career stage and tempo of artistic output, it remains unclear how generalizable this connection is beyond a handful of the most popular artists. Studying a considerably broader range of artists, musical styles, and periods will be critical to gain a comprehensive picture of this potentially significant phenomenon.

It would also seem pertinent to consider not only the effects of physical aging, but those resulting from psychological maturation as well. Research has shown, for example, that older individuals exhibit higher levels of psychological well-being (Murray, 2007) and fewer negative emotions (Phillips et al., 2008), compared to younger listeners. Younger people tend to en-

gage with music for identity, positive and negative mood management, reminiscence, diversion, arousal, and social interaction (Lonsdale & North, 2011), while older individuals do so for entertainment, connection, well-being, time management, therapeutic benefits, and spirituality (Hays & Minichiello, 2005). A recent study suggests that music preferred by older individuals contains higher levels of love-tenderness and lower pain-sadness levels than those listened to by younger people (Mavrolampados et al., 2023). As a consequence, different reasons for engaging with music will likely lead to differences in the audio characteristics of the music one engages with (Duman et al., 2022). To what extent this applies to the music we create remains an open question, but one that certainly deserves further investigation.

Conclusions

Despite the significant within-artist variation, all 10 artists exhibited a downward trend in musical tempo across their careers, with MAT decreasing by almost one and a half standard deviations from artists' early twenties to their late fifties. Artist age was thus found to be a statistically significant predictor of the tempo of music released by the world's most successful recording artists, offering evidence for an intimate connection between body movement and musical creativity. Further research should explore more diverse collections of artists and music and should focus on teasing apart the relative effects of physical versus psychological maturation on tempo of creative output across the lifespan.

References

Burger, B., Thompson, M. R., Luck, G., Saarikallio, S. H., & Toiviainen, P. (2014). Hunting for the beat in the body: On period and phase locking in music-induced movement. *Frontiers in Human Neuroscience*, *8*, Article 903. https://doi.org/10.3389/fnhum.2014.00903

Chase, M. H., Engelhardt, J. K., Adinolfi, A. M., & Chirwa, S. S. (1992). Age-dependent changes in cat masseter nerve: An electrophysiologi-

cal and morphological study. *Brain Research*, *586*(2), 279–288. https://doi.org/10.1016/0006-8993(92)91637-t

Duman, D., Neto, P., Mavrolampados, A., Toiviainen, P., & Luck, G. (2022). Music we move to: Spotify audio features and reasons for listening. *PLOS ONE*, *17*(9), Article e0275228. https://doi.org/10.1371/journal.pone.0275228

Eerola, T., & Vuoskoski, J. K. (2013). A review of music and emotion studies: Approaches, emotion models, and stimuli. *Music Perception*, *30*(3), 307–340. https://doi.org/10.1525/mp.2012.30.3.307

Goodchild, M., Gingras, B., & McAdams, S. (2016). Analysis, performance, and tension perception of an unmeasured prelude for harpsichord. *Music Perception*, *34*(1), 1–20. https://doi.org/10.1525/mp.2016.34.1.1

Hays, T., & Minichiello, V. (2005). The contribution of music to quality of life in older people: An Australian qualitative study. *Ageing & Society*, *25*(2), 261–278. https://doi.org/10.1017/S0144686X04002946

Leman, M., & Maes, P.-J. (2014). The role of embodiment in the perception of music. *Empirical Musicology Review*, *9*(3–4), 236–246. https://doi.org/10.18061/emr.v9i3-4.4498

Li, T. L. H., & Chan, A. B. (2011). Genre classification and the invariance of MFCC features to key and tempo. In K.-T. Lee, W.-H. Tsai, H.-Y. M. Liao, T. Chen, J.-W. Hsieh, & C.-C. Tseng (Eds.), *Advances in multimedia modeling: 17th International Multimedia Modeling Conference, MMM 2011, Taipei, Taiwan, January 5–7, 2011: Proceedings, part I* (pp. 317–327). Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-17832-0

Lonsdale, A. J., & North, A. C. (2011). Why do we listen to music? A uses and gratifications analysis. *British Journal of Psychology*, *102*(1), 108–134. https://doi.org/10.1348/000712610x506831

Luck, G., & Toiviainen, P. (2012). Movement and musical expression. In A. R. Brown (Ed.), *Sound musicianship: Understanding the crafts of music* (pp. 167–177). Cambridge Scholars Publishing.

Lundqvist, L.-O., Carlsson, F., Hilmersson, P., & Juslin, P. N. (2009). Emotional responses to music: Experience, expression, and physiology. *Psychology of Music*, *37*(1), 61–90. https://doi.org/10.1177/0305735607086048

Mavrolampados, A., Duman, D., Burunat, I., Snape, N., Neto, P., Hartmann, M., & Toiviainen, P. (2023). *Impact of age and gender on affective experiences in music* [Manuscript in preparation].

McAuley, J. D., Jones, M. R., Holub, S., Johnston, H. M., & Miller, N. S. (2006). The time of our lives: Life span development of timing and event tracking. *Journal of Experimental Psychology: General*, *135*(3), 348–367. https://doi.org/10.1037/0096-3445.135.3.348

Murray, E. A. (2007). The amygdala, reward and emotion. *Trends in Cognitive Sciences*, *11*(11), 489–497. https://doi.org/10.1016/j.tics.2007.08.013

Palmer, C. (1997). Music performance. *Annual Review of Psychology*, *48*, 115–138. https://doi.org/10.1146/annurev.psych.48.1.115

Phillips, L. H., Henry, J. D., Hosie, J. A., & Milne, A. B. (2008). Effective regulation of the experience and expression of negative affect in old age. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *63*(3), 138–145. https://doi.org/10.1093/geronb/63.3.p138

Webster, G. D., & Weir, C. G. (2005). Emotional responses to music: Interactive effects of mode, texture, and tempo. *Motivation and Emotion*, *29*(1), 19–39. https://doi.org/10.1007/s11031-005-4414-0