MOTION EXPERIENCES IN CLASSICAL AND POPULAR MUSIC

Clemens Wöllner
University of Sheffield, UK
Humboldt-Universität Berlin, Germany

ABSTRACT

Background: Evidence for the significance of motion experiences in listening to music stems from philosophical, music-theoretical, psychological, and neurobiological research. Whilst these different disciplines seem to focus on various aspects, motion experiences in music can broadly be categorized as (a) apparent motion based on grouping and Gestalt principles, (b) virtual spatial motion in electronic music, (c) metaphorical motion, and (d) bodily movement reactions.

Aims: This paper attempts to investigate the relationship between structural features of the music, bodily responses and perceived metaphorical motion. Interactions with emotional experience, familiarity and preference are also addressed.

Method: Twenty participants (musicians and non-musicians) listened to five popular and five classical pieces of music either primarily based on pitch (melody, harmony) or on timing (rhythm, beat) aspects as judged in a pilot study. Employing a naturalistic paradigm, participants were simply asked to tap their foot to the music if and when they felt like doing so. The mean number of taps in relation to the total number of beats (tapping rate) and the starting time for the tapping were analysed. Physiological measures (GSR, heart rate) and a number of questionnaire items were also recorded.

Results: In general, musical examples with salient timing features as compared to pitch features caused a significantly higher desire to tap (questionnaire) for the classical examples and stronger bodily movements (tapping rate) for the popular examples. Furthermore, whereas participants tapped at a higher tapping rate with the popular musical examples ($p<0.001$), the classical examples were more frequently associated with aspects of metaphorical motion such as gestural experiences. While the variables 'familiarity' and 'preference' showed significant correlations with the tapping rate across all musical examples, no such relationships were found with the mean tempo.

Conclusions: The results suggest that specific factors of the music may elicit bodily movement reactions and lead to differences in the perception of metaphorical motion aspects. Tapping to music in a naturalistic setting is different from metre finding tasks and offers insights into a common but complex way of bodily responses to music.

1. INTRODUCTION

Motion aspects are important experiential dimensions of music for composers, performers and listeners. Musical motion, which can primarily be specified through rhythmic, harmonic, melodic and dynamic parameters, plays a fundamental role in the music's impact and meaning (Shove & Repp, 1995; Clarke, 2001). Yet one question has not been sufficiently scrutinized: In which way and what exactly do listeners perceive as musical motion?

(a) A large body of experimental research in connection with musical motion has been devoted to grouping and Gestalt principles. For example, series of separate tones, played at adequate time intervals, are perceived as coherent auditory streams or apparently moving sounds (Bregman, 1990, 173-174; Deutsch, 1999, 313-314; Gjerdingen, 1994). (b) Music that is rendered over loudspeakers at different positions in space can give rise to the impression of spatial motion, which forms a particularly important dimension in some electroacoustic compositions (Stockhausen, 1963; Windsor, 2000). (c) While in apparent and virtual spatial motion the stimulus information of the source itself directly lead to the perception of seemingly moving objects, motion qualities of music in metaphorical terms are conceived in 'higher-order' processes that depend on previous experiences in other domains. That means, metaphors of space, movement and animation are constructed such that music is perceived as flowing, going up or down, holding back or pushing forward or as resembling human gestures (Pratt, 1931, 185-188; Scruton, 1997, 80-96; Walker, 2000). (d) The last theoretical perspective on motion involves an observable behavioural component. Specific bodily movement reactions to music are already observed with young children (Ferrara & Tafuri, 1994). Some researchers suggest a neurobiological basis for these reactions (Clynes & Walker, 1982, 172-174) or a mediating role of the vestibular system in connection with sensory-motor interactions (Todd, 1999; Todd & Clody, 2000).

In summary, specific research paradigms strongly affect the different definitions of musical motion. Generalizations across listeners seem only appropriate for basic perceptual phenomena such as apparent or virtual spatial motion, but it is arguably whether different listeners consistently perceive metaphorical motion in the same way or whether they move their bodies to different types of music similarly. For that reason, further aspects such as musical preference, familiarity, and emotional involvement with the music need to be considered. Moreover, correlations with measures of physiological arousal, e.g. heart rate and Galvanic Skin Resistance (GSR), can provide additional information.

While aspects of metaphorical motion can be addressed with questionnaires and free verbal descriptions, in this study the bodily movement reactions are explored by a tapping device. Much research was done on tapping to music, primarily in connection with pulse and metre finding or subjective rhythmization tasks (for a summary see Parncutt, 1994; Snyder & Krumhansl, 2001). Since this paper aims to focus on the quality of bodily reactions to music as they occur in daily life rather than focussing on mechanisms of pulse finding, a naturalistic approach was developed for this study where the tapping itself functions

ISBN 3-931852-67-9
ISSN 1617-6847

as dependent variable and the participants can freely decide to tap if and when the music evokes the wish to tap. The starting time of the individual tapping and a normalized tapping rate are then analysed. The tapping rate (TR) is calculated by the total number of taps divided by the perceptually obtained total number of beats.

The musical examples were chosen out of 40 examples from a pilot study, where participants rated the salience of timing (rhythm, beat) and pitch aspects (melody, harmony). 5 classical and 5 popular examples were selected for the experiment reported in this paper; two pieces for each musical domain were primarily based on timing and two on pitch aspects, while one classical and one popular musical example with no significant differences has also been included for control reasons. Without knowing the purpose of the pilot study, participants freely described all pieces included in this experiment in some terms related to motion (for more detail on this method cf. Friberg, Sundberg & Frydén, 2000).

The following main hypotheses will be tested:

1. Salient musical features (timing or pitch aspects) will cause differences in perceived motion and performed bodily movement.

2. There are differences in the responses between all classical and all popular examples.

3. Participating music students differ in their responses from students without regular musical training.

2. METHOD

Participants. 20 students participated in the study (14 male and 6 female), aged 19 to 33 years (median: 22.5 years). Ten participants studied music, and the other ten students had never received any regular musical training. A further PhD music student (male, 32 years old) took part in the perceptual assessment of the total beat rate for all musical examples.

Procedure. While listening to individually randomised orders of the musical examples, participants were asked to tap their preferred foot on a pedal when they felt that the 'music is making them tap'. The musical examples were rendered over headphones and the tapping was recorded using a microphone, both were simultaneously controlled using the software Pro Tools (version 5.0.1) on a Macintosh. Directly before and after each listening period, the heart rate (with a Polar Accurex Plus device) and the Galvanic Skin Resistance (White Gold 020) were recorded as discrete measures. Next the questionnaire was provided and the different items were answered on 7-point Likert scales, as well as with nominal responses and free verbal descriptions. The experiment was conducted in single sessions that lasted from 30 to 45 minutes. In order to allow comparisons between the tapping response for the different musical examples, one further participant was asked to indicate the total number of beats after repeated listening by tapping with a pen on a table 'like a conductor would perform it at the lowest level', which was recorded using the same apparatus as for the main experimental sessions. Subsequently, the tapping response for each participant and each musical example were normalized by calculating the tapping rate (TR).

3. RESULTS

For the classical domain, examples with salient pitch aspects as compared to timing aspects achieved significantly higher rating scores for preference (liking) and emotional experience, but the wish to tap was stronger with the latter, as revealed by two-tailed t-tests. However, no significant differences were found in the actual tapping rate (TR). In contrast for the popular examples, while emotional experience and familiarity with the music were higher for pitch-based pieces, examples with salient timing aspects achieved significantly higher responses in the TR.

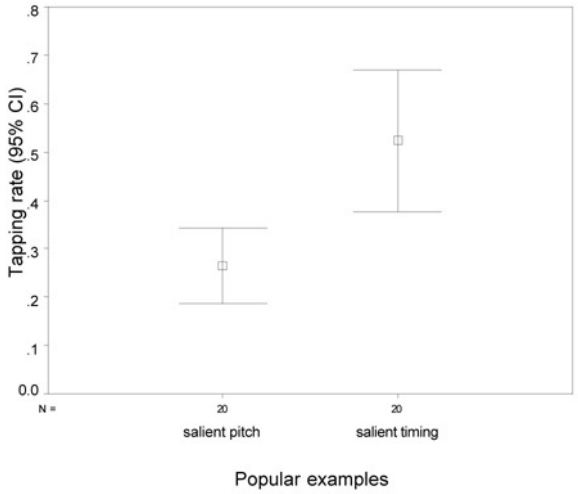

Figure 1: Differences in the tapping rate between all popular pieces with salient pitch and salient timing aspects (p=0.001). Note: 0 would have been no tapping at all and 1.0 consistent tapping along with the beat.

Comparisons between all classical and all popular musical examples resulted in a number of significant differences in the questionnaire, the TR and the heart rate changes. First, participants liked the classical pieces more than the popular ones ($p=0.001$) and also had stronger emotional experiences with them ($p<0.001$). On the contrary, they could better imagine dancing ($p<0.001$) and felt a stronger wish to tap ($p<0.001$) with the popular examples. As for the aspects of metaphorical motion, participants indicated more often that the 'music was moving in itself' and that the 'music resembled a human gesture' for the classical pieces than for the popular ones, as shown by Wilcoxon Z-tests for the two response categories 'yes' and 'no / don't know'. The free verbal descriptions mirror a great variety of different associations and emotional states evoked by the music, which becomes particularly evident in the descriptions of gestures associated with the music.

ISBN 3-931852-67-9
ISSN 1617-6847

A one-way ANOVA revealed significant differences between musicians and non-musicians: for separate group analyses of both classical and popular pieces, musicians could better imagine dancing, had a stronger wish to tap and knew the pieces better than the non-musicians. For the TR, no differences were found between the two experimental groups of participants. In general, the TR was significantly higher for the popular examples than for the classical ones.

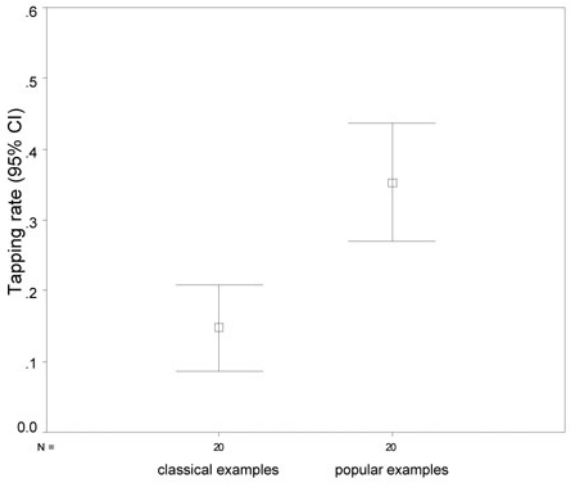

Figure 2: Differences in the tapping rate between all classical and popular examples ($p<0.001$).

Regarding the starting time of the tapping, the mode and the median, indicating important measures of the actual tapping behaviour across participants, were compared with the structure of the musical examples. For most pieces, these values mark particular points in time such as the beginning of a melodic theme or e.g. the first beat of the second bar.

The heart rate decreased significantly during the listening period for all but one musical example, regardless of the relative salience of pitch or timing aspects. The mean heart rate decrease was significantly higher for the classical than for the popular pieces. Differences in the GSR were only obtained for one musical example.

Finally, all Likert-scale questionnaire items, the TR, and the physiological measures were correlated. For preference, familiarity and emotional experience, strong correlations were found between these aspects and most other questionnaire items, indicating the importance of these variables. The TR was significantly correlated with the extent to which participants liked the music, could imagine dancing to it, and how strong their wish to tap has been. No correlations were found with the GSR changes and only few with the mean heart rate changes. The faster the mean tempo for the single musical examples had been, the more participants could imagine dancing, had a stronger wish to tap, and the less they felt emotionally involved with the music. Yet, there was no correlation between the mean tempo and the TR, nor with the physiological measures.

4. DISCUSSION

Listeners' experiences of perceived metaphorical motion and performed bodily movement with classical and popular music were investigated with cognitive, behavioural, and physiological response paradigms.

(1) Overall, the results support the first hypothesis: there occurred clear differences between all musical examples with salient pitch and with salient timing aspects. Curiously, participants wanted to tap more with the classical timing-based pieces but did not perform it (TR), whereas they tapped more with the popular examples with salient timing aspects, but did not indicate it on the questionnaire. Here cognitive judgements, such as the 'wish to tap' on the questionnaire, did not correspond with the participants' behaviour. Moreover, there was no impact of the mean tempo on the actual tapping, in contrast to the questionnaire items (imagine dancing and wish to tap). Nonetheless, these explorative data cannot sufficiently reject the notion of the strong connection between tempo and bodily movement (Garielsson, 1973; Parncutt, 1994; Friberg, Sundberg & Frydén, 2000). More research with controlled tempo manipulations is needed in order to specify the impact of tempo and tempo changes on bodily reactions to music.

There might be some controversy over the question whether factors in the music itself elicit and 'arouse' movement reactions, or whether the listeners deliberately decide when to move to music so as to 'express' their musical experiences. While cognitive decisions undoubtedly precede bodily movements such as dancing and other deliberate activities, support for the first proposition stems from research on physiological reactions to music (cf. Todd & Cody, 2000). Additionally, since definite structural features of the music and the musical domain clearly led to differences in the tapping behaviour, it can be argued that specifically musical factors do exist that elicit and shape bodily movement reactions.

(2) The results of all three experimental approaches show differences between classical and popular musical examples. Whereas the popular music achieved higher scores for aspects related to bodily movement and resulted in increased tapping behaviour, the classical pieces were more often perceived in terms of metaphorical motion. One explanation for these differences could lie in social-psychological concepts of the listeners' attitudes: classical music is widely associated with generally different listening situations and behaviour than popular music. The significantly stronger heart rate decrease for the classical pieces seems to support that notion in addition. Secondly, some general differences in texture, timbre, timing and rhythmic structure between the classical and popular pieces might also account for the obtained results. Nonetheless, using true musical examples, these parameters are not completely controllable.

(3) In this study, while musicians could better imagine dancing and the wish to tap was stronger than for non-musicians, these differences are not reflected in the tapping behaviour. Thus in contrast to findings by Drake and Penel (2000), musicians did not tap at a slower level. Consequently, while musically trained listeners may perceive larger structural units in the music, this is not necessarily reflected in the way they freely tap to music.

ISBN 3-931852-67-9
ISSN 1617-6847

Tapping in a naturalistic way does not automatically imply tapping to the metre of the music. This method can provide important insights into the way listeners truly perceive and react to music and should be considered in future research.

Preference and familiarity seem important factors for any sort of musical experience and were related to most questionnaire items and the movement reactions analysed as TR in the present study. The impact of emotional experience is less clear-cut since no correlations with the TR were obtained. Furthermore, the ratings for emotional experience were significantly higher for both classical and popular pieces with salient pitch aspects, whereas the wish to tap (classical examples) and the actual TR (popular examples) were higher for the timing-based pieces. These results show a discrepancy between the strength of self-reported emotional response and performed bodily movement. Since the focus of this study was rather on motion experiences, more specific research on different emotional states and their relationship with motion experiences is needed in order to elucidate and empirically validate the old etymological connection between motion and e-motion.

The results of this study suggest that elicited bodily movement and perceived metaphorical motion are not necessarily related to each other and should be investigated as different behavioural and perceptual components in the experience of music.

5. REFERENCES

1. Bregman, A.S. (1990). *Auditory scene analysis. The perceptual organization of sound*. Cambridge/MA: MIT Press.

2. Clarke, E.F. (2001). Meaning and the specification of motion in music. *Musicae Scientiae*, 5/2, 213-234.

3. Clynes, M. & Walker, J. (1982). Neurobiological functions of rhythm, time, and pulse in music (chap. 10). In M. Clynes (ed.), *Music, mind, and brain: the neuropsychology of music*. New York: Plenum.

4. Deutsch, D. (1999). Grouping mechanisms in music (chap. 9). In D. Deutsch (ed.), *The psychology of music (2nd ed.)*. New York: Academic Press.

5. Drake, C., Penel, A. & Bigand, E. (2000). Tapping in time with mechanically and expressively performed music. *Music Perception, 18/1*, 1-23.

6. Ferrara, E. & Tafuri, J. (1994). Kinetic patterns in children's responses to music. In I. Deliège (ed.), *Proceedings of the International Conference for Music Perception and Cognition Liège*.

7. Friberg, A., Sundberg, J. & Frydén, L. (2000). Music from motion: Sound level envelopes of tones expressing human locomotion. *Journal of New Music Research, 29/3*, 199-210.

8. Gabrielsson, A. (1973 b). Adjective ratings and dimension analyses of auditory rhythm patterns. *Scandinavian Journal of Psychology, 14*, 244-260.

9. Gjerdingen, R.O. (1994). Apparent motion in music. *Music Perception, 11/4*, 335-370.

10. Parncutt, R. (1994). A perceptual model of pulse salience and metrical accent in musical rhythms. *Music Perception, 11/4*, 409-464.

11. Pratt, C.C. (1931/1968). *The meaning of music. A study in psychological aesthetics*. New York: Johnson Reprint Corp.

12. Scruton, R. (1997). *The aesthetics of music*. Oxford: University Press.

13. Shove, P. & Repp, B.H. (1995). Musical motion and performance: theoretical and empirical perspectives. In J. Rink (ed.), *The practice of performance. Studies in musical interpretation* (pp. 55-83). Cambridge: University Press.

14. Snyder, J. & Krumhansl, C.L. (2001). Tapping to ragtime: Cues to pulse finding. *Music Perception, 18/4*, 455-489.

15. Stockhausen, K. (1963). Musik und Raum. In: *Texte zur elektronischen und instrumentalen Musik, Band I*. [Music and space. In: *Texts on electronic and instrumental music, vol. I.*] Köln: DuMont.

16. Todd, N.P.M. (1999). Motion in music: A neurobiological perspective. *Music Perception, 17/1*, 115-126.

17. Todd, N.P.M. & Cody, F.W. (2000). Vestibular responses to loud dance music: a physiological basis of the "rock and roll threshold"? *Journal of the Acoustical Society of America, 107,* 496-500.

18. Walker, M.E. (2000). Movement and metaphor: towards an embodied theory of music cognition and hermeneutics. *Bulletin of the Council of Research for Music Education, 145*, 27-42.

19. Windsor, L. (2000). Through and around the acousmatic: The interpretation of electroacoustic sounds (chap. 1). In S. Emmerson (ed.), *Music, electronic media and culture.* Aldershot: Ashgate.

ISBN 3-931852-67-9
ISSN 1617-6847