

The effect of metrical structure on the auditory-motor coordination of dance-like movement

Takahide Etani¹, Akito Miura¹, Masahiro Okano², Masahiro Shinya³, and Kazutoshi Kudo⁴

¹Graduate School of Arts and Sciences, The University of Tokyo

²Ritsumeikan Global Innovation Research Organization, Ritsumeikan University

³Graduate School of Integrated Arts and Sciences, Hiroshima University

⁴Graduate School of Interdisciplinary Information Studies, The University of Tokyo

Keywords: sensorimotor synchronization, dance, rhythm, accent, meter

Since dancing to music is a universal culture of human beings, it is reasonable to assume that humans have the basic ability to synchronize their movement with auditory rhythm. The degree of synchronization is affected by various factors such as the loudness of music and the metrical structure of rhythm [1,2]. The present study investigated the effect of metrical structure on the performance of auditory-motor coordination of dance-like rhythmic movement. Since previous study showed that off-beat finger tapping was more stable in structured sound sequence condition than in non-structured sound sequence condition [3], we hypothesized that metrical structure would stabilize auditory-motor coordination of dance-like rhythmic movement.

Metrical structure can be provided by manipulating loudness, pitch, or timbre of sound consisting the beat. In order to investigate whether the effect of metrical structure differ among the features of sound providing metrical structure, we created metrical structure on metronome beats by manipulating the loudness of the metronome in experiment 1, and by manipulating the pitch of the metronome in experiment 2. In both experiments, participants synchronized their dance-like knee-bending movement with metronome beats in structural condition (repeating loud sound and soft sound alternatively in experiment 1, and repeating high pitched sound and low pitched sound alternatively in experiment 2) and in non-structural condition (repeating the same sound in both experiments). Their knee-bending movement was recorded by using a goniometer and a motion capture system. In the analysis, the stability of the synchronization and the subjective difficulty score

were compared between structural condition and non-structural condition.

In experiment 1, the result of the synchronization stability showed that participants synchronized better in structural condition, and their subjective difficulty score also showed that synchronizing with structural condition was less difficult. In experiment 2, the result of the synchronization stability showed that there was no significant difference between structural condition and non-structural condition. However, the subjective difficulty score showed that synchronizing in structural condition was less difficult.

To conclude, although there was a difference in the synchronization performance between experiment 1 and experiment 2, our results suggest that metrical structure facilitates synchronizing dance-like movement with auditory rhythm.

References

- [1] Van Dyck E, Moelants D, Demey M, Deweppe A, Coussement P, Leman M. 2013 The Impact of the Bass Drum on Human Dance Movement. *Music Percept. An Interdiscip. J.* **30**, 349–359.
- [2] Burger B, Thompson MR, Luck G, Saarikallio SH, Toiviainen P. 2014 Hunting for the beat in the body : on period and phase locking in music-induced movement. *Front. Hum. Neurosci.* **8**, 1–16.
- [3] Keller PE, Repp BH. 2005 Staying offbeat: Sensorimotor syncopation with structured and unstructured auditory sequences. *Psychol. Res.* **69**, 292–309.