The Influence of Mother Tongue and Musical Experience on Rhythm Perception

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I. Introduction

- Mother tongue rhythm is said to affect rhythm perception in music and with stimuli consisting of pure tones (e.g. Iversen, Patel & Ohgushi 2008; Patel 2010)
- Hannon & Trehub (2005) also showed that both infants and adults (but especially infants) familiarized with non isochronous rhythms can better detect changes in non-isochronous rhythms, than subjects unfamiliar with them
- Research questions:
  1. If mother tongue rhythm and musical experience affect ability to detect rhythmic differences, will speakers of Japanese be better at detecting such differences than the English participants in Hannon & Trehub? In Japanese, rhythm irregularities, particularly lapses, are frequent and reflected in traditional music styles.
  2. Will Japanese participants respond in the same way to linguistic, tonal and musical stimuli?
  3. Will musical experience make them more sensitive to differences?

II. Methods

Participants

37 Japanese musicians (29 F, 8 M) and 31 Japanese non musicians (20 F, 11 M), 18-32 years old

Task

- In each trial, participants were asked to rate (from 1 = very similar to 6 = very different) the rhythmic difference between a familiarization stimulus and a test stimulus
- The experiment run on OpenSesame
- A session consisted of 14 sets of trials for each of four types of stimuli; each set was repeated three times
- Each participant provided 168 responses (14 sets × 4 stimulus types × 3 repetitions)

Stimuli

- Linguistic stimuli were a succession of [ma] syllables; strong (accented) syllables had high falling pitch (from 252 Hz to 186 Hz); unaccented [ma] had flat pitch (186 Hz)
- The musical stimuli were computer-generated; downbeats were higher and louder than unaccented notes
- There were two types of pure tone stimuli, both with inter-onset interval of 200 ms; 150-50 stimuli had a 50 ms silence between tones; 50-150 stimuli had 150 ms silence. Accented tones were 150% louder than unaccented ones.

Rhythm structures

Two types of familiarization stimuli:

- isochronous rhythm SWSW (S = strong; W = weak)
- non-isochronous rhythm: SWSWW

Controls: familiarization and test stimulus were the same

Structure preserving (SP): an element is removed, but the one proceeding it twice as long; e.g.

Isochronous: S:SW-SWSW

Non-Isochronous: S:SWW-SWSWW

Lapse: an extra W element is added; e.g.

Isochronous: SWSWW-SWSW

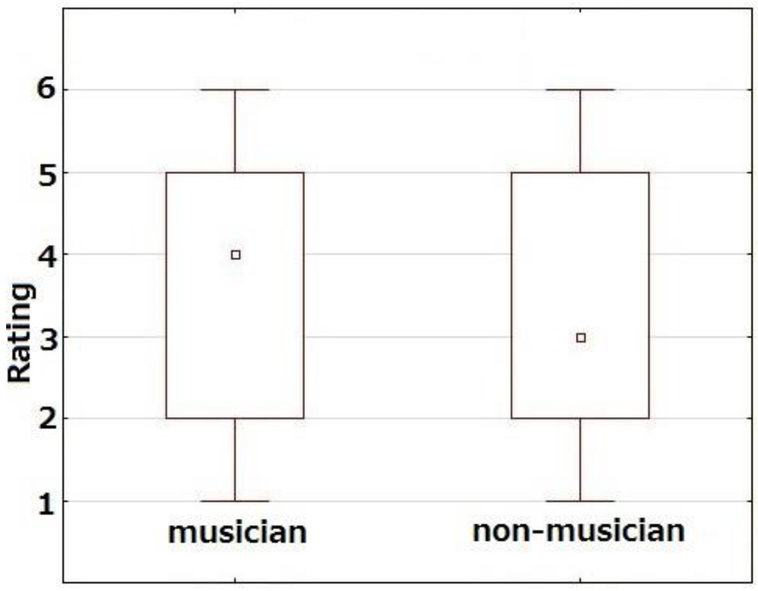
Non-Isochronous: SWSWWW-SWSWW

Clash: two strong elements were next to each other without length adjustments (as in SP); e.g.

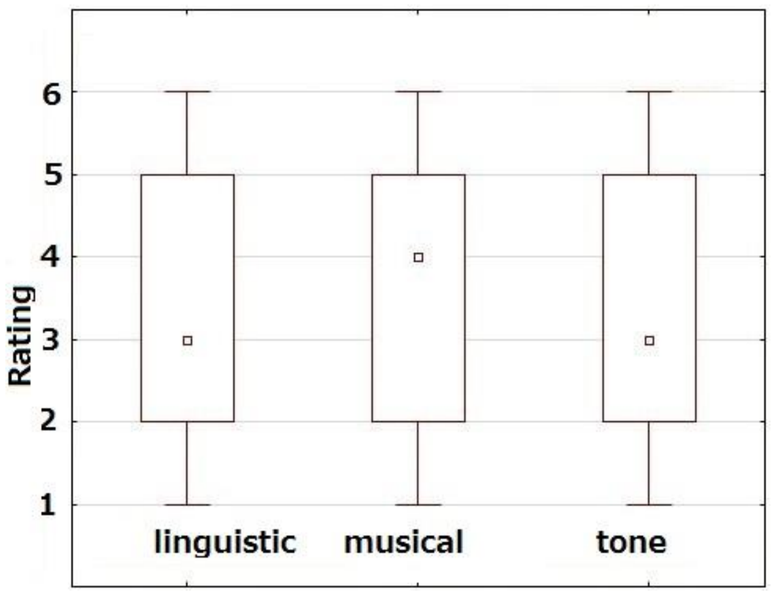
Isochronous: SSW-SWSW

Non-Isochronous: SSWW-SWSWW

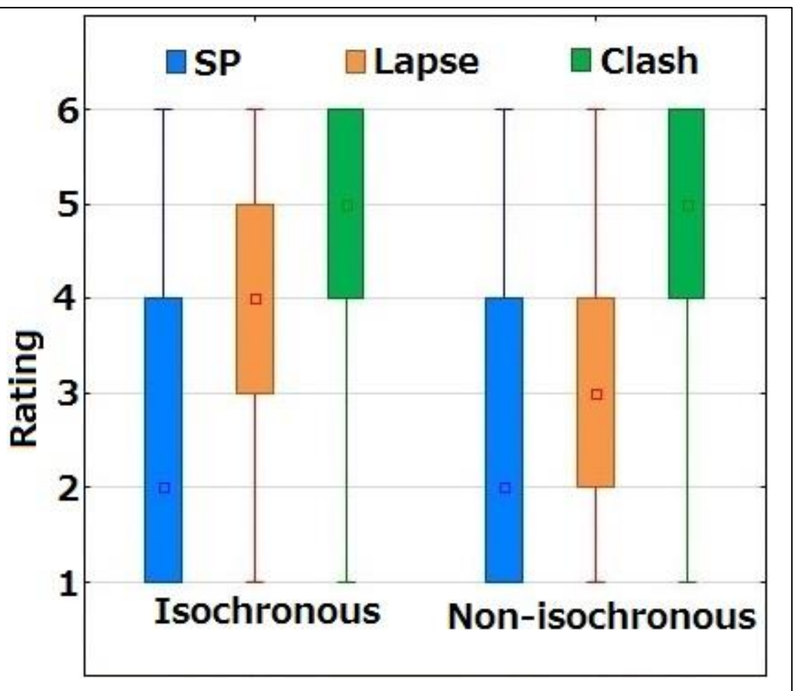
III. Results



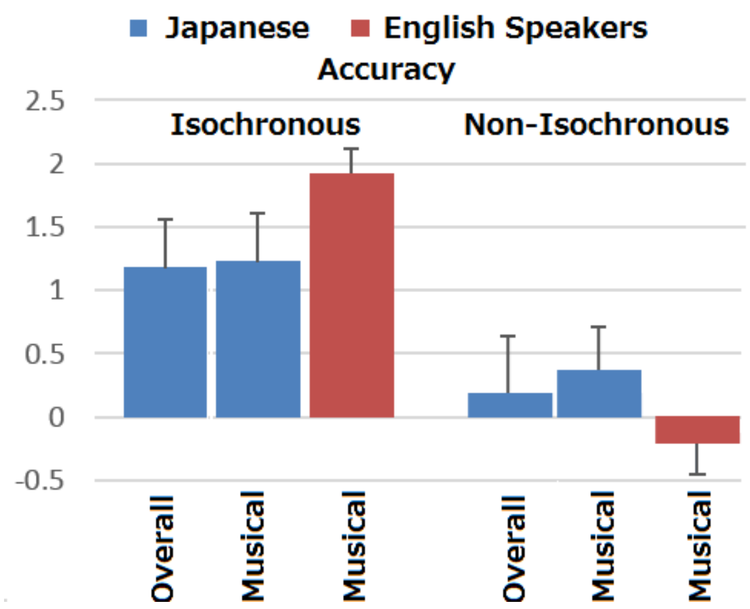
Musicians were more sensitive to rhythm changes than non musicians [Wald (1) = 6.78, $p > 0.01$]



There is no significant difference between types of stimuli [Wald (2) = 5.1, *n.s.*]



Both in isochronous and non-isochronous trials, clashes were more highly rated than lapses, i.e. clashes created a greater sense of dissimilarity than lapses did [Wald (2) = 2822.95, $p > 0.001$]



Accuracy is the difference between the mean rating for structure-violating stimuli and the mean rating for structure-preserving stimuli (error bars show SE). The English data are from Hannon & Trehub (2005), whose design is comparable to the one used here. The negative value for non-isochronous stimuli among English speakers suggests that they interpreted violations as non-violations (i.e. they did not detect violations) when rating non-isochronous stimuli. Japanese speakers, on the other hand, were more sensitive to rhythm changes in non-isochronous stimuli, but also somewhat less sensitive than the English speakers to changes in isochronous stimuli.

IV. Discussion and Conclusions

- Musical training seems to affect rhythm perception, making musicians more sensitive to rhythm changes than non-musicians (as would be expected)
- Similar ratings for the three types of stimuli (linguistic, musical and tonal) support the view that rhythm is processed in similar manner in these "modalities", though the present data do not support a specific direction of influence (from music to language or v.v.)
- Lower ratings of lapses than clashes suggests that Japanese speakers are more tolerant of lapses, possibly due to the frequency of lapses in Japanese
- Considering the perception of non-isochronous stimuli together with the data of Hannon & Trehub (2005), the present study suggests that differences in mother tongue rhythm can affect rhythm perception, particularly sensitivity to violations in rhythms one is familiar with

V. References

Hannon, E. E., and S. E. Trehub. 2005. Tuning in to musical rhythms: Infants learn more readily than adults. *Proceedings of the National Academy of Sciences of the United States of America* 102(35): 12639-12643.

Iversen, John R., A. D. Patel, and K. Ohgushi. 2008. Perception of rhythmic grouping depends on auditory experience. *JASA* 124(4): 2263-2271.

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