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The relationship between the human body, motor tasks, mood and musicality: How do you feel the beat?

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ABSTRACT

Embodied rhythm encompasses the notion that perceptual preferences are constrained by physical factors, may be goal-orientated and guided by cultural/environmental influences (Leman, 2008). A study by Todd, Cousins & Lee (2007) yielded evidence suggesting that body size is a possible determining physical factor in beat perception, i.e. the larger the body, the longer the preferred beat period (PBP). We report here a follow-up experiment investigating the relationship between body size, performance on motor tasks, and PBP, and possible mediating effects of musicality and mood state. 40 subjects completed a mixed design experiment, incorporating anthropometric measurements, motor tasks (walking and tapping, estimating preferred step period and spontaneous inter-tap interval respectively), psychometric tests of mood, and a measure of musicality, alongside the perceptual paradigm estimating PBP used by Todd et al. (2007). Using a variety of methods of statistical analysis, we found some evidence of a positive relationship between (some) anthropometric variables and both preferred step period and PBP, as predicted, as well as suggestive evidence of effects of musicality and mood variables.

Background

The idea that there is a link between musical rhythm and physical motion is a very old one (see e.g. Todd, 1995), and one which is well supported by experimental evidence: in particular of the coincidence of preferred tempi in music with walking cadences and the periodicities of other motor tasks such as finger-tapping (Fraisse, 1982; MacDougall & Moore, 2005; Moelants, 2002; van Noorden and Moelants, 1999). Most importantly, there is now growing evidence of a link between movement and rhythm *perception* (see e.g. Trainor, 2007, for a review), supporting a more general view that perceptual preferences are constrained by physical factors (Leman, 2008). A study by Todd, Cousins & Lee (2007) added to this evidence with findings which suggested that an important physical factor constraining one's perceptual rhythmic preferences is one's own body: they found a relationship between body size, as measured by standard anthropometric indices, and preferred beat period (PBP), as measured by performance on a perceptual task.

A number of questions arise from their study. The first concerns the nature of the relationship between anthropometric factors and perception. If, as hypothesized, it is mediated by locomotion, then following Repp (2007), there should be stronger relationships between locomotion (specifically, preferred step period) and anthropometry and between locomotion and perception than between anthropometry and perception. The second concerns the importance of cultural factors. Styns, van Noorden, Moelants & Leman (2007), following MacDougall and Moore (2005), suggested that the perception of pulse may be due to a culturally determined internalized model of the locomotion system rather than one driven by one's own body mechanics as claimed by Todd et al (2007). Whether or not this conclusion is justified, it is likely that PBP will be influenced by musical training and enculturation, as evidenced by their effect on performance in synchronization tasks (e.g. Drake & El Heni, 2006; Drake & Penel, 2000; Repp, 2010; see also Morrison & Demorest, 2009, for a more general perspective). The third concerns the possible influence of mood. Given the influence of mood (and bodily states more generally) on visual judgements (see Proffitt, 2006, for a review), then as Repp (2007) speculated, there may also be an effect on PBP.

Aims

We tested three hypotheses:

1. There is a positive relationship between anthropometric variables and PBP (i.e. the bigger the body, the longer the PBP), as reported by Todd et al (2007).

2. Preferred step period is influenced by anthropometric variables and is a strong predictor of PBP.

3. Performance on all tasks is influenced by mood and musical training.

Method

40 subjects (20 females and 20 males) took part in the mixed design experiment, incorporating anthropometric measurements, motor tasks (walking and tapping, estimating preferred step period and spontaneous inter-tap interval respectively), psychometric tests of mood (POMS SF), and a measure of musicality (Goldsmiths Musical Sophistication Index), along with a perceptual paradigm estimating PBP first used in Todd et al (2007).

Results

In principle, this hypothesised set of complex relationships between observable and also latent variables (e.g. PBP) would suggest an analysis using structural equation modelling (SEM) to model all relationships simultaneously. However, with a sample size of n=40 and the high number of parameters to be estimated SEM approaches tend not to converge on stable solutions that would allow generalisability to a larger population. Thus, instead we will use a combination of techniques to investigate the evidence for the three hypotheses individually.

Bivariate correlations failed to uncover any significant relationship between anthropometric measures and PBP or between PBP and preferred step period, though there were significant correlations between female height and preferred step period ($r = 0.52$, $p = 0.002$), between female spontaneous inter-tap interval and PBP ($r = -0.58$, $p = 0.009$) and male levels of depression and PBP ($r = 0.51$, $p = 0.035$). We also found no significant relationships between anthropometric variables and spontaneous inter-tap interval for either gender, although we did find a significant influence of preferred step period on spontaneous inter-tap interval using the Approximative General Independence Test ($p = 0.005$, two tailed) for males only.

We found high inter-correlational patterns between the five indicators of body size, suggesting that these five variables can be reduced to one general factor using factor analysis. We therefore performed a maximum-likelihood principal factor analysis extracting only one factor (Body Size) which explained 62.4% of the variance in the correlation matrix. All five indicators had high loadings (all > .48) on this factor. We obtained a Pearson's correlation coefficient between step period and body size of .38 which was significant for our dataset ($p= .028$, 1-tailed). However, only 14.7% of the variance in the gait data is explained by the body size of the participants, suggesting that other variables also influence gait.

Multiple regression revealed that when the mood variables of vigour and depression were accounted for (separately), the study partially supported the evidence previously found by Todd et al (2007), at least for males: mood appeared to mediate the relationships between shoulder breadth and PBP ($r = .745$, $r^2 =.555$, $p =.012$). We checked these results using the non parametric Approximative General Independence Test (AGIT): it also suggested a significant influence of shoulder breadth on PBP for males ($p = 0.012$). The same AGIT test did not find a significant relationship for females between anthropometric variables and PBP. However, using multiple regression, we found the GOLD MSI variable 'musical perception and production abilities' appeared to mediate the relationship between height and PBP ($r = .740$, $r^2 = .548$, $p = .007$) for females and females only.

Conclusions

By utilising several methods of statistical analysis we have shown that there is a positive relationship between anthropometric variables and preferred step period. We have also found some evidence of a relationship between anthropometric variables and PBP (though more convincingly for males than females), thereby partially corroborating Todd et al.'s (2007) original findings, but not between PBP and preferred step period. Further investigation is needed in order to elucidate the possible effects of mood and musicality suggested by some of our findings, and to explore more fully the differences between males and females.

Keywords

Anthropometric; Embodied Rhythm; Preferred Beat Period; Gait (Preferred Step Period); Inter Tap Interval

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