



Dancers' Auditory Perception of Microtiming Deviations Within Drum Grooves

Purpose

The purpose of this descriptive study is to investigate the differences in microtiming discrimination—the perception of rhythmic fluctuations at the millisecond level—between dancers, percussionists, and participants inexperienced in formal musical or dancing instruction. This study aims to produce correlative data that can provide insight for music educators when teaching with popular music, multicultural music, and movement or dancing in the classroom.

Method & Results

The participants completed an "A-Not-AR with Sureness" discrimination task online where they compared 12 reference drum samples (three for each musical style) with several variations of each sample in a random order within blocks, for a total of 48 pairs. The original, unaltered sample was always presented first, followed by either the identical sample or one with a microtiming deviation. The subjects had to determine if the second audio sample was A or Not A, and indicate their level of confidence by deciding if they were sure, not sure, or guessing their answer. The altered drum samples differed only in swing ratio with microtiming deviations of ±10ms, 20ms, and 40ms. Musical styles included Latin, jazz, and hip-hop, as well as snare drum patterns. Receiver operating characteristic (ROC) was used to plot correct detections versus false positives with the area under the curve (AUC).

Participants

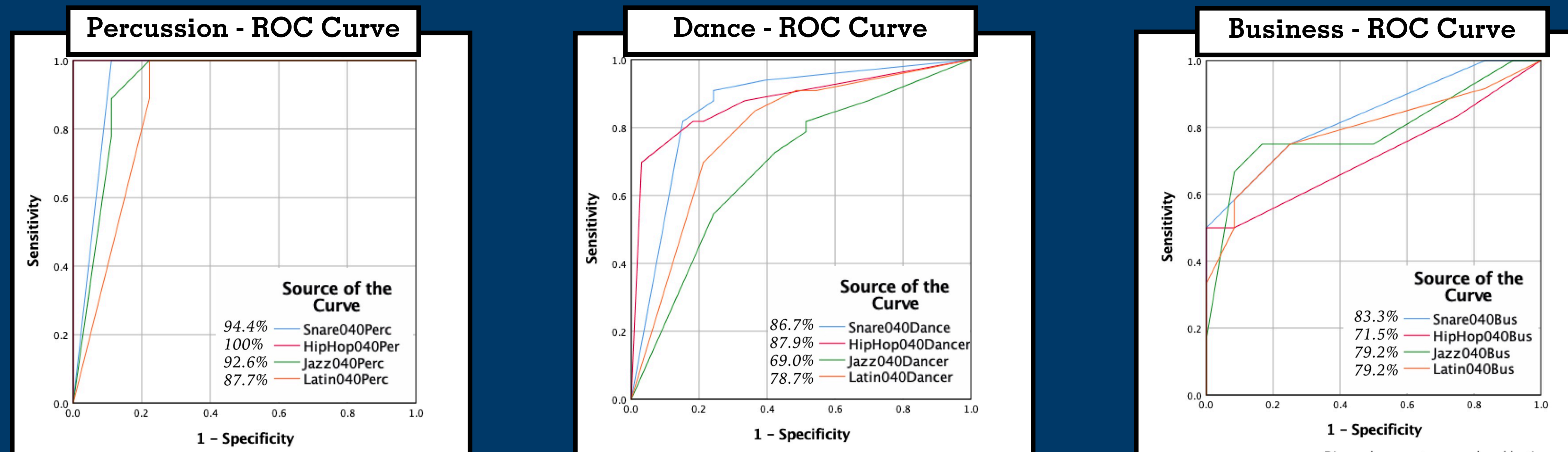
Group	n	Mean Age	Musical Instr.	Dancing Instr.
Percussion	3	22.67 SD=2.5	10.0 yrs SD=4.0	0.33 yrs SD=0.6
Dance	11	36.8 SD=16.5	10.3 yrs SD=13.6	27.4 yrs SD=17.7
Business	4	23.3 SD=4.4	1.0 yrs SD=1.0	0.75 yrs SD=1.0

Research Questions

1. How do dancers' auditory perception of microtiming deviations in drum grooves in various styles of music differ from percussionists and participants inexperienced in formal musical or dancing instruction?
2. To what extent does dancing experience in a specific musical style affect the microtiming discrimination of the participant?

Background

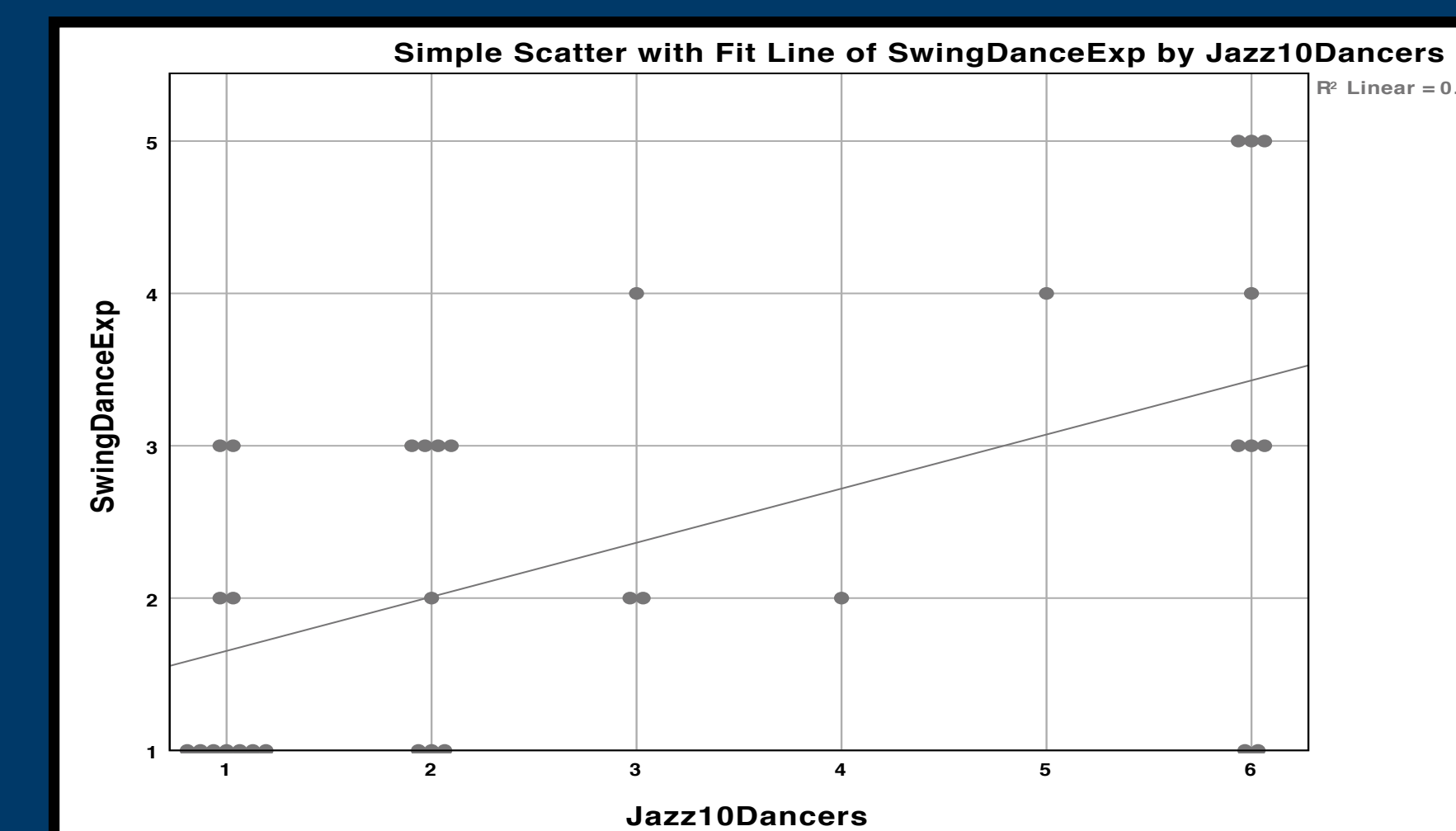
- Groove can be defined as the innate feeling of wanting to move some part of your body along with the music (Davies, Madison, Silva, & Gouyon, 2013)
- Music cognition researchers have documented the neurological relationship between movement and musical rhythms (Bengtsson et al., 2009; Grahn & Brett, 2007; Leow, Parrott, & Grahn, 2014; Loehr & Palmer, 2009; Thaut, 2009; Thaut, Trimarchi, & Parsons, 2014; Trainor et al., 2009; Witek et al., 2014)
- It has also been established that percussionists have a higher microtiming discrimination than nonmusicians (Davies, Madison, Silva, & Gouyon, 2013; Rammsayer & Altenmüller, 2006; Rammsayer, Buttkeus, & Altenmüller, 2012)
- Popular approaches to music teaching include elements of learning rhythm through movement, including Dalcroze Eurhythmics, Orff Schulwerk, Kodály, and Music Learning Theory. (Abramson, 1980; Anderson, 2011; Bowyer, 2015; Caldwell, 1993; Gordon, 2012; Juntunen & Hyvönen, 2004; Mead, 1994; Shamrock, 1986)



Group	Snare			Hip-Hop			Jazz			Latin		
	AUC	Error ^a	p ^b	AUC	Error ^a	p ^b	AUC	Error ^a	p ^b	AUC	Error ^a	p ^b
Percussion	.944	.064	.001	1.000	.000	.000	.926	.072	.002	.877	.092	.007
Dance	.867	.048	.000	.879	.045	.000	.690	.066	.008	.787	.058	.000
Business	.833	.084	.006	.715	.110	.073	.792	.098	.015	.792	.097	.015

Group	Snare				Hip-Hop				Jazz				Latin			
	Area Diff.	Error ^a	z	p	Area Diff.	Error ^a	z	p	Area Diff.	Error ^a	z	p	Area Diff.	Error ^a	z	p
Percussion vs. Dance	.077	.074	1.034	.300	.121	.044	2.778	.003**	.236	.094	2.514	.012*	.090	.103	.087	.383
Percussion vs. Business	.111	.104	1.069	.285	.285	.106	2.674	.007**	.134	.116	1.156	.248	.085	.128	.066	.506
Dance vs. Business	.034	.097	.351	.726	.164	.115	1.425	.154	-.102	.115	-.373	.187	-.005	.110	-.046	.964

Correlation between self-reported dancing experience (1-5) and A-Not AR with Sureness (Dancers Only)							
Dancing Style	Mean Experience	Pearson -10ms	p	Pearson -20ms	p	Pearson -40ms	p
Swing	2.36 SD=1.36	.559**	.001	.289	.103	-.113	.532
Hip-Hop	2.4 SD=0.84	-.159	.377	-.464**	.006	-.200	.265
Salsa/Latin	2.6 SD=1.43	.195	.278	.151	.401	-.199	.268



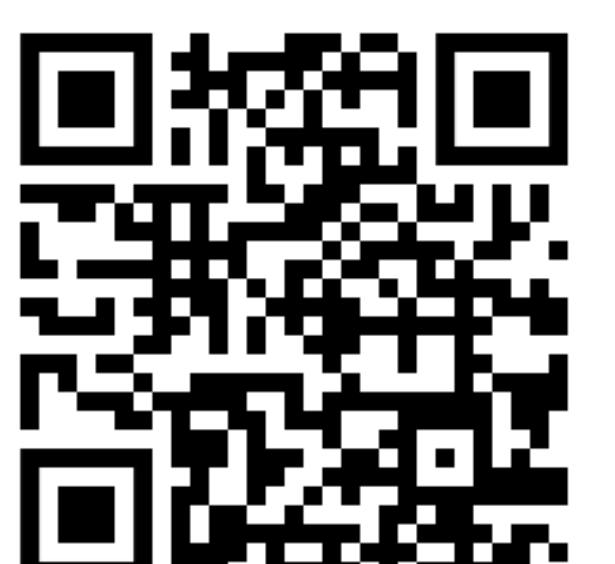
Discussion

Preliminary analysis indicates that the percussionists group were able to perceive the 40ms microtiming deviations with more confidence than the other two groups, supporting previous research on the superior rhythmic acuity of percussionists. However, due to high variance and a small sample size, a significant difference could not be established between the three groups. There is a statistically significant, positive, and strong correlation between the dance group's self-reported swing dancing experience and their composite mean of -10ms jazz variations. $r_{(n=11)} = +.559, p = .001$. The results were not consistent with the hip-hop and Latin samples. Additional analysis is required to determine the difficulty of each drum sample and the consistency of each participant's use of the sureness scale. As research on beat perception and synchronization of dancers is still in its infancy, this pilot study helps lay the groundwork for future investigations on this topic.

Future Research

- Expand the study with a larger sample size
- Recruit subjects with any music or dancing experience
- Include more styles of music
- Compare microtiming discrimination before and after dancing instruction in specific styles of music
- Determine to what extent audiation is a factor

References and abstract can be found at www.benguerrero.com/grooveperception or scan the QR code



*. Correlation is significant at the 0.05 level (2-tailed).
**. Correlation is significant at the 0.01 level (2-tailed).
a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5