Tapping doesn't help: Perception-Action Dissociation in Musical Tempo Judgment

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Speed on the dance floor: Auditory and visual cues for musical tempo ☆

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ABSTRACT

Musical tempo is most strongly associated with the rate of the beat or "tactus," which may be defined as the most prominent rhythmic periodicity present in the music, typically in a range of 1.67–2 Hz. However, other factors such as rhythmic density, mean rhythmic inter-onset interval, metrical (accentual) structure, and rhythmic complexity can affect perceived tempo (Drake, Gros, & Penel, 1999; London, 2011Drake, Gros, & Penel, 1999; London, 2011). Visual information can also give rise to a perceived beat/tempo (Iversen, et al., 2015), and auditory and visual temporal cues can interact and mutually influence each other (Soto-Faraco & Kingstone, 2004; Spence, 2015). A five-part experiment was performed to assess the integration of auditory and visual information in judgments of musical tempo. Participants rated the speed of six classic R&B songs on a seven point scale while observing an animated figure dancing to them. Participants were presented with original and time-stretched (±5%) versions of each song in audio-only, audio + video (A + V), and video-only conditions. In some videos the animations were of spontaneous movements to the different time-stretched versions of each song, and in other videos the animations were of "vigorous" versus "relaxed" interpretations of the same auditory stimulus. Two main results were observed. First, in all conditions with audio, even though participants were able to correctly rank the original vs. time-stretched versions of each song, a song-specific tempo-anchoring effect was observed, such that sped-up versions of slower songs were judged to be faster than slowed-down versions of faster songs, even when their objective beat rates were the same. Second, when viewing a vigorous dancing figure in the A + V condition, participants gave faster tempo ratings than from the audio alone or when viewing the same audio with a relaxed dancing figure. The implications of this illusory tempo percept for cross-modal sensory integration and working memory are discussed, and an "energistic" account of tempo perception is proposed.

Speed on the Dance Floor

Based on Janata, Tomic, et al (2012) the following pieces were used as stimuli for this experiment:

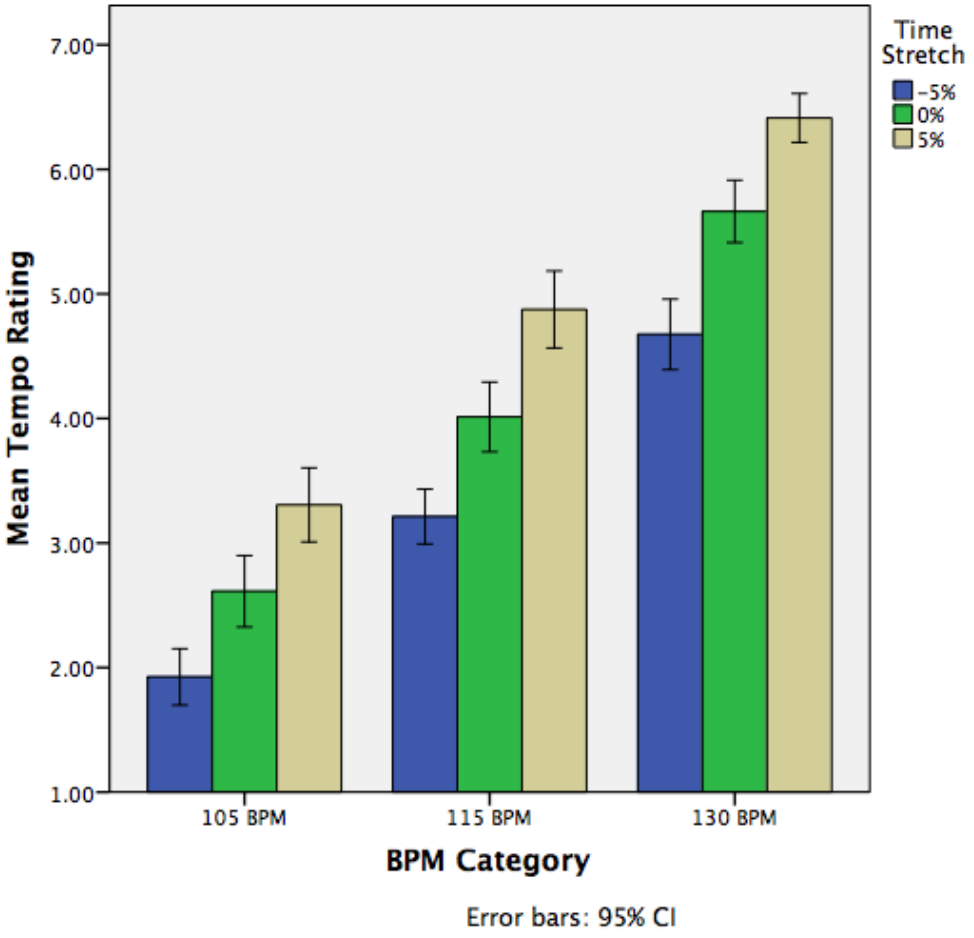
Artist	Title	Original BPM	Flux	R&B Chart
Temptations	Get Ready	134.5	High	#1 (1966)
Supremes	Where Did Our Love Go?	133	Low	#1 (1964)
Supremes	Stop, In the Name of Love	117	High	#2 (1964)
Wilson Pickett	The Midnight Hour	113	Low	#1 (1965)
Stevie Wonder	Signed, Sealed, Delivered	105.5	High	#1 (1970)
Temptations	My Girl	103	Low	#1 (1964)

Speed on the Dance Floor

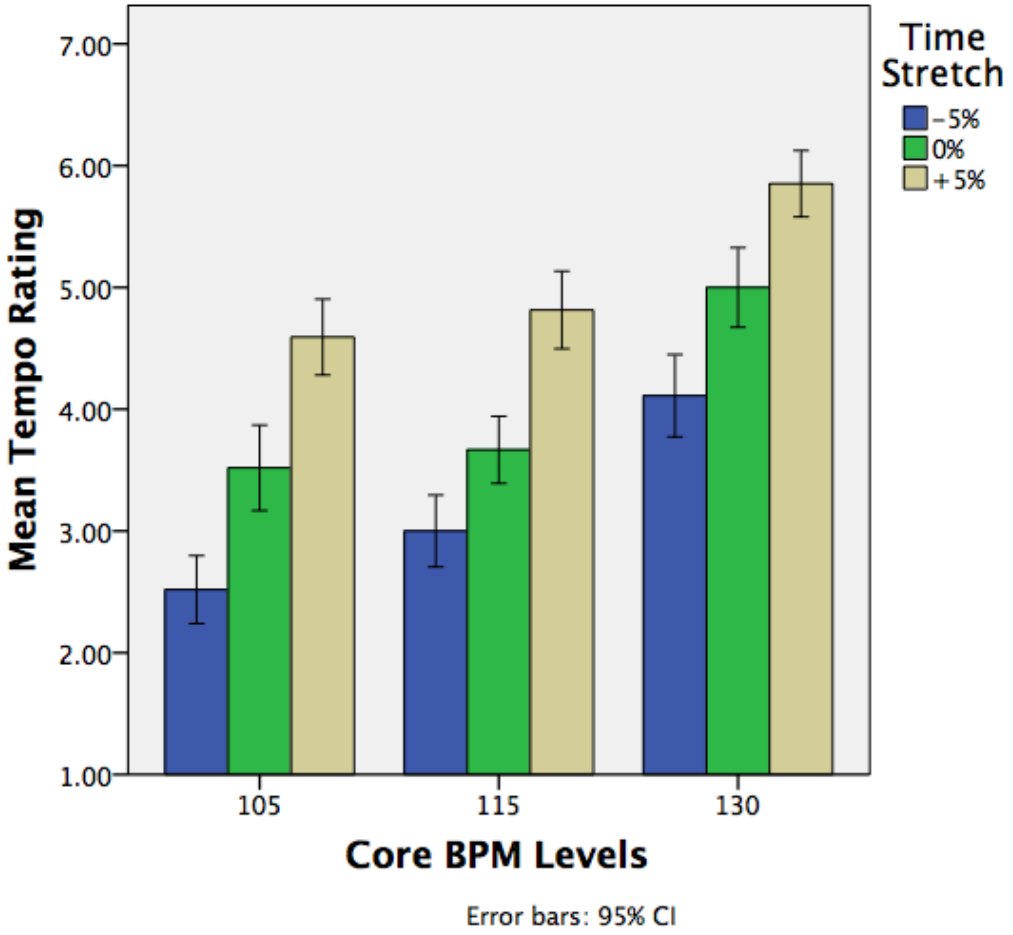
Experimental Design and Task

- Participants given audio presentation of stimuli
  - Stimuli at original and time-stretched (±5%) Tempos
  - Randomized order for each participant
- Experimental Task: judgment of musical speed (and not simply BPM) on a 7-point scale.

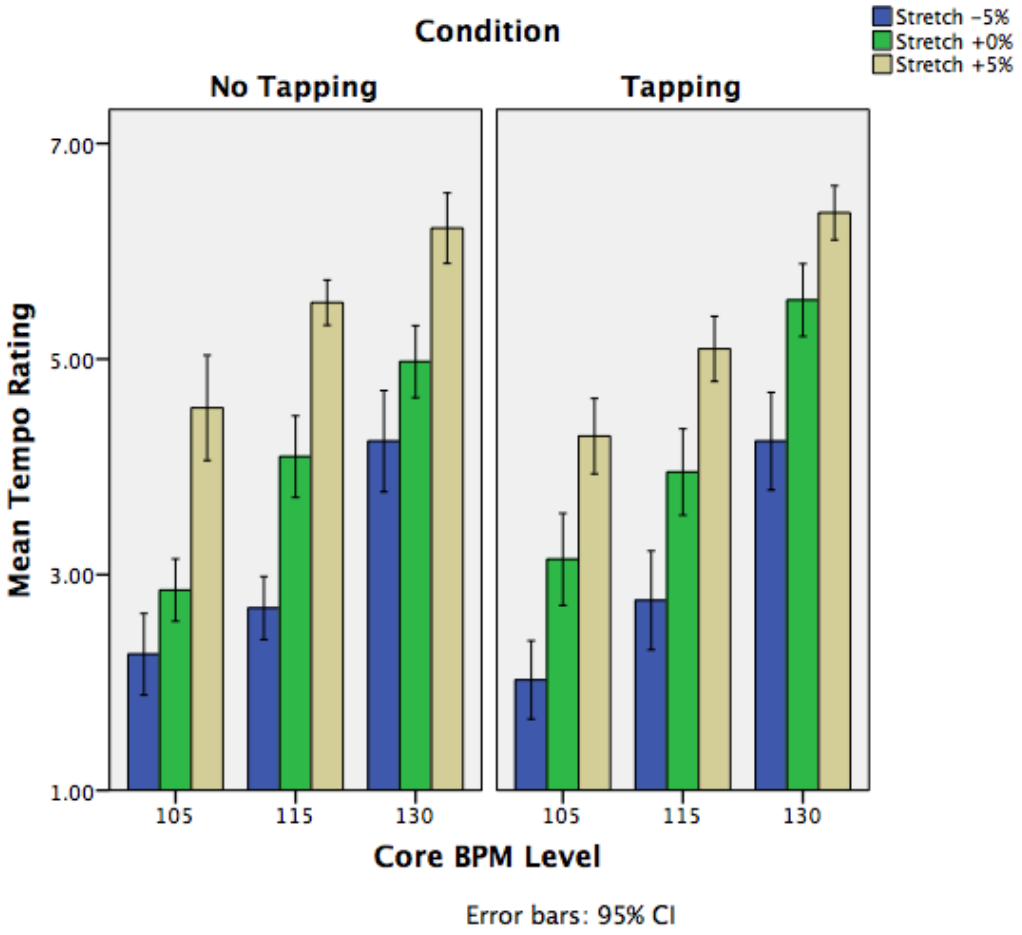
Expected Result



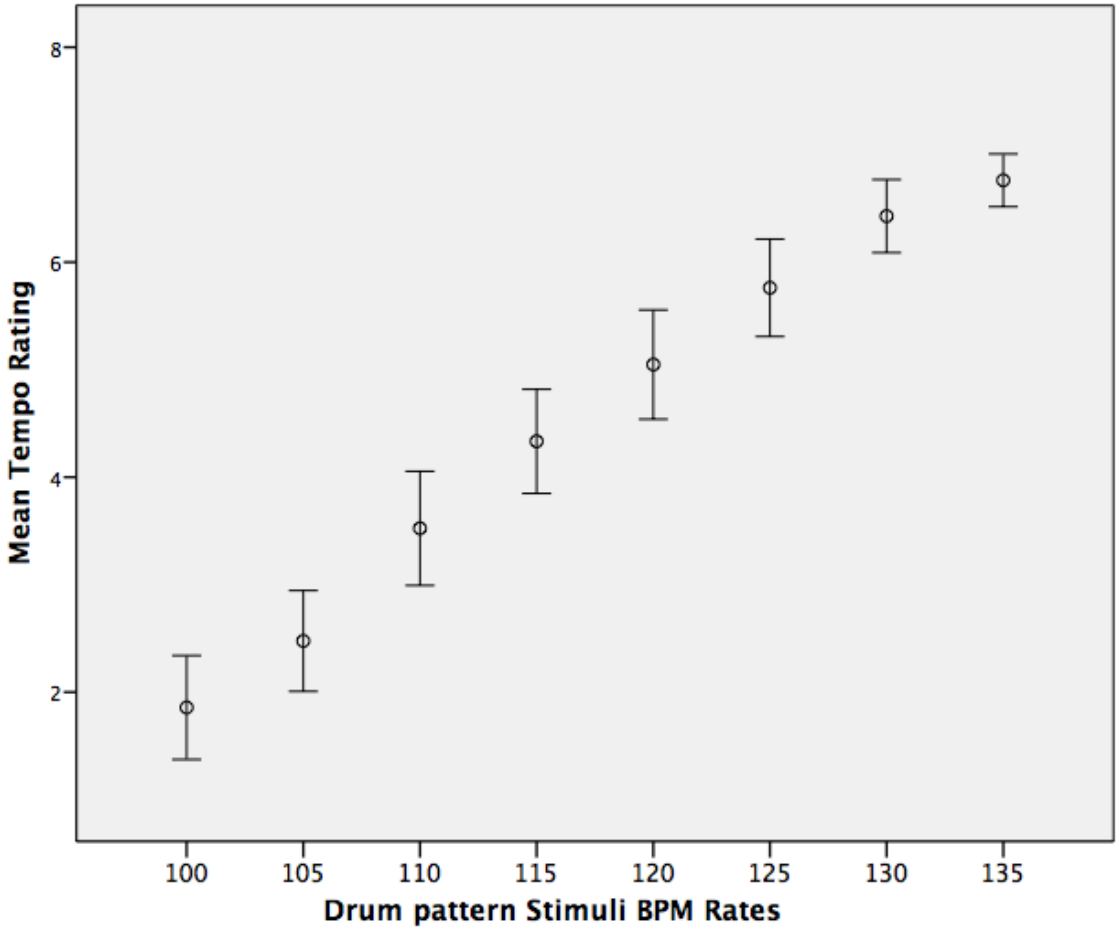
Actual Result



New Experiment: Tapping



Drum Patterns Accurately Rated



Tapping Was Accurate

Tapping Data, Averaged across all participants (all measurements in milliseconds; corrected for octave errors.)

BPM Categories	**135**	**130**	**125**	**120**	**115**	**110**	**110**	**105**	**100**
Objective IOI	438	462	485	496	522	548	543	570	600
Mean tapping IOI	443	462	486	496	516	545	541	560	591
SD of tap IOI	43	41	43	47	55	44	60	65	54
Objective vs. Avg.	-5	0	-1	0	6	4	2	10	9

A Perception-Action Dissociation?

- Perception-action dissociations have been found in vision
  - Grasping task with a Müller-Lyer Illusion cue
  - Eye tracking with a Roelofs effect
- Here we have some evidence for a dissociation in audition
  - Sensorimotor engagement is veridical
  - Cognitive judgment is not