The Beat Alignment Test (BAT): Surveying beat processing abilities in the general population

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Abstract

The ability to perceive a musical beat (and move in synchrony with it) seems widespread, but we currently lack normative data on the distribution of this ability in musically untrained individuals. To aid in the survey of beat processing abilities in the general population, as well as to attempt to identify and differentiate impairments in beat processing, we have developed a psychophysical test called the Beat Alignment Test (BAT). The BAT is intended to complement existing tests of rhythm processing by directly examining beat perception in isolation from beat synchronization. The goals of the BAT are 1) to study the distribution of beat-based processing abilities in the normal population and 2) to provide a way to search for "rhythm deaf" individuals, who have trouble with beat processing in music though they are not tone deaf. The BAT is easily implemented and it is our hope that it is widely adopted. Data from a pilot study of 30 individuals is presented.

Introduction

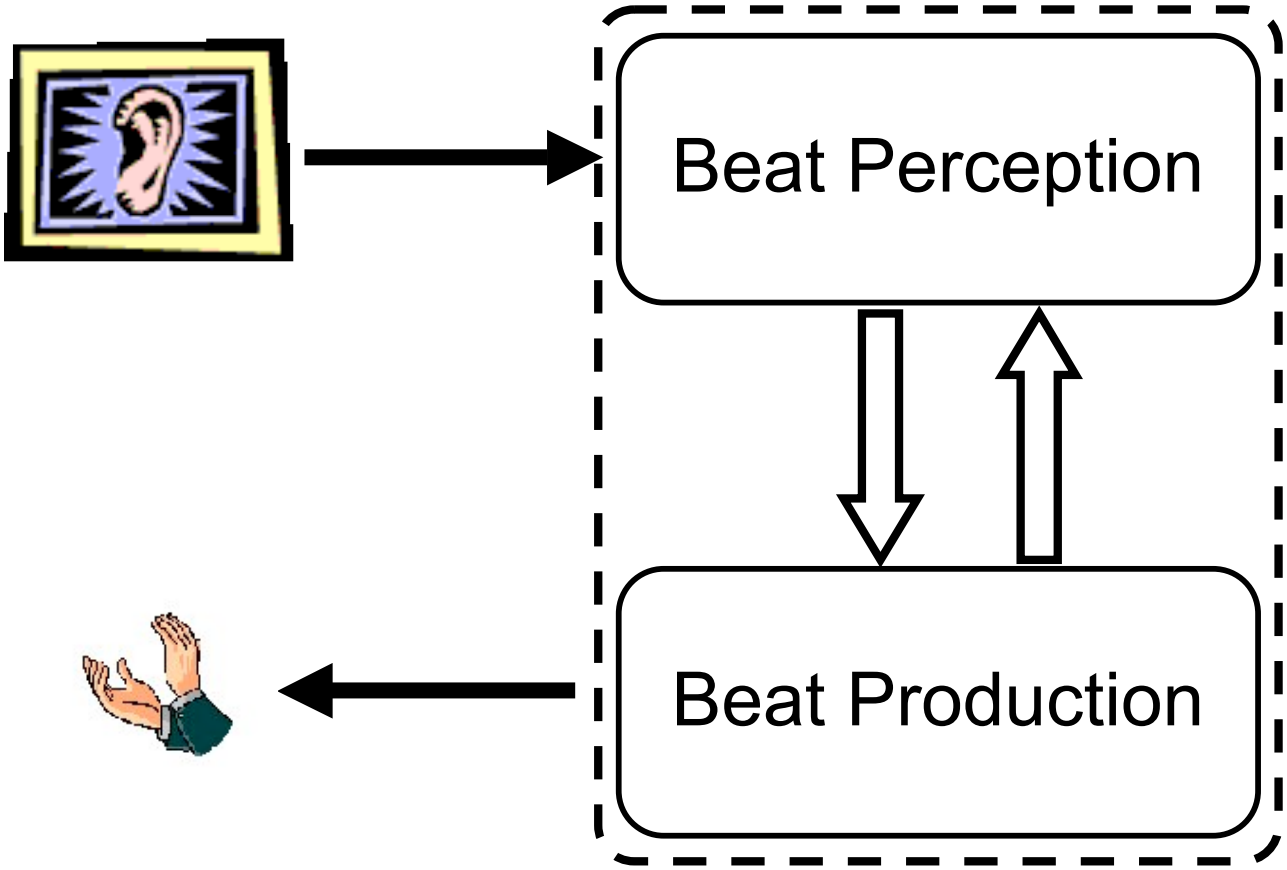
- How widespread is the ability to perceive (and move to) a musical beat?

- Goals
  - Survey beat processing abilities in the population
  - Identify selective impairments of beat processing

"Rhythm Deafness"

- Mostly anecdotal evidence
- Does it exist in a pure form?
  - i.e. not simply as a consequence of pitch perception impairments

Simple model of beat processing



Perception and Production

- How tightly coupled is performance on beat perception and production tasks?
  - Normal perception with impaired production?
- Cf. dissociations between deficits in pitch perception and production
  - (Dalla Bella, et al. 2007; Loui, et al. 2008)

Synchronizing with real music

- Few studies have investigated synchronization with real musical passages in musically-untrained individuals

  – E.g. Drake, et al. 2000; Snyder & Krumhansl, 2001

The BAT Test

- The Beat Alignment Test (BAT)
  - Easy, naturalistic
  - Musical excerpts from multiple genres
  - Complements existing tests
  - Examines beat perception in isolation from synchronization
  - Freely available

The BAT Test

- Subtests
  1) Synchronization with metronome
  2) Synchronization with musical passages
  3) Perception of beat in musical passages
  4) Questionnaire

Synchronization with a beat

- Spontaneous tapping at preferred tempo
- Synchronization with metronome
  - 400, 550, 700 ms IOI
- Synchronization with music

Testing perception of musical beat

- Judge if beeps superimposed on excerpts are "on the beat" or not.
  - Perturbations of tempo or phase:
    - On beat
    - Tempo error (+/- 10%)
    - Phase error (+/- 25% of beat period)

Musical Excerpts

Style	Piece	Artist
Rock	Hard to handle	Black Crowes
Rock	One way or another	Blondie
Rock	Hurts so good	J. Mellencamp
Rock	Panama	Van Halen
Jazz	1 o'clock jump	Benny Goodman
Jazz	Stompin' at the savoy	Benny Goodman
Jazz	Tuxedo junction	Glenn Miller
Jazz	King Porter stomp	Glenn Miller
Pop Orchestral	NY, NY	Boston Pops
Pop Orchestral	A chorus line	Boston Pops
Pop Orchestral	Superman	Boston Pops
Pop Orchestral	Richard Rogers Waltzes	Boston Pops

Average duration: 16s

Synchronization results

Variation in metrical level of synchronization

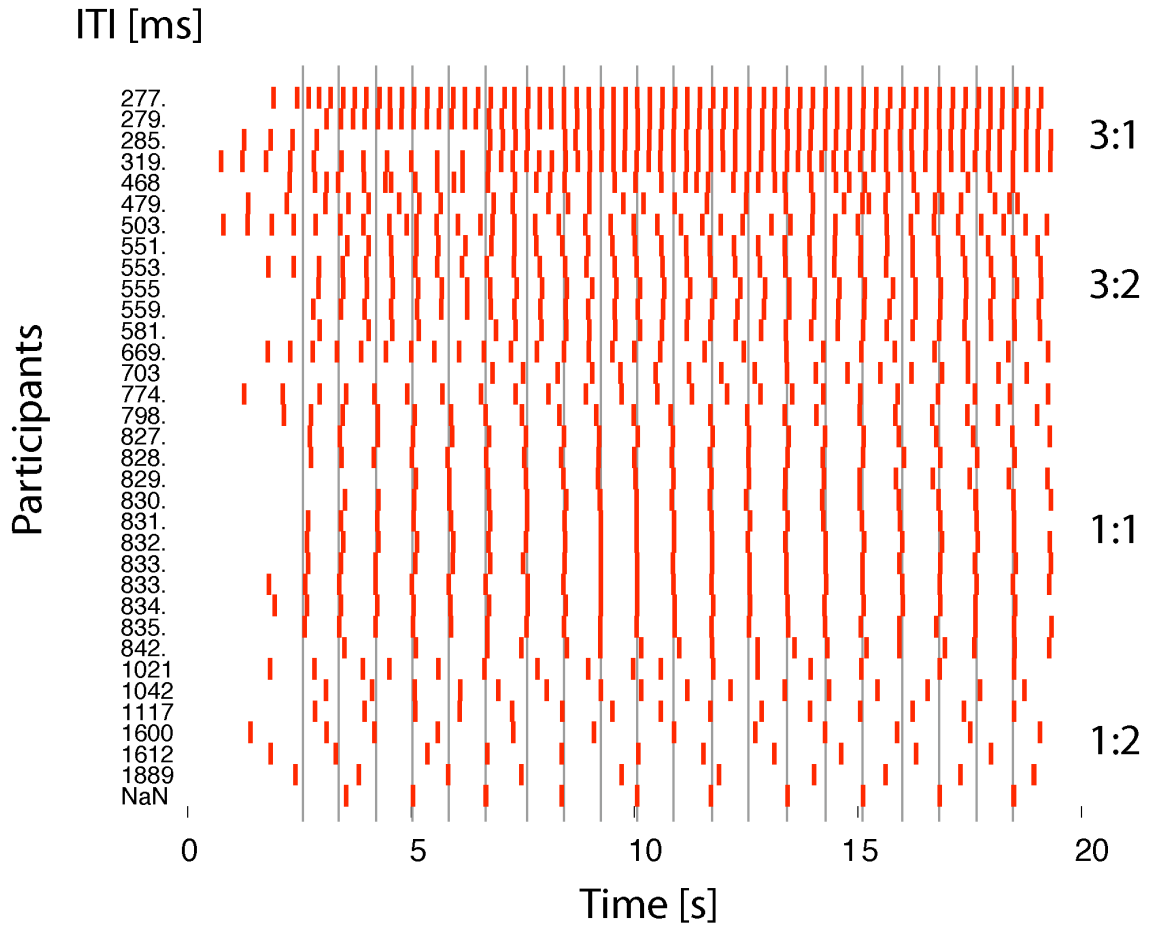


Figure 1. Example of all participant's synchronization to one musical excerpt (Richard Rodgers Waltzes). Gray lines indicate the musical beats; Red lines indicate time of each tap. Participant's mean ITI is shown.

Examples of tempo matching

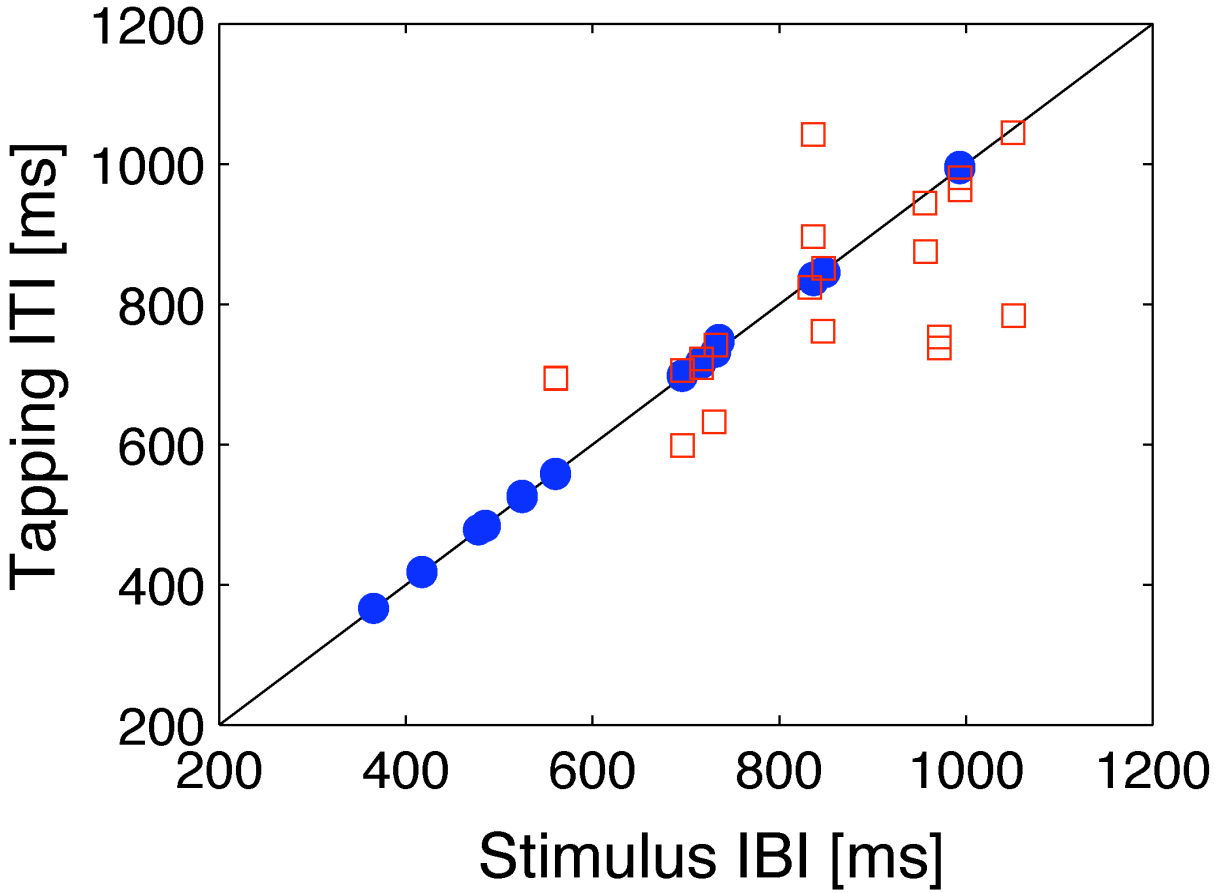


Figure 2. Examples of synchronization accuracy for two participants. Inter-tap interval (ITI) is plotted versus the tactus inter-onset interval (IOI) of the musical excerpt for all excerpts. Shown are a participant with excellent accuracy (filled circles) and the participant with the worst tempo accuracy (open squares).

Overall tempo tracking

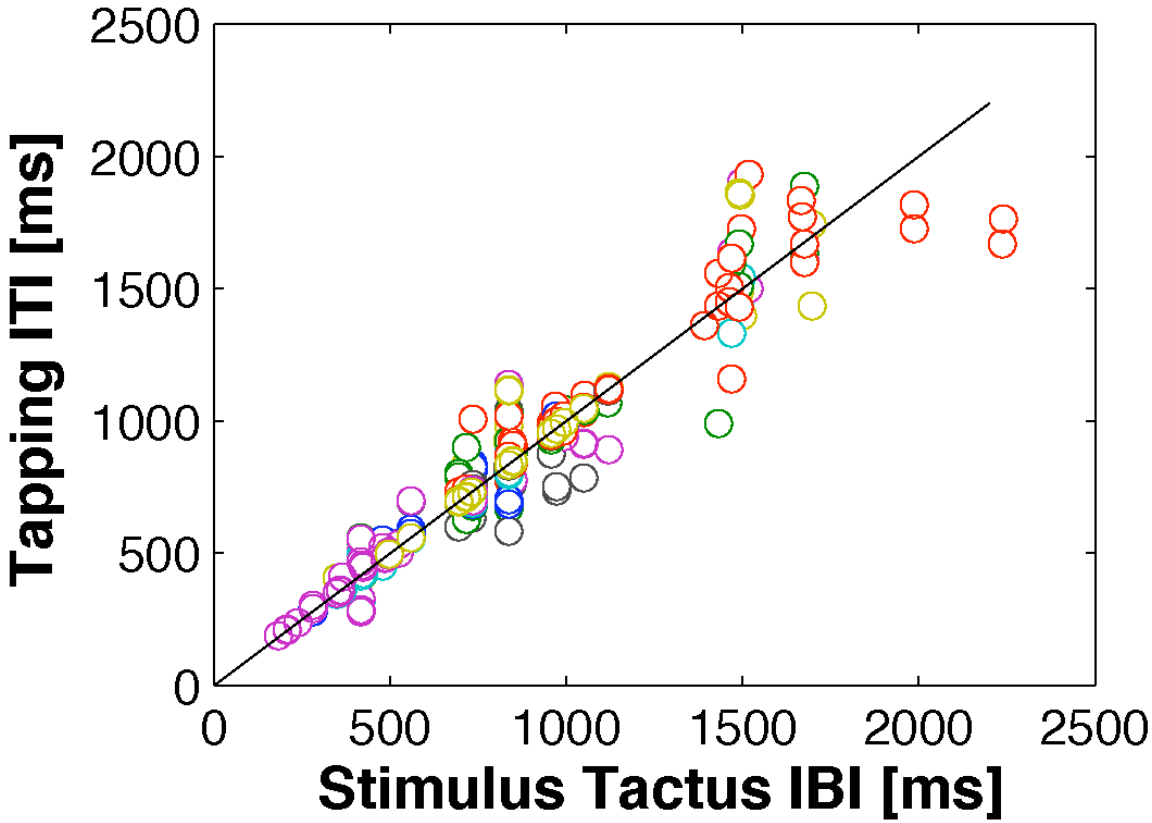


Figure 3. Synchronization performance across all participants and excerpts. Tapping ITI is plotted versus the tactus IOI of the musical excerpts, as in Figure 2.

Perception performance

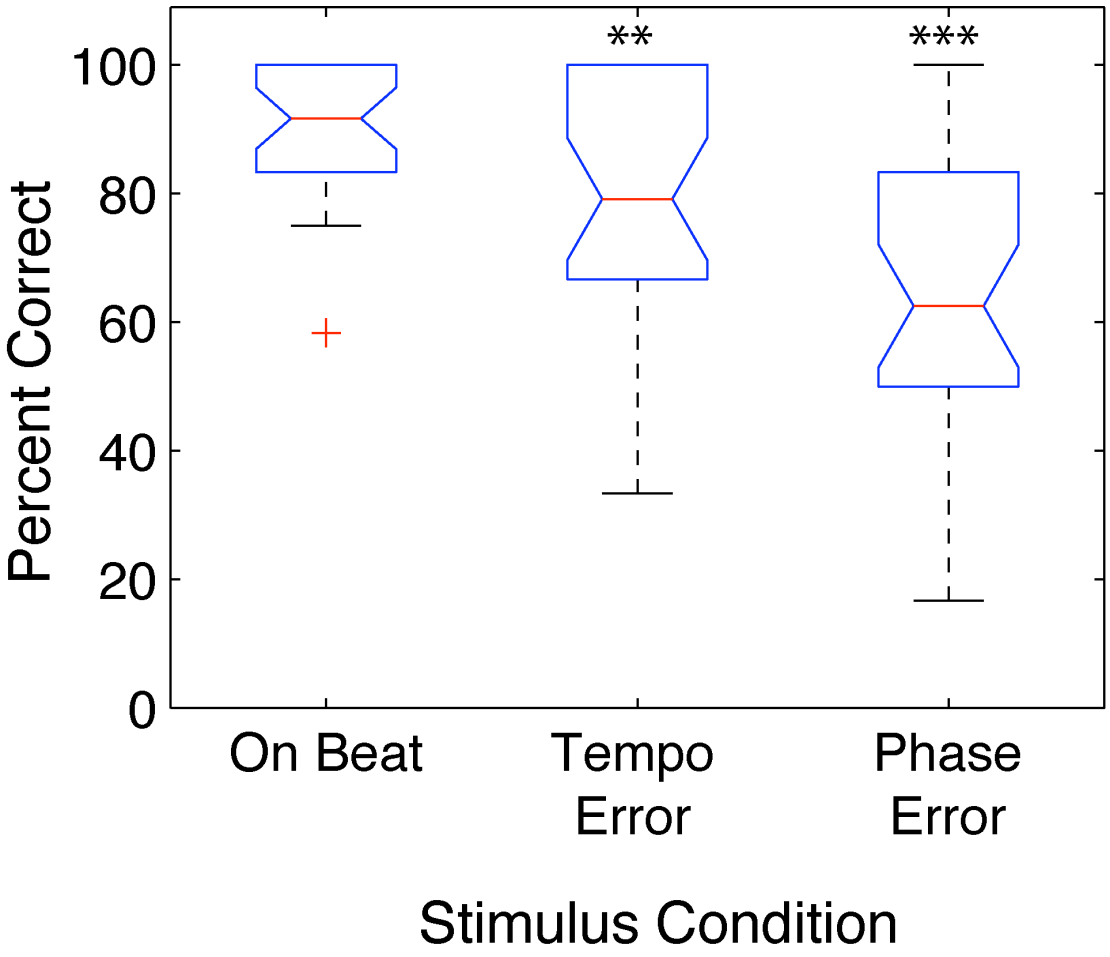


Figure 4. Beat perception performance across all 30 participants for three beat alignment conditions: on beat, tempo error, and phase error.

Perception and synchronization

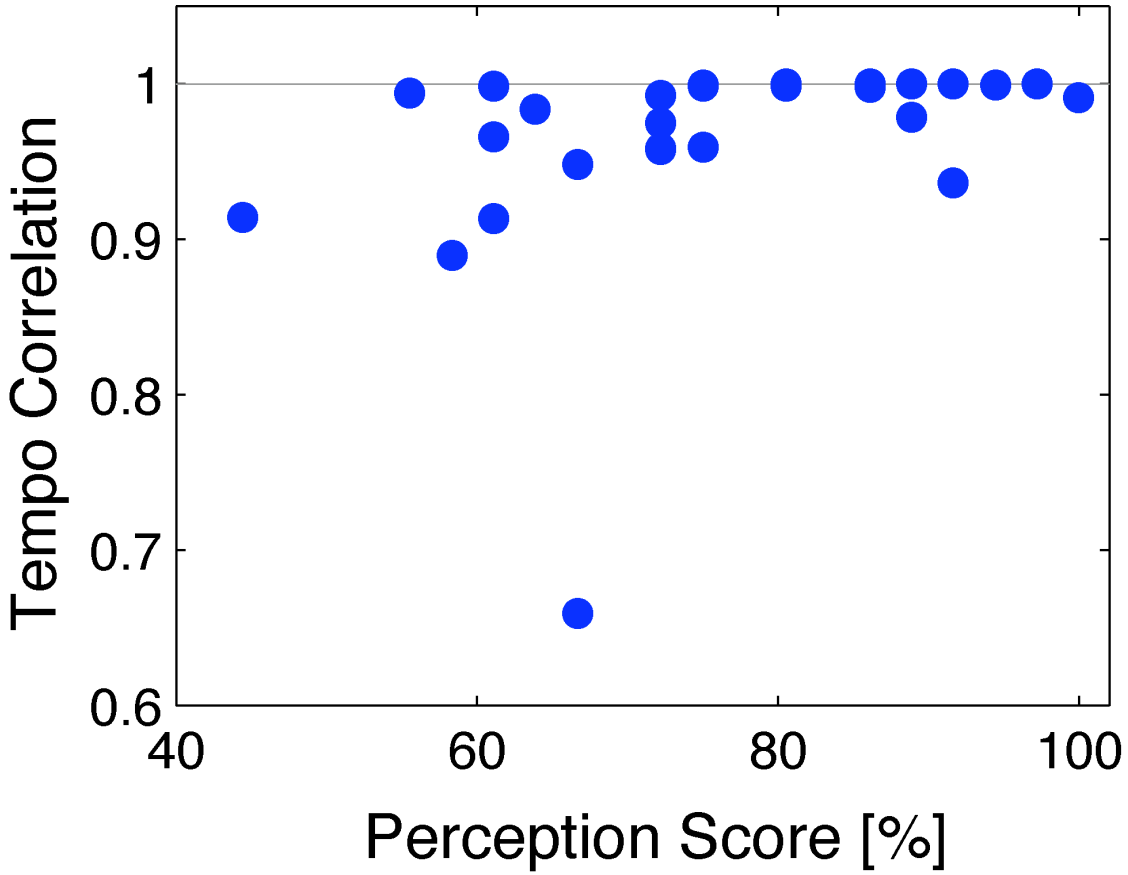


Figure 5. Correlation of tapping tempo and musical excerpt tempo vs. score on the perceptual task. Each point shows the mean across all excerpts for one participant.

Perception and synchronization 2

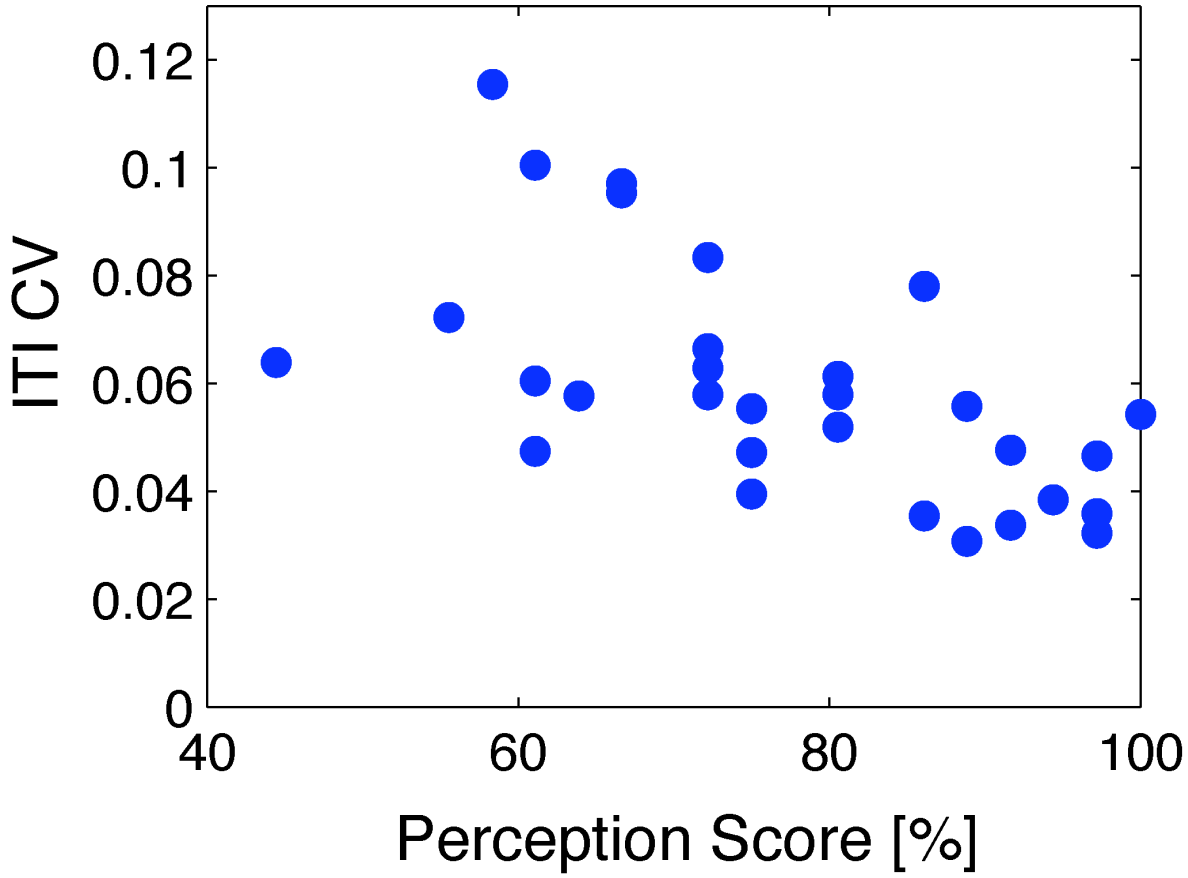


Figure 6. Variation in tapping (CV of ITIs) vs. score on the perceptual task.

Summary

- The BAT test was easily understood by non-musicians
- Synchronization
  - Tempo matching was generally good
- Perception
  - Synchronization performance correlated with perception score
- Future
  - Larger sample
  - Include MBEA

Join us!

- The BAT is easy to administer and freely available:
  - www.nsi.edu/users/iversen/bat/BAT_TEST.zip

References

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