

Pitch induces nonlinear illusory percepts of time

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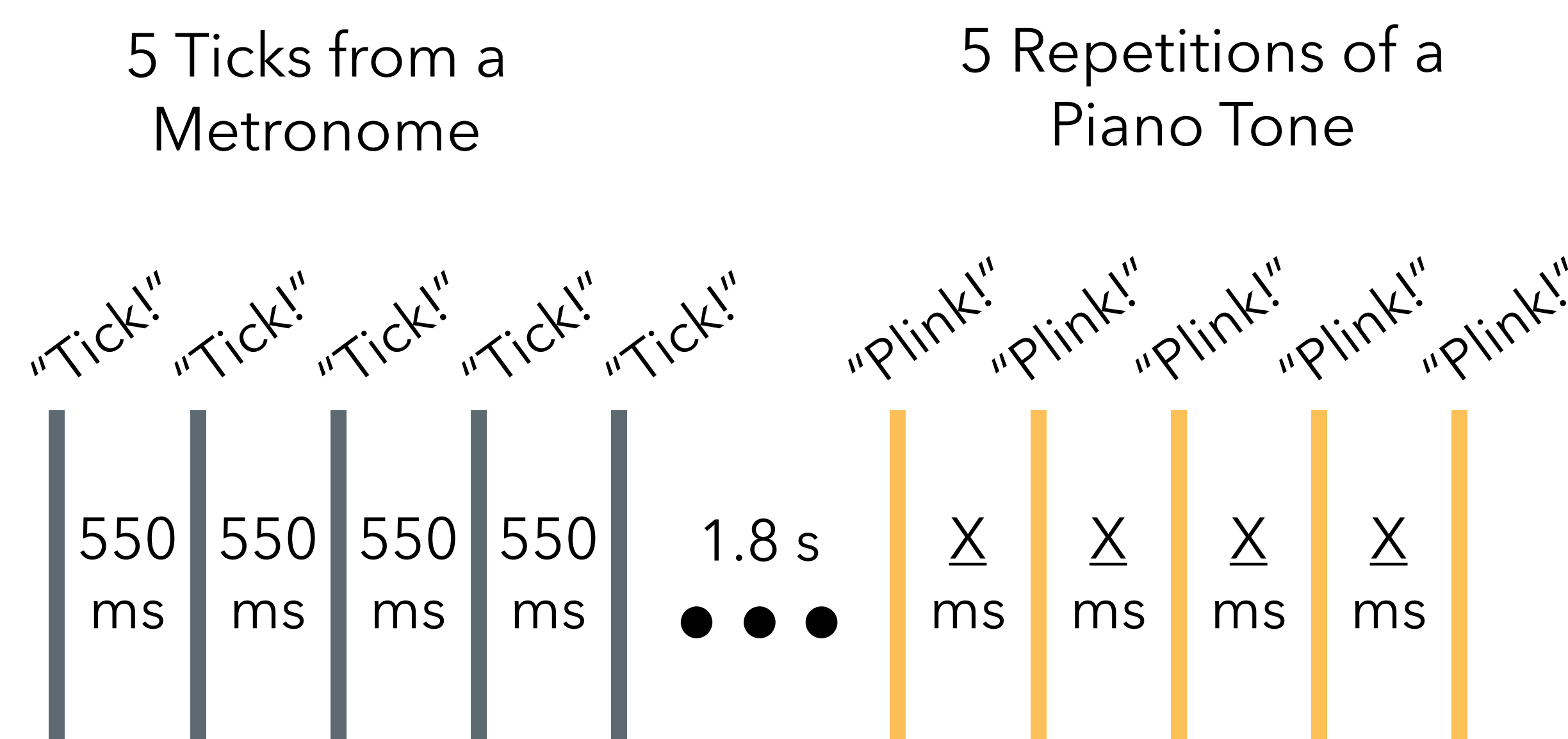
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Introduction

- Tempo is a critical cue to emotion in speech and music.^{1,5}
- Acoustic and contextual features can alter perceived tempo and induce illusions of tempo change.^{2,3,4}
- Humans perceive high-pitched speech/music as faster than low-pitched speech/music.^{3,4}
- Prior studies are limited by comparing only one lower register to one higher register, leaving pitch height confounded with other factors.
- **Research Questions:**
 1. Is the influence of pitch consistent across the entire frequency spectrum?
 2. Does the influence of pitch vary with tempo?
 3. Do synchronous movements enhance or attenuate illusory tempo effects?
 4. Can illusory tempo effects be observed in a non-musical/non-language context?

Methods

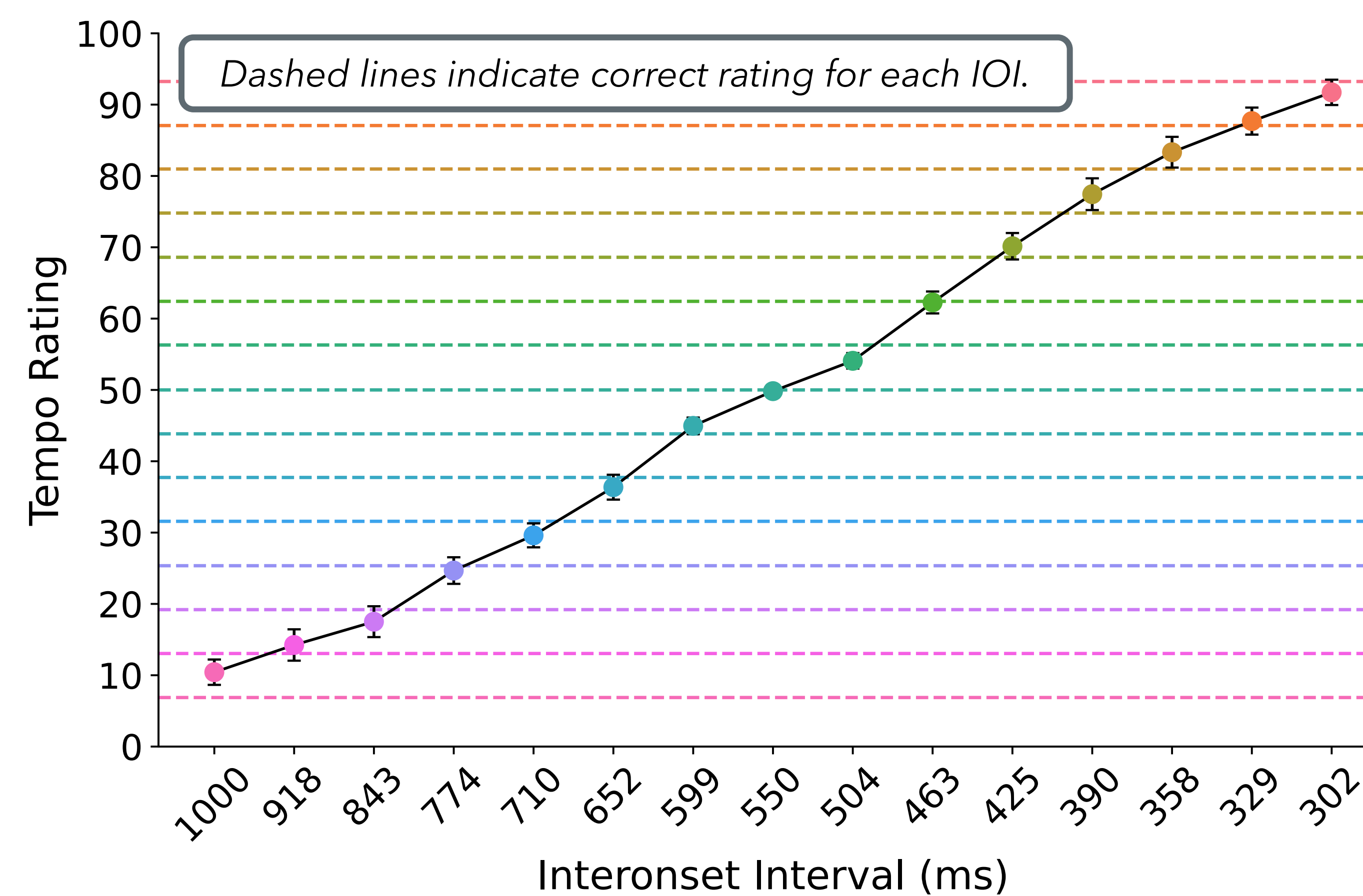
- **Participants:** 62 (32 tap; 30 no-tap)
- **Design:**
 1. Tone ranged from A2 (110 Hz) to A7 (3520 Hz)
 2. Tone repeated at rate between 1000 and 302 ms
 3. Instructed half of participants to tap with stimuli
- **Relative Tempo Judgment Task:**



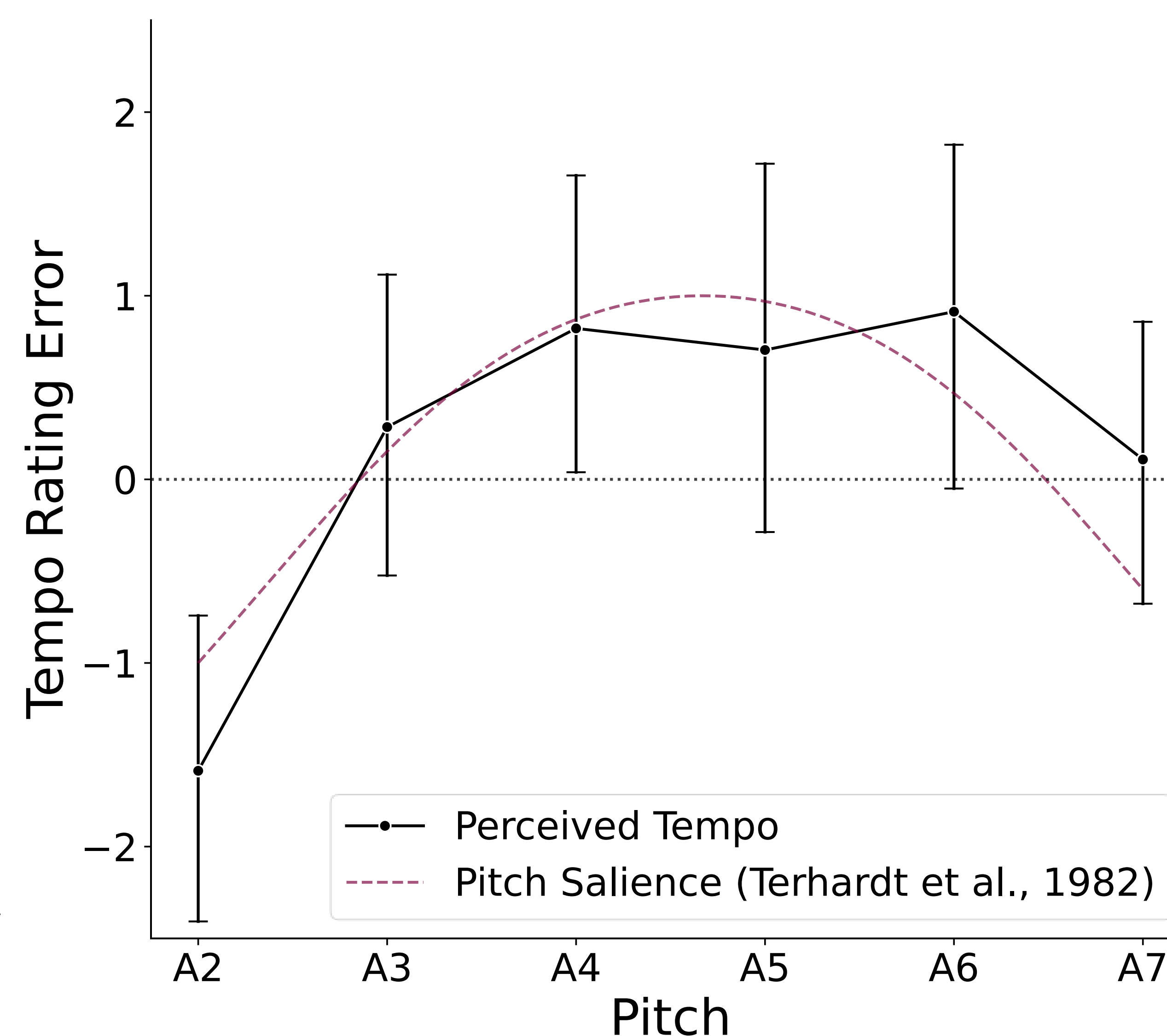
Half as Fast (0) Equal Rates (50) Twice as Fast (100)

Results

Raw Tempo Ratings

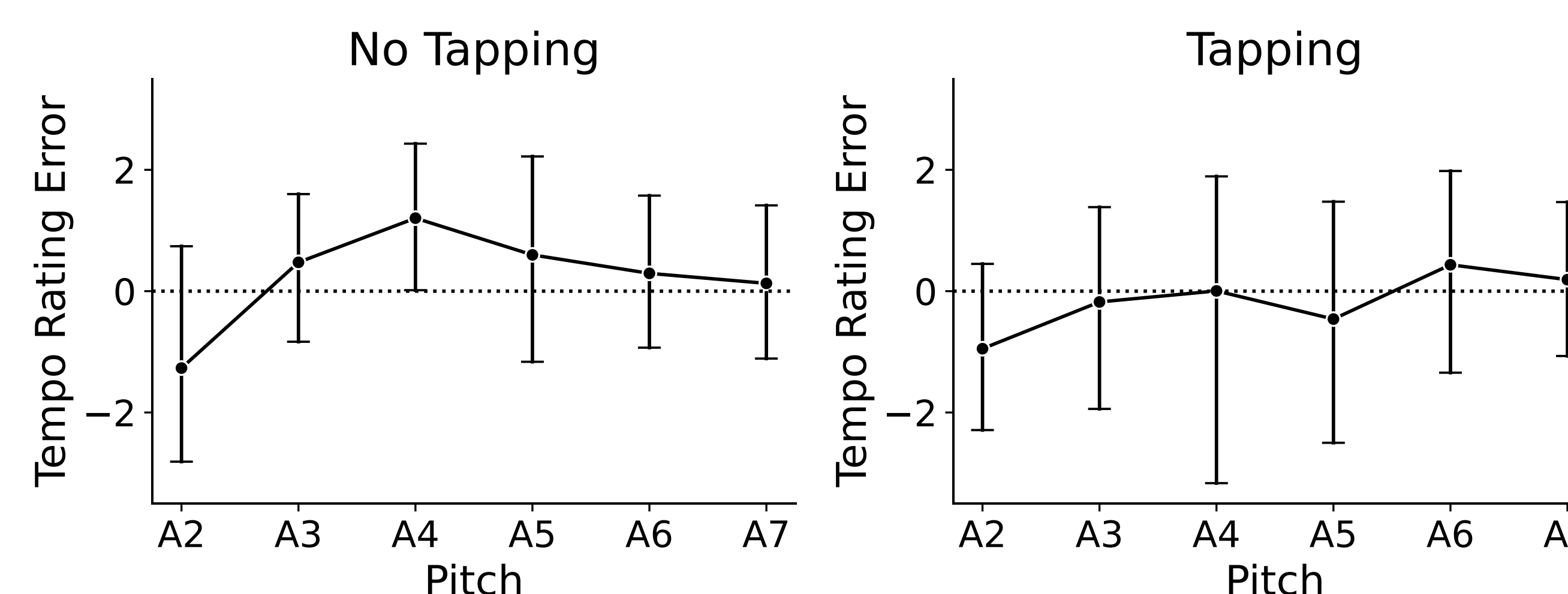


Illusory Tempo Effect



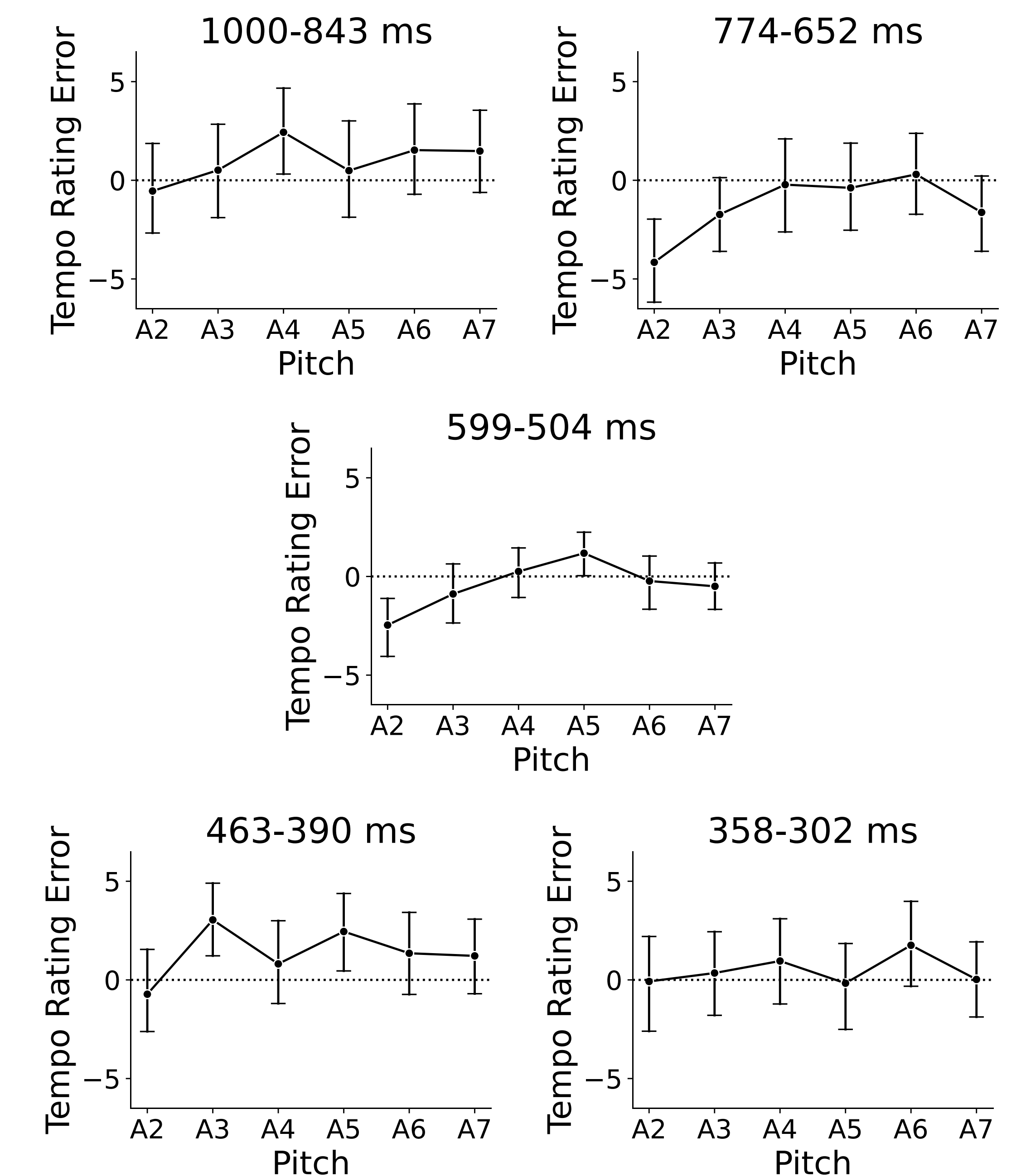
Pitch exhibited a quadratic effect on perceived tempo.

Synchronous Tapping



Synchronous tapping did **not** significantly alter the illusory tempo effect.

Pitch x Tempo Interaction



The illusory tempo effect did **not** significantly differ across tempo ranges.

Discussion

- Current findings challenge the idea that **pitch height** drives illusory percepts of time, as tempo ratings changed nonlinearly with octave.
- The effect of pitch may be better explained by a feature such as **pitch salience**, which peaks at middle frequencies and falls off at extremes.⁶
- The influence of pitch did not interact with the actual tempo of the stimulus, nor with synchronous tapping.
- Illusory tempo effects appear to **generalize** beyond speech and music and may operate at the level of basic perception.

References

1. Battcock, A., & Schutz, M. (2019). Acoustically expressing affect. *Music Perception*, 37(1), 66-91. doi: 10.1525/MP.2019.37.1.66
2. Boltz, M. G. (1998). Tempo discrimination of musical patterns: Effects due to pitch and rhythmic structure. *Perception and Psychophysics*, 60(8), 1357-1373. doi: 10.3758/BF03207998
3. Boltz, M. G. (2011). Illusory tempo changes due to musical characteristics. *Music Perception: An Interdisciplinary Journal*, 28(4), 367-386. doi: 10.1525/mp.2011.28.4.367
4. Boltz, M. G. (2017). Memory for vocal tempo and pitch. *Memory*, 25(10), 1309-1326. doi: 10.1080/09658211.2017.1298808
5. Scherer, K. R. (1986). Vocal affect expression: A review and a model for future research. *Psychological Bulletin*, 99(2), 143-165. doi: 10.1037/0033-2909.99.2.143
6. Terhardt, E., Stoll, G., & Seewann, M. (1982). Algorithm for extraction of pitch and pitch salience from complex tonal signals. *Journal of the Acoustical Society of America*, 71(3), 679-688. doi: 10.1121/1.387544