Auditory brightness perception investigated through intra- and crossmodal interference

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It is a difficult matter to define tone quality in words; we must encroach upon the domain of sight, feeling, and even taste.

Nikolai Rimsky-Korsakov (1913)

A sound's timbre describes its harshness or softness, its dullness or brightness.

Jean-Jacques Rousseau (1765)

Timbre and Metaphor

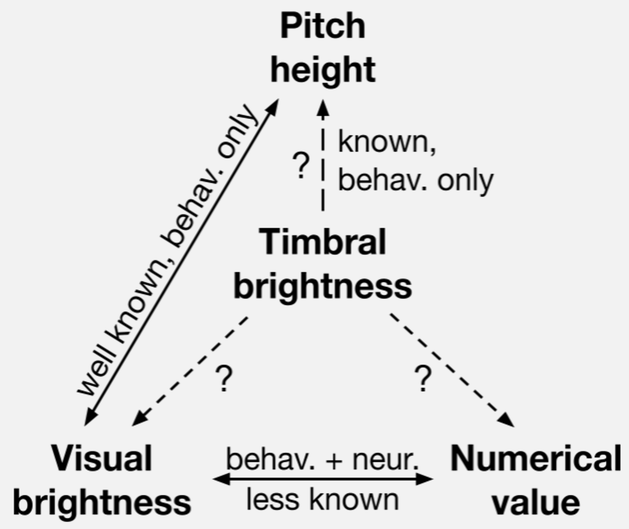
Timbre commonly described using vision and touch terms

Timbral *brightness* is among the most studied "metaphors we listen with"

Psychoacoustically associated with the centroid of the spectral envelope

Neurocognitive mechanisms remain largely unknown

Matching across modality-specific mental representations, or linking to supramodal constructs?

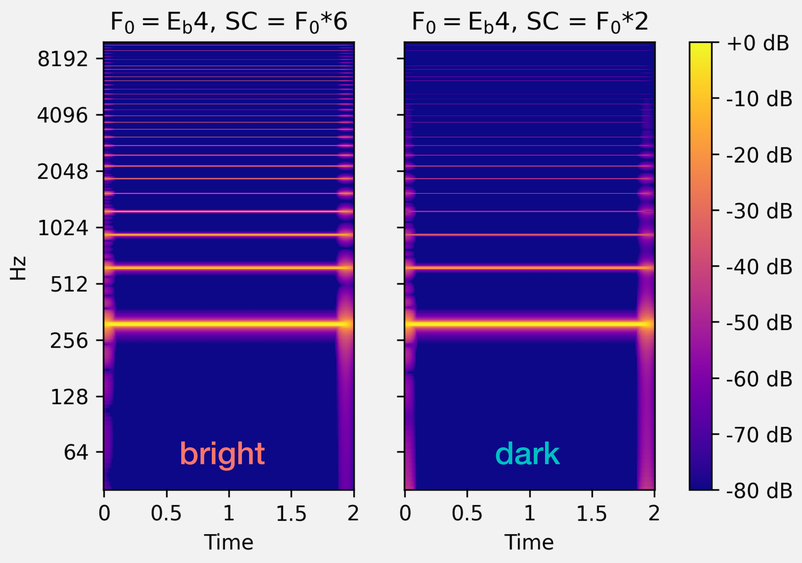


Behavioral study: Triangulating interaction paradigms

- Online participant samples
- 4 experiments (n = 50–70 each) varying in priming, onset timing, deadline

Exp.	Pitch height / Timbral brightness	Visual brightness	Numerical value	Response deadline
1	primed BL + primed T concurrent onsets	BL + primed T sequential onsets		No
2	***	BL + primed T concurrent onsets		Yes
3	***	primed BL + primed T sequential onsets		Yes
4	primed BL + primed T concurrent onsets		***	No/Yes

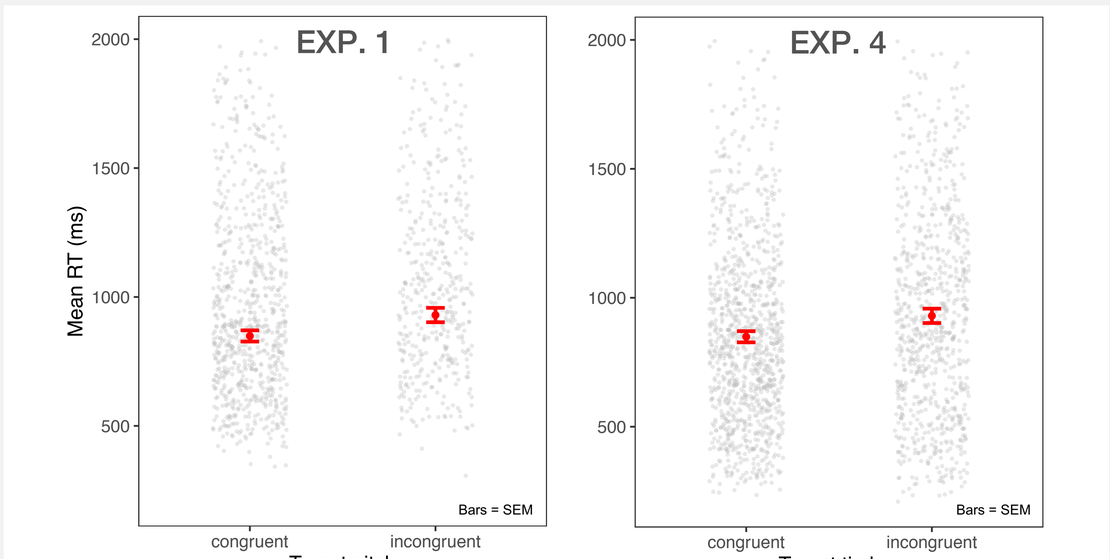
- F_0 / visual / numerical stimuli: 2 baseline (BL) x 2 target (T)
- F_0 / SC stimuli: additive harmonic complexes up to 10 kHz



Intramodal interference

Do semantically incongruent matches between pitch/timbre decrease reaction speed and accuracy? **YES.**

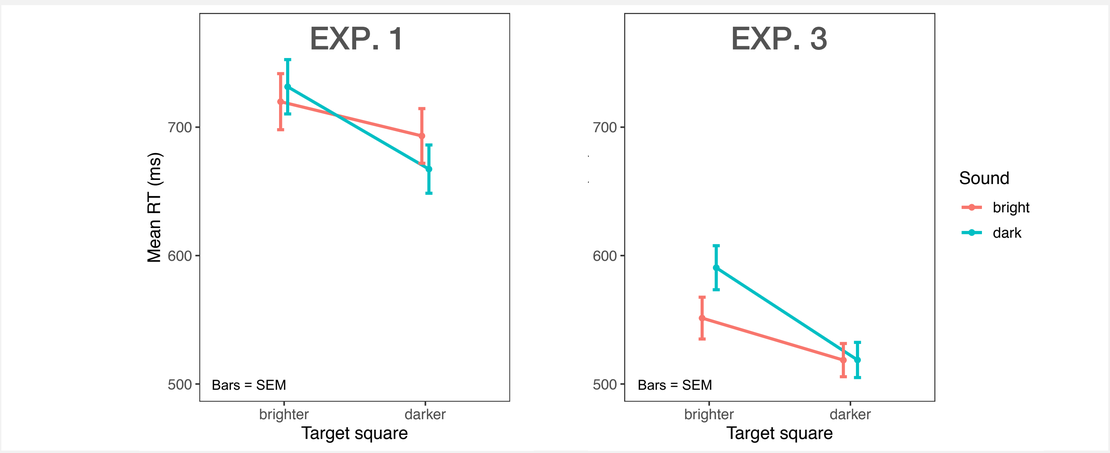
- Timbral brightness affects pitch height comparisons (Exp. 1)
  RT: $\chi^2 = 67.5$, $p < .0001$; accuracy: $\chi^2 = 199.4$, $p < .0001$
- Pitch height differences affect timbral brightness comparisons (Exp. 4)
  RT: $\chi^2 = 34.8$, $p < .0001$; accuracy: $\chi^2 = 166.7$, $p < .0001$



Crossmodal interference

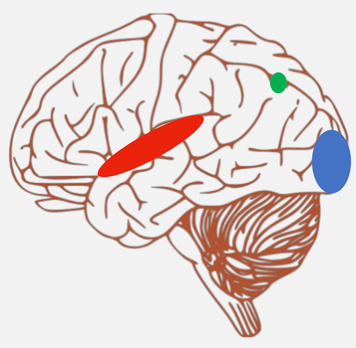
Do semantically incongruent matches between visual/timbral brightness decrease reaction speed and accuracy? **INCONCLUSIVE.**

- Visual * timbral brightness interactions in Exp. 1 & 3, respectively
  RT: $\chi^2 = 4.73$, $p = .03$; and $\chi^2 = 10.5$, $p = .001$
- Non-significant interactions in Exp. 2 & 4; no effect on response accuracy
- Numerical value task: null (Exp: 1–3)



Neuroimaging study

- Data collection in fall 2022
- Examine activation and functional connectivity between spectral, pitch, visual, and supramodal areas (generalized magnitude) during oddball-like task
- Areas of interest: Superior temporal gyrus (pitch), primary visual cortex (brightness), intraparietal sulcus (supramodal)



Significance

Timbre modulates discrimination in other perceptual domains (pitch height, vision)

Expands understanding of timbre semantics and multisensory processing

Imaging study (fall 2022) compares two competing mechanisms: *direct crossmodal connectivity* vs. *supramodal representation*

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