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Hearing through your eyes: modulation of the visually-evoked auditory response
by transcranial electrical stimulation

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Background

- Some people 'hear' visual events as sounds¹
- They also show better discrimination of visual 'Morse-code' sequences, relative to auditory¹.
- We measured sequence discrimination while applying Transcranial Alternating Current Stimulation (TACS) over auditory vs visual cortex.
- *Does TACS effect depend on individual differences in ability to hear flashes, and visual:auditory discrimination?*

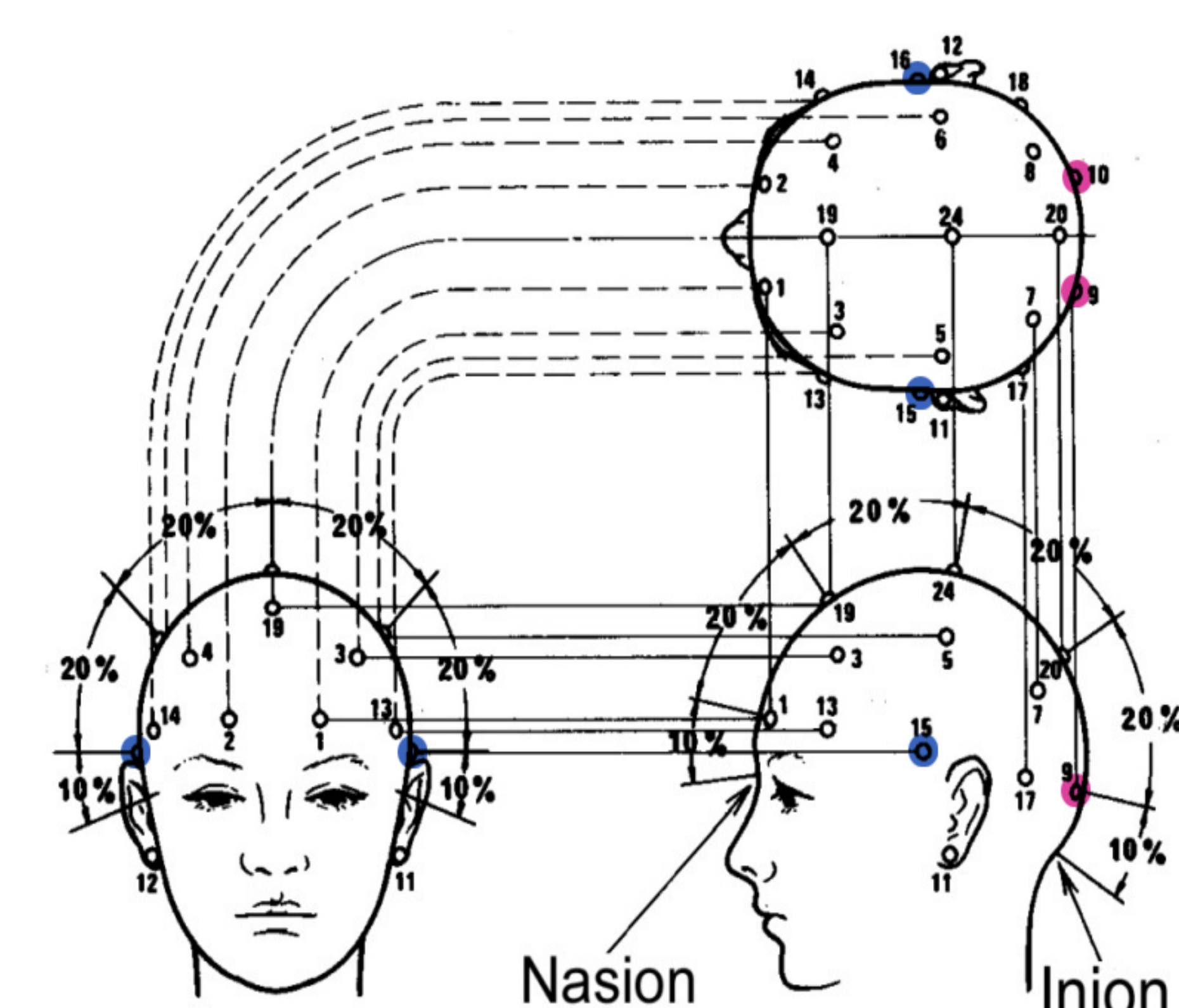
Methods

26 Participants:

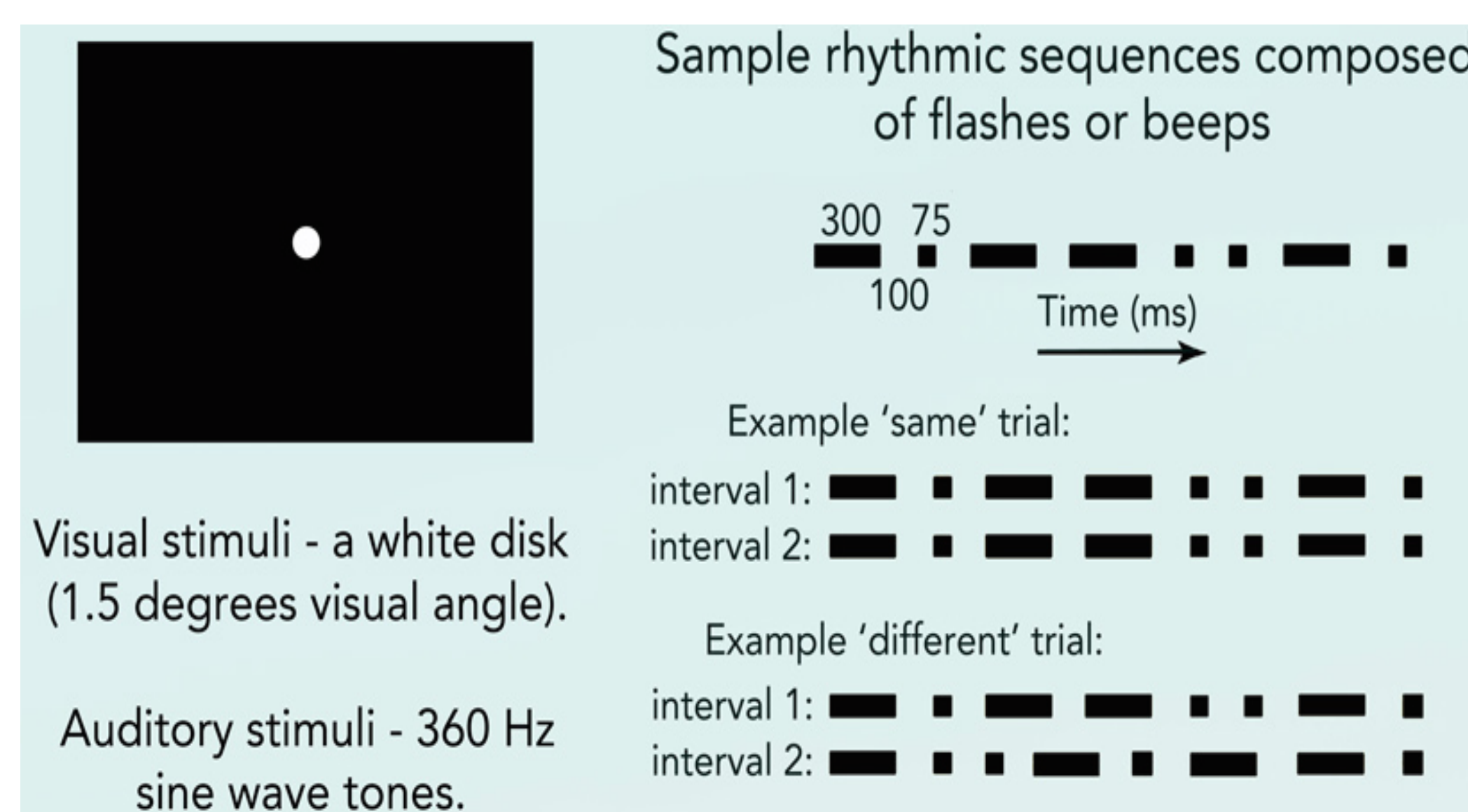
- 18 to 55 years (M24, SD 8.69)
- including six self-reporting synaesthetes (e.g. grapheme-colour, music-colour) and 14 musicians (musical training for 5 to 46 years (M15.3, SD 9.9))
- 23 were asked: 'did you hear faint sounds accompanying flashes?'

10Hz TACS:

- 1000µA bilateral for 15 minutes during task
- Stimulation vs Sham double-blinded; counterbalanced within-session
- Sites: occipital pole (O1, O2) vs temporal (T3, T4); counterbalanced between session

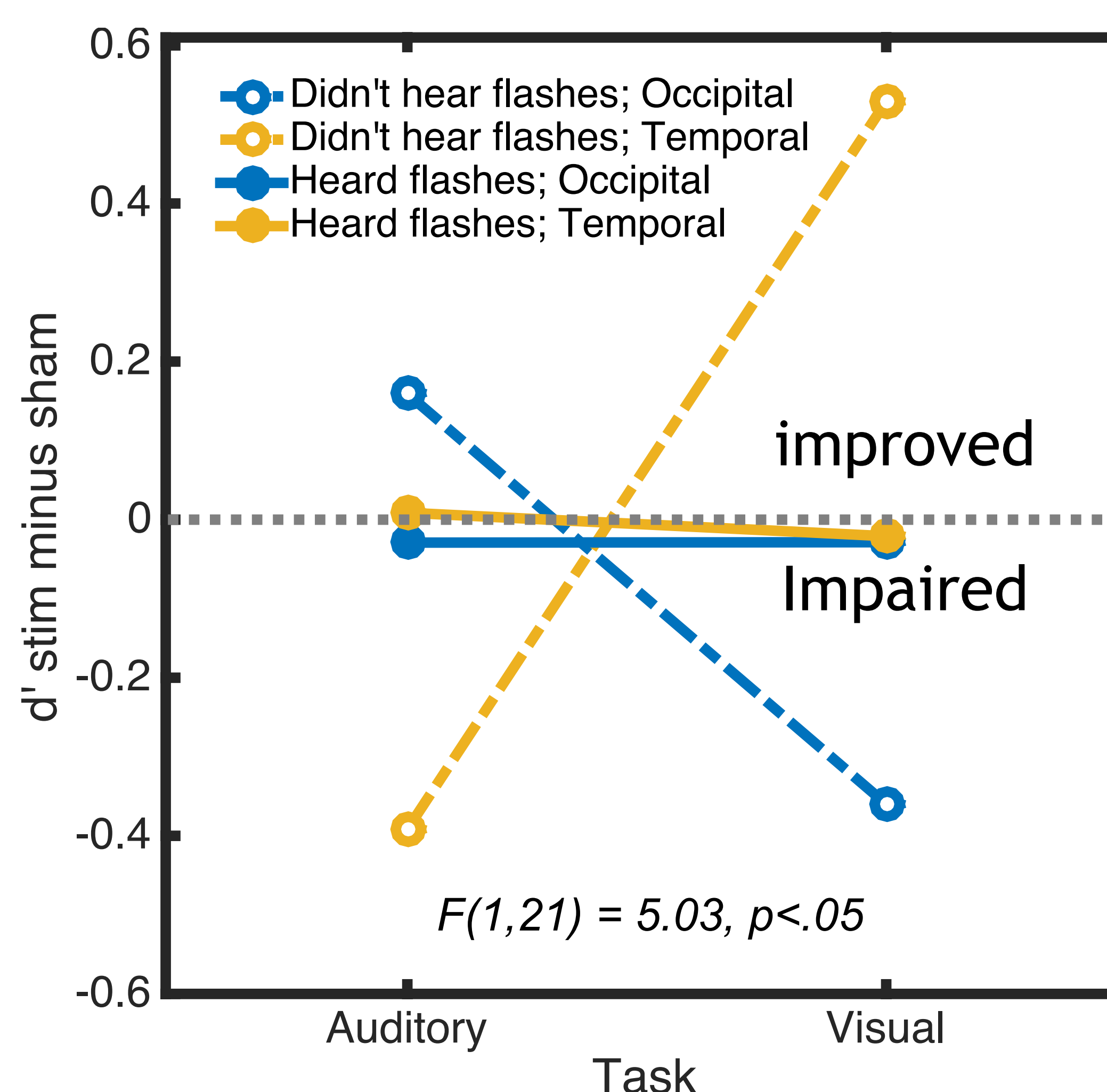


Task



Results

a) TACS effect depends on 'hearing flashes'

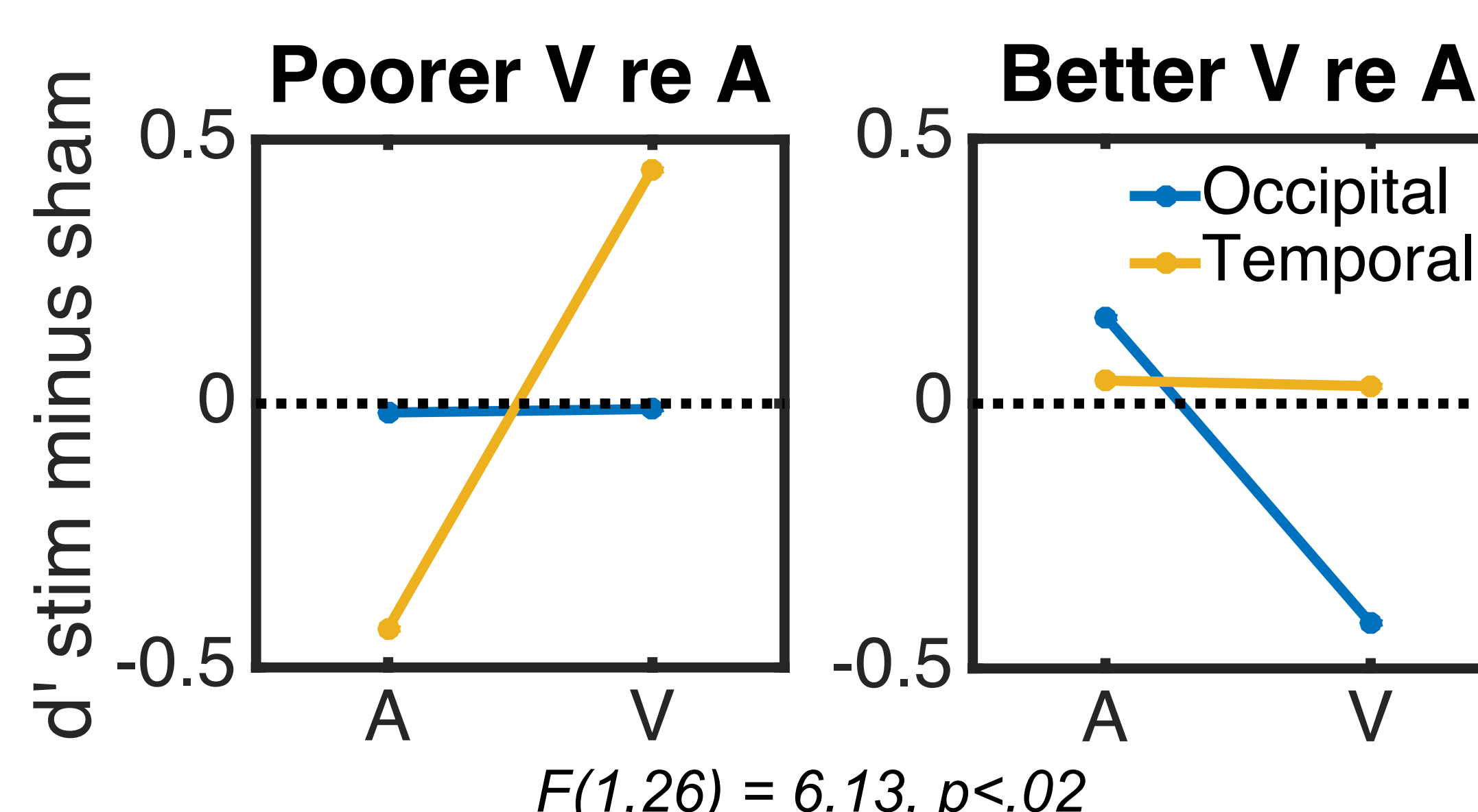


b) Hearing flashes is more prevalent in synaesthetes

$\chi^2 = 4.41$ $p = 0.04$		Synaesthesia		
		No	Yes	Σ
Hear flashes?	No	12	2	14
	Yes	4	5	9
Σ		16	7	23

- But synaesthesia per se does not predict TACS effect

c) Visual:Auditory bias modulates TACS effects



'Morse code' sequences:

- Same/Different discrimination
- Unimodal Auditory and Visual
- Modality randomised each trial
- 8 Long and short events
- Events 3 to 7 shuffled in 'Different' trials

Interpretation

a) Cortices inhibit each other²

- Inhibition carried by alpha oscillations³
- Alpha TACS biases competition between cortices
- *Hearing-flashes people have less inhibition? → weaker TACS effect*

b) Supports 'unmasking' theory of synaesthesia⁴

c) Individuals also differ in balance between cortices

- Indexed by V:A performance
- TACS to dominant cortex disrupts inhibition of sub-dominant cortex
- Less effect of TACS on sub-dominant cortex as it is already inhibited. Further support for TACS biasing competition

Conclusions

- People who hear flashes use both vision and audition together to solve the sequencing task
- This may involve cooperative representations across visual and auditory cortices which resist disruptive effects of TACS.

References

1. Saenz, M., & Koch, C. (2008) *Current Biology*, 18(15), 650-651
2. Mattingley, J., Driver, J., Beschin, N., Robertson, I. (1997) *Neuropsychologia*, 35(6), 867-880; Iurilli, G. et al, (2012) *Neuron*, 73 814-828
3. Klimesch, W., Sauseng, P., & Hanslmayr, S. (2007). *Brain Research Reviews*, 53(1), 63-88
4. Grossenbacher, P. & Lovelace, C. (2001) *Trends in Cognitive Sciences*, 5(1), 36-41; Cohen Kadosh, R., Walsh, V. (2006) *Current Biology*, 16(22), R962-3.