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

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Background
- Some people ‘hear’ visual events as sounds
- They also show better discrimination of visual ‘Morse-code’ sequences, relative to auditory.
- 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
- Sample rhythmic sequences composed of flashes or beeps
- ‘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

Results
a) TACS effect depends on ‘hearing flashes’
- F(1,35) = 6.33, p<0.05
- Improved
- Poorer V re A

b) Hearing flashes is more prevalent in synaesthetes
- \( \chi^2 = 4.41 \)
- p = 0.04
- Synaesthesia
  - No
  - Yes
  - \( \Sigma \)
  - Hear flashes?
  - No
  - 12
  - 2
  - 14
  - Yes
  - 4
  - 5
  - 9
  - \( \Sigma \)
  - 16
  - 7
  - 23
- But synaesthesia per se does not predict TACS effect

Visual:Auditory bias modulates TACS effects

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.

Interpretation
a) Cortices inhibit each other
- Inhibition carried by alpha oscillations
- Alpha TACS biases competition between cortices
- Hearing-flashes people have less inhibition? \( \rightarrow \) weaker TACS effect

b) Supports ‘unmasking’ theory of synaesthesia

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

References

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