How Do Sound and Vision Integrate?
Visual ERPs With and Without Simultaneous Auditory Inputs

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INTRODUCTION

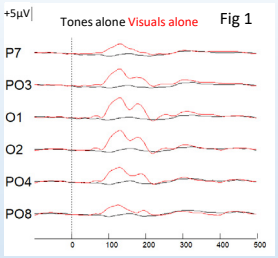
- Auditory and visual input are normally segregated in their paths to the sensory cortices but may interact.
- Reconzone (2003) found when presented with auditory and visual temporal sequences, auditory distractors altered visual perception, indicating auditory input was driving visual perception.
- We examined whether early visual ERP components to visual stimuli presented at a steady pace are altered when auditory stimuli are presented slower, faster or at the same pace.

METHODS

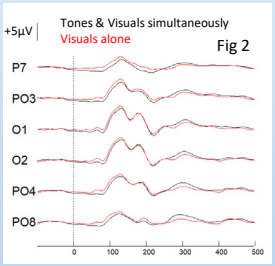
- Ss: 18 undergraduate nonmusic majors.
- EEG: 128 channel EGI system
- Visual stimuli: squares and diamonds
- Auditory stimuli: 440 and 1000 Hz tones.
- Responses: to oddball stimulus in 5 conditions, 240 stimuli per condition at 2/s:
  - 1) Auditory only: oddballs were 1000 Hz.
  - 2) Visual only: oddballs were diamonds
  - 3) Simultaneous: 440 Hz tones simultaneous with visual oddball series at 2/s
  - 4) Fast tones at 2.816/s with visual series
  - 5) Slow tones 1.42/s with visual series
- ERP components examined: P1, N170, P2 at sites O1, Oz O2, PO3, PO4, P7, P8, referenced to the common average. Filtered .1 to 30 Hz.

RESULTS

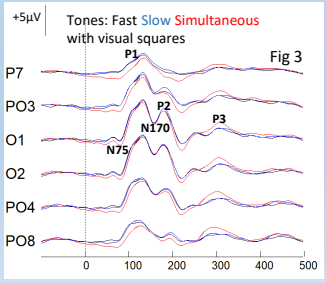
Tones alone do not elicit visual ERP components at posterior sites.



Visual squares during simultaneous tones elicited slightly more negative peaks than during visual stimuli alone.



During simultaneous tones, visual stimuli elicited more negative amplitudes for P1, N170 and P2 (*p*<.005, .001, and .001, respectively) than during faster and slower tones, which did not differ.



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Discussion at MIMM 12:30 poster session: Zoom
https://us02web.zoom.us/j/84598714684?pwd=NjZJSk42OUh2eTNLQWdLUGU2eFNvUT09.
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DISCUSSION

Simple auditory stimuli do not on their own (Figure 1) elicit visual ERP components and when simultaneously presented (Figure 2) appear to induce slightly more negative sensory components of the visual ERP waveform.

Asynchronous tones do not seem to alter the ERP responses to the visual stimuli, so distracting noise alone does not affect the ERP peaks. However, the synchronous tones elicited significantly reduced peaks in the visual ERP compared to the asynchronous tones. Thus, simultaneous cross–modal presentation interacts at the level of the visual sensory cortex despite the tones on their own not yielding similar components.

The question remains as to how this interaction occurs. The general negativity (or reduced positivity) of the waveform is reminiscent of the 'processing negativity' associated with increased attention (Naatanen, 1992). Thus, the interaction may not be sensory per se, but rather an attention effect that influences the general cortical response, including at the posterior sites. This may be supported by two other findings – that it apparently precedes the visual cortical response (even before the N75, not scored here), and the increased amplitude of the P3 (*p*<.001) that is associated with attention allocation.

IMPLICATIONS

Auditory-Visual interactions the EEG from sensory cortical coding may be more related to attention, expectation and cognitive factors than to true sensory integration. More studies manipulating expectation are needed to resolve this issue.

References
Naatanen, R. (1992). *Attention and brain function*. Hillsdale, NJ: LEA.
Recanzone, G.H. (2003). Auditory influences on visual temporal rate perception. *Journal of Neurophysiology, 89,* 1078-1093.