

Brain Mechanisms Underlying a Sound-Induced Visual Illusion

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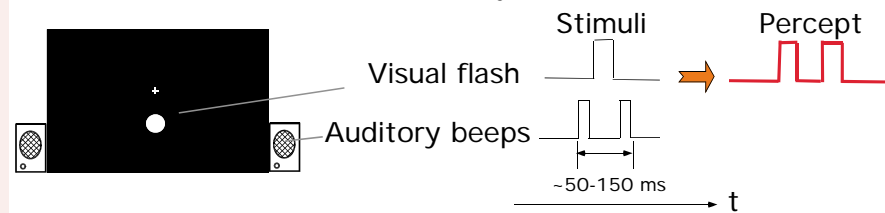
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Introduction

Sound-induced illusory flash

(Shams, Kamitani & Shimojo, *Nature* 2000)



Implications of the Illusion

- Vision is NOT always the dominant modality in multimodal perception.
- Major qualitative alteration of visual perception by sound: unlike quantitative changes in visual features, or disambiguation of ambiguous visual input by sound (e.g., Stein et al., 1996; Sekular et al., 1997).
- This robust illusion obtained with the simple stimulus configuration may be useful to reveal fundamental nature of cross-modal interactions in the brain.

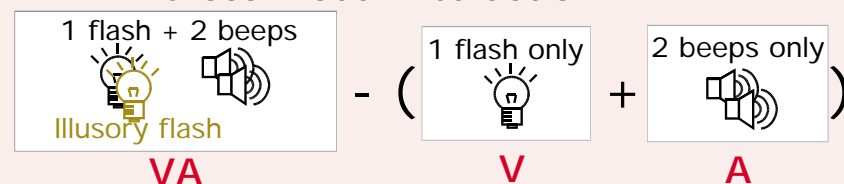
Question

At what level of perceptual processing do these cross-modal interactions occur? What mechanism underlies them?

Approach

Recording event-related potentials (ERPs) from the occipital cortex, to measure modulation of visual cortical activity by sound.

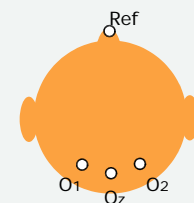
Cross-modal interaction =



- "Visual" evoked potentials corresponding to the illusory flash?
- At what latency?
- Equivalent to a physical flash?

Methods

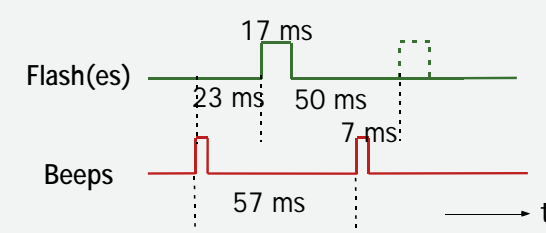
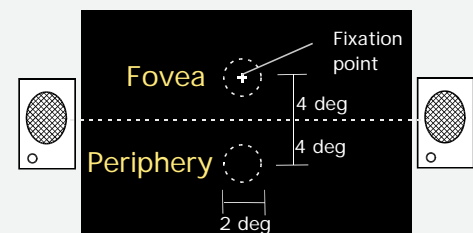
Event-Related Potentials (ERP)



<Conventional flash VEP protocol>

- 3 electrodes in the occipital lobe (Oz O1 O2, International 10-20 System), referred to the nose.
- Eye movements monitored by EOG.
- Epochs of -100 to 360 ms relative to the onset of the (first) flash.

Stimuli

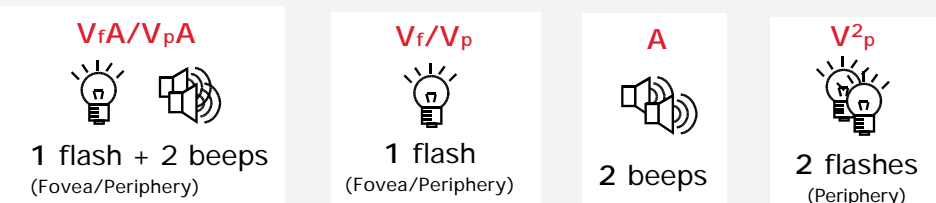


Flash: A white disk (Fovea or Periphery) on a dark computer screen.



Beep: 3.5kHz, 77dB tone from two speakers (symmetrically placed; height, between the two positions of the disk).

6 conditions x 100 trials:



Subjects

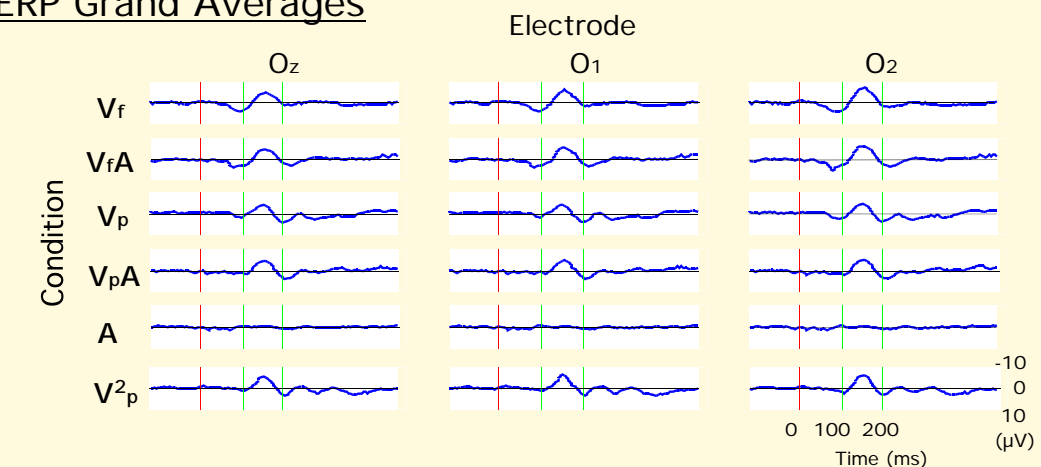
13 volunteers (ages 17-45 years, normal or corrected-to-normal vision, 8 males and 5 females).

Task

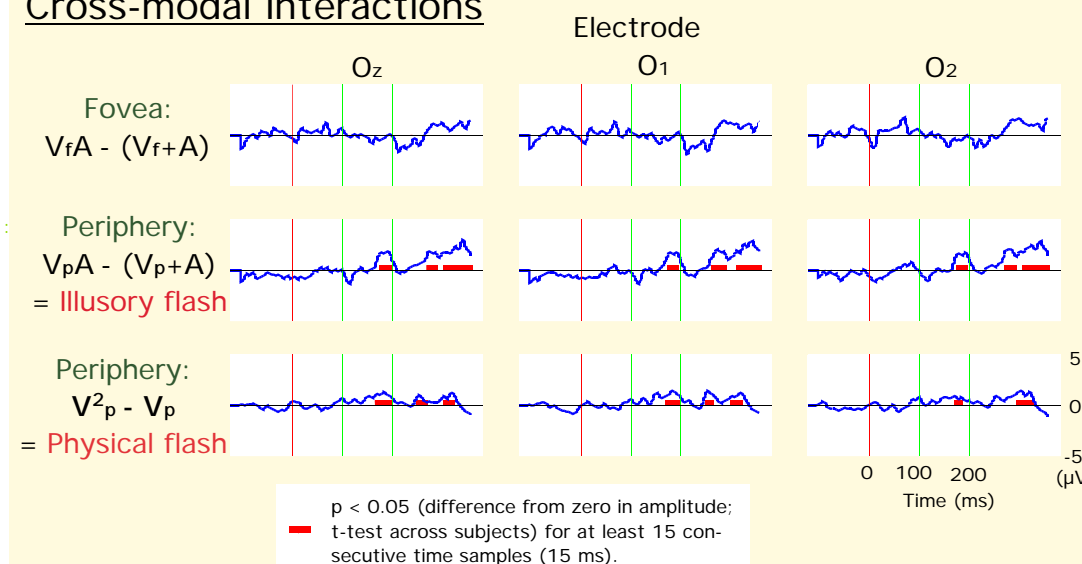
Report the number of perceived flashes.

ERP Results

ERP Grand Averages

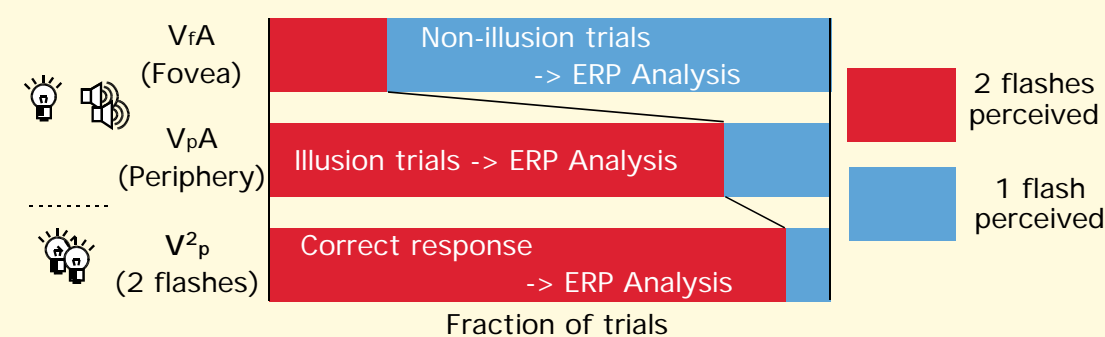


Cross-modal Interactions



- No significant cross-modal interaction in Fovea/Non-illusion trials.
- Significant cross-modal interaction in Periphery/Illusion trials.
- Hence a nice neurophysiological correlate with the perception of the sound-induced illusory flash.
- Cross-modal interaction as early as 170 ms post-stimulus, suggesting modulation in so-called "modality-specific" (visual) pathways.
- Similar modulation by an additional physical flash, indicating equivalence of the illusory and physical flashes, as measured with "visual" evoked potentials.

Behavioral Results



- The illusory flash was perceived more frequently in Periphery than in Fovea.

Conclusion

Sound modulates early "visual" evoked potentials, in accordance with the illusory visual percept. Thus, cross-modal integration may occur already in "modality-specific" sensory areas.

