Wired for sound: How the brain senses visual illusions

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In a study that could help reveal how illusions are produced in the brain's visual cortex, researchers at the UCSD School of Medicine have found new evidence of rapid integration of auditory and visual sensations in the brain. Their findings, which provide new insight into neural mechanisms by which visual perception can be altered by concurrent auditory events, will be published online in the April 12 edition of the *Journal of Neuroscience*.

When subjects were shown a single flash of light interposed between two brief sounds, many subjects reported seeing two distinct flashes of light. Investigating the timing and location of the brain processes that underlie this illusory effect – the illusion of seeing two flashes in the presence of two auditory signals, when only one flash actually occurs – can reveal how information from different senses are integrated in the brain.

The study of 34 subjects was carried out in the laboratory of Steven A. Hillyard, Ph.D., UCSD professor of neurosciences. "This type of perceptual illusion has been described before," said first author Jyoti Mishra, graduate student in the Hillyard lab. "The surprising finding we made is that the illusion depends on a rapidly timed sequence of interactions between the auditory and visual cortical areas."

"This is part of a set of new findings by scientists in the field that show how integration of multiple sensations can happen much more rapidly than we thought before," said Mishra. "We show physiological evidence that visual and auditory stimulation might not be processed separately, then merged together, as previously assumed, but that an almost-simultaneous integration of the sensations may actually take place in the brain."

The UCSD scientists measured event-related potentials (ERPs), brain responses that are directly related to the perceptual experiences induced by sensory stimuli, using an electrophysiological or EEG recording procedure that measures electrical activity of the brain through the skull.

"In subjects who reported seeing a second flash, the ERP measurements showed a boost of activity within the visual cortex of the brain immediately after hearing the second sound," said Mishra, adding that the second sound amplified the brain activity stimulated by the first sound. Perception of the second illusory flash was also marked by a rapid enhancement of processing in the auditory cortex of the brain. By observing the auditory boost, the researchers could predict when subjects would report seeing the visual illusion of a second flash.

"Our results provide evidence that perception of the illusory second flash is based on a very rapid and dynamic interplay between the auditory and visual cortices of the brain – on a time scale less than one tenth the blink of an eye." Mishra said. Interestingly, the pattern was very different between individuals who did or didn't see the second flash, indicating that the brain's wiring and the strength of integration between the different sensory cortices may differ between individuals, or even vary over time. "It suggests that there are consistent differences in the neural connectivity that are possibly shaped during one's development and through experience," she said.

Next, the researchers plan to look at whether or not attention affects these illusory sensations. These studies could shed light on how people deprived of one sensation often compensate by developing another – for instance, blind people with a more acute sense of hearing.

Source: University of California - San Diego