Paying attention sets off symphony of cell synchronization

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You know the sensation. When something has your full attention you see it vividly. And when you don't pay attention, you're liable to miss something important. Now a new Northwestern University study sheds light on how attention operates.

The mystery of how attention improves the perception of incoming sensory stimulation has been a long-time concern of scientists. One hypothesis is that when you pay attention neurons produce stronger brain activity, as if the stimulus itself was stronger. That would mean that paying attention might make something appear more intense, and possibly distort its actual appearance.

In the Northwestern study, EEG measures of brain activity were used to show precisely how attention alters brain activity. The team of psychologists and neuroscientists used a new strategy for understanding the mechanisms whereby sustained attention makes us process things more effectively, literally making the world come into sharper focus.

"When you pay attention cells aren't only responding more strongly to stimuli," said co-author Marcia Grabowecky, research assistant professor of psychology in Northwestern's Weinberg College of Arts and Sciences. "Rather a population of cells is responding more coherently. It is almost like a conductor stepping in to control a large set of unruly musicians in an orchestra so that they all play together. Cells synchronize precisely to the conductor's cues."

The article, "Attention Induces Synchronization-Based Response Gain in Steady-State Visual Evoked Potentials," will be published in *Nature Neuroscience*. It was published Dec. 17 in advance of the print version on Advance Online Publication (AOP) on Nature Neuroscience's Web site.

Each participant in the study wore a cap with 64 electrodes to record their brain waves. The brain waves fluctuated in sync with flickering stimuli that appeared on a computer screen. At any given time, two target patterns were shown, but subjects were told to pay attention to one and ignore the other. Sometimes the target patterns were fairly dim. At other times they were quite bright.

EEG responses from the participants showed more brain activity for brighter stimuli, as expected, but responses also varied depending on attention. The patterns of these brain waves allowed the investigators to obtain a thorough description of how attention altered neural function.

"For dynamic stimuli at the focus of attention, the timing of brain activity became more precisely synchronized with the flickering," said Satoru Suzuki, associate professor of psychology at Northwestern and co-author of the study.

The results suggest that attention can make a stimulus stand out by making brain responses to the stimulus more coherent. "This doesn't change the stimulus but can make it more effective for guiding our behavior," Grabowecky said.

"When you need to dig deep to summon that extra ounce of attention, it's as if you engage a symphony of brain activity that can come to your rescue as millions of neurons together make the music that represents a vivid conscious experience," added Ken Paller, professor of psychology at Northwestern and co-investigator of the study.

Source: Northwestern University