Scientists create touch-based illusion

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Anyone who has seen an optical illusion can recall the quirky moment when you realize that the image being perceived is different from objective reality. Now, a team of scientists from MIT, Harvard and McGill has designed a new illusion involving the sense of touch, which is helping to glean new insights into perception and how different senses—such as touch and sight—work together.

Ambiguous visual images are fascinating because it is often difficult to imagine seeing them any other way—until something flips within the brain and the alternative perception is revealed. This phenomenon, known as perceptual rivalry, is of great interest to neuroscience. Because rivalrous illusions produce changes in perception that are independent of changes in the stimulus itself, they may help to understand how the brain gives rise to conscious experience.

"The most familiar illusions involve vision," explains Christopher Moore, a principal investigator at the McGovern Institute for Brain Research at MIT and an assistant professor in MIT's Department of Brain and Cognitive Sciences. "But we're interested in discovering general principles of perception, and we wanted to see whether similar illusions can occur in the tactile domain."

Moore is senior author of a paper on the new illusion published on the *Current Biology* web site on July 17.

In the visual illusion known as the apparent motion quartet, two dots are presented at diagonally opposite corners of an imaginary square. When

the pattern alternates between the two diagonals—top left/bottom right followed by top right/bottom left—people perceive the dots as moving back and forth either horizontally or vertically. After a period of time, typically a minute or two, most observers report that the axis of motion appears to flip from vertical to horizontal or vice versa.

An example of the illusion can be seen at http://web.mit.edu/~tkonkle/www/AmbiguousQuartet.html.

To create a tactile version of this illusion, Olivia Carter, a postdoctoral researcher at Harvard University, and Talia Konkle, a graduate student in Moore's MIT lab, used a new piezoelectric stimulator device developed by Qi Wang and Vincent Hayward at McGill University. This device, originally designed as a computer Braille display, uses a centimeter-square array composed of 60 "tactors" to deliver precisely controlled touch stimuli to the finger tips of volunteer subjects.

When volunteer subjects were given the diagonally alternating stimuli, they perceived them as moving smoothly back and forth—and just as with the visual illusion, the direction of apparent motion flipped back and forth from vertical to horizontal, on average about twice per minute, even though there was no change in the stimulus itself.

The authors went on to show that after a period of adaptation to an unambiguous horizontal or vertical stimulation (produced by activating a row of tactors in succession), subjects were more likely to perceive a subsequent ambiguous stimulus as being in the orthogonal direction. Similar after-effects are common in vision and were once thought to reflect fatigue in the brain circuits responsible for a particular perceptual interpretation, but are now thought to reflect a continual recalibration of the brain to its sensory environment. In another experiment, an ambiguous touch stimulus was interrupted by a three-second break, after which subjects tended to experience the same direction as before the

break, suggesting that the prior interpretation was somehow retained in memory and used to reinterpret the ambiguous stimulus.

Real-world objects often stimulate multiple senses simultaneously, and our brains must combine these disparate stimuli into a unified interpretation of the world. The authors used their tactile illusion to explore the interaction between touch and vision. They instructed their subjects to make vertical or horizontal eye movements during the ambiguous touch stimuli. Subjects perceived that the direction of tactile motion shifted into alignment with the direction of the eye movements, but only if the head and finger were also aligned. Tilting the head sideways 90 degrees produced a shift to the other direction—suggesting that the tactile and visuomotor systems are somehow aligned with respect to the external world.

"We don't yet understand what's happening in the brain during these illusions," says Konkle. "But we think this illusion will be a useful new tool to understand more about the similarities between different sensory modalities and how they all work together."

Source: Massachusetts Institute of Technology