Hit a 90 mph baseball? Scientists pinpoint how we see it coming

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Source: University of California - Berkeley

Summary: How does San Francisco Giants slugger Pablo Sandoval swat a 95 mph fastball, or tennis icon Venus Williams see the oncoming ball, let alone return her sister Serena's 120 mph serves? For the first time, vision scientists have pinpointed how the brain tracks fast-moving objects.

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In new research, vision scientists have pinpointed how the brain tracks fast-moving objects.

Credit: © Tom Wang / Fotolia [Click to enlarge image]

How does San Francisco Giants slugger Pablo Sandoval swat a 95 mph fastball, or tennis icon Venus Williams see the oncoming ball, let alone return her sister Serena's 120 mph serves? For the first time, vision scientists at the University of California, Berkeley, have pinpointed how the brain tracks fast-moving objects.

The discovery advances our understanding of how humans predict the trajectory of moving objects when it can take one-tenth of a second for the brain to process what the eye sees.

That 100-millisecond holdup means that in real time, a tennis ball moving at 120 mph would have already advanced 15 feet before the brain registers the ball's location. If our brains couldn't make up for this visual processing delay, we'd be constantly hit by balls, cars and more.

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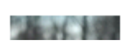

Breaking Ball Too Good to Be

Thankfully, the brain "pushes" forward moving objects so we perceive them as further along in their trajectory than the eye can see, researchers said.

"For the first time, we can see this sophisticated prediction mechanism at work in the human brain," said Gerrit Maus, a postdoctoral fellow in psychology at UC Berkeley and lead author of the paper published today (May 8) in the journal, *Neuron.*

A clearer understanding of how the brain processes visual input -- in this case life in motion -- can eventually help in diagnosing and treating myriad disorders, including those that impair motion perception. People who cannot perceive motion cannot predict locations of objects and therefore cannot perform tasks as simple as pouring a cup of coffee or crossing a road, researchers said.

This study is also likely to have a major impact on other studies of the brain. Its findings come just as the Obama Administration initiates its push to create a Brain Activity Map Initiative, which will further pave the way for scientists to create a roadmap of human brain circuits, as was done for the Human Genome Project.

Using functional Magnetic Resonance Imaging (fMRI) Gerrit and fellow UC Berkeley researchers Jason Fischer and David Whitney located the part of the visual cortex that makes calculations to compensate for our sluggish visual processing abilities. They saw this prediction mechanism in action, and their findings suggest that the middle temporal region of the visual cortex known as V5 is computing where moving objects are most likely to end up.

For the experiment, six volunteers had their brains scanned, via fMRI, as they viewed the "flash-drag effect," a visual illusion in which we see brief flashes shifting in the direction of the motion, as can be seen in the videos above.

"The brain interprets the flashes as part of the moving background, and therefore engages its prediction mechanism to compensate for processing delays," Maus said.

The researchers found that the illusion -- flashes perceived in their predicted locations against a moving background and flashes actually shown in their predicted location against a still background -- created the same neural activity patterns in the V5 region of the brain. This established that V5 is where this prediction mechanism takes place, they said.

In a study published earlier this year, Maus and his fellow researchers pinpointed the V5 region of the brain as the most likely location of this motion prediction process by successfully using transcranial magnetic stimulation, a non-invasive brain stimulation technique, to interfere with neural activity in the V5 region of the brain, and disrupt this visual position-shifting mechanism.

"Now not only can we see the outcome of prediction in area V5," Maus said. "But we can also show that it is causally involved in enabling us to see objects accurately in predicted positions."

On a more evolutionary level, the latest findings reinforce that it is actually advantageous not to see everything exactly as it is. In fact, it's necessary to our survival:

"The image that hits the eye and then is processed by the brain is not in sync with the real world, but the brain is clever enough to compensate for that," Maus said. "What we perceive doesn't necessarily have that much to do with the real world, but it is what we need to know to interact with the real world."

Story Source:

The above story is based on materials provided by **University of California - Berkeley**. The original article was written by Yasmin Anwar. *Note: Materials may be edited for content and length.*

Journal Reference:

1. Gerrit W. Maus, Jason Fischer, David Whitney. **Motion-Dependent Representation of Space in Area MT**. *Neuron*, 2013; 78 (3): 554 DOI: 10.1016/j.neuron.2013.03.010

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