

## Tennis: Referees More Likely To Make Mistakes When Calling Balls 'Out'

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A universal bias in the way people perceive moving objects means that tennis referees are more likely to make mistakes when they call balls "out" than when they call them "in," according to a new report in the October 28th issue of *Current Biology*.

Because recent rule changes allow professional tennis players to challenge the refs' calls, athletes could exploit the new findings to their advantage, according to researchers at the University of California, Davis.

Like all visual illusions, the new discovery provides visual neuroscientists with a window on how the brain processes information, explained David Whitney.

"The visual system faces a big challenge when trying to code the locations of objects so that we can perceive them,"

Whitney said. "Consider one of the difficulties: every time we move our eyes, the image on our retina moves. Even if our coffee cup is actually stationary on our desk, we move our eyes and head while reaching to pick it up so the image of the cup will move on our retina. This is a problem because the visual system is sluggish—it takes a hundred or more milliseconds for us to become aware of an image that strikes our retina. So, by the time we perceive an object like the coffee cup in one location, it will have already changed location as we move toward it. Our perception lags behind reality. The visual system has mechanisms that help alleviate this problem of living in the past, but these mechanisms are not perfect and occasionally result in visual illusions—like the misperception of tennis ball location we discovered."

Similar kinds of perceptual biases in the visual system had been documented before, but rarely in real-world situations. People consistently misperceive moving objects as shifted in the direction of their motion, so that at any moment they appear to be farther along their path than they are. Whitney said he realized it might be possible to study this in the context of tennis when he saw a referee call overturned by a player's challenge during a Wimbledon match.

On a tennis court, a ball could physically bounce in the court but be called out, or a ball could physically bounce out of the court but be called in. If tennis referees were bias-free, they would be equally likely to make each of these two kinds of errors. But because objects generally appear to be shifted in the direction of their motion, referees should incorrectly judge balls as being out more often.

Whitney's team confirmed that prediction. In a review of more than 4,000 randomly selected Wimbledon tennis points, the researchers uncovered 83 incorrect calls. Of those, 70 of the errors were of the type predicted.



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*Credit: iStockphoto/Rolf Bodmer*

Further study of the phenomenon in the laboratory confirmed that the refs' mistakes are not the result of poor refereeing. Rather, the errors are a general artifact of the way the human brain processes visual information about motion.

Indeed, the researchers said, tennis players and audience members surely make the same mistakes that refs do. The new findings suggest, however, that players could maximize their opportunity to challenge calls by focusing on balls that are called "out," since they are more likely to be incorrect.

The report also suggests that every shot in professional tennis should perhaps be reviewed by instant replay. "If that proves prohibitively time-consuming, the rules allowing players to challenge referee judgments should be scrutinized at least, in light of the current findings," they wrote. "If all else fails," they added, "perhaps professional tennis venues should follow the French, and universalize the clay court," where skid marks on the clay reduce reliance on the referees' motion perception.

The researchers include David Whitney, Nicole Wurnitsch, Byron Hontiveros, and Elizabeth Louie of The Center for Mind and Brain, University of California in Davis, California.

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