Study sheds light on brain's perception of falling objects

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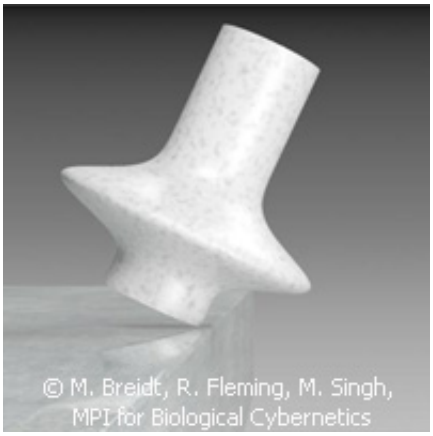

If you thought that judging the position of a falling object is easier when you're lying on your side, think again. New research, led by the Max Planck Institute (MPI) for Biological Cybernetics in Germany and presented in the journal *Public Library of Science (PLoS) ONE*, shows that while the physical laws governing object stability are well represented by the brain, you can better determine how objects fall when you're upright. The results shed new light on existing theories of how humans perceive the physical stability of objects.

According to Newton's laws of motion, an object will fall when its centre of mass lies beyond its base of support. The question, however, is how does your brain know whether the object will fall or not?

"The force of gravity is not sensed directly," explains Dr. Michael Barnett-Cowan, project leader for motion perception at the MPI for Biological Cybernetics and lead author of the study. "It is the indirect effects of gravity that are detected."

In the 1850s, German physiologist Hermann Aubert tilted to one side and saw a vertical line as being tilted towards him. "Since Aubert we now know that the brain combines visual and vestibular information to determine gravity's direction relative to an internal representation of our body's orientation," says Dr. Barnett-Cowan, a postdoctoral neuroscientist from Canada.

The team used laptops to test the study participants' judgement of object stability and vertical line estimates. After testing them in upright positions as well as on their sides, the researchers discovered that people's perception of the chances that an object will fall is relative to this biased perceived direction of gravity rather than the true direction of gravity.

"We might expect the brain to depend primarily on visual heuristics and assumptions about an object when assessing whether it will fall or not," says Professor Roland Fleming, a co-author of the study who is now at the University of Giessen in Germany. "Surprisingly, however, we find that observers' judgements of object stability are biased towards the tilt of the body."

Commenting on the findings, co-author Professor Manish Singh of Rutgers University in the United States says: "Since the work of Jean Piaget it has been known that children and adults have difficulty in solving problems involving the physical laws which govern equilibrium, but in everyday life we seem to be quite good at estimating object stability. Our results suggest that solving such problems may depend on integrating multisensory information."

According to Heinrich Bülthoff, head of the MPI for Biological Cybernetics, the findings provide insight into how our brain combines information from multiple sensory organs to provide an accurate representation of objects, contrary to using single sensory organs, when they do not offer an accurate representation of the physical world.

People for the most part see the world when they're in an upright position. "Here visual, vestibular and body sense cues are aligned and the brain can make use of this redundant information to maintain optimal perception and action, particularly when information from one sense is poor or lost," Dr. Barnett-Cowan says.

More information: Barnett-Cowan, M., et al. (2011) Perceived object stability depends on multisensory estimates of gravity. *PLoS ONE*, published online 27 April. DOI: 10.1371/journal.pone.0019289

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