People plan their movements, anticipate force of gravity by 'seeing it' through visual cues rather than 'feeling it'

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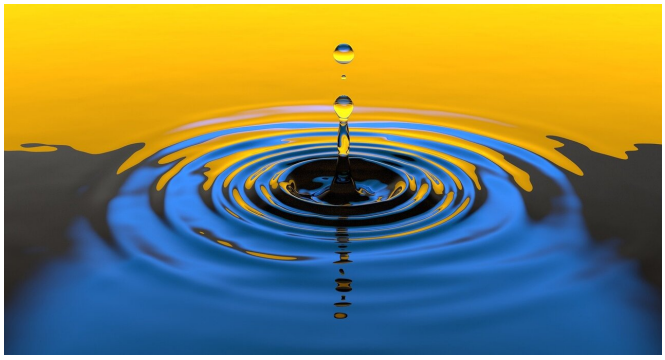

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Gravity is the unseen force that dominates our entire lives. It's what makes walking uphill so difficult and what makes parts of our body eventually point downhill. It is unyielding, everywhere, and a force that we battle with every time we make a move. But exactly how do people account for this invisible influence while moving through the world?

A new study in *Frontiers in Neuroscience* used virtual reality to determine how people plan their movements by "seeing" gravity using visual cues in the landscape around them, rather than "feeling it" through changes in weight and balance. Ph.D. Student Desiderio Cano Porras, who worked in Dr. Meir Plotnik's laboratory at the Sheba Medical Center, Israel and colleagues found that our capability to anticipate the influence of gravity relies on visual cues in order for us to walk safely and effectively downhill and uphill.

In order to determine the influence of vision and gravity on how we move, the researchers recruited a group of 16 young, healthy adults for a virtual reality (VR) experiment. The researchers designed a VR environment that simulated level, uphill, and downhill walking. Participants were immersed in a large-scale virtual reality system in which they walked on a real-life treadmill that was at an upward incline, at a downward decline, or remained flat. Throughout the experiment, the VR visual environment either matched or didn't match the physical cues that the participants experienced on the treadmill.

Using this setup, the researchers were able to disrupt the visual and physical cues we all experience when anticipating going uphill or downhill. So, when participants saw a downhill environment in the VR visual scenery, they positioned their bodies to begin "braking" to go downhill despite the treadmill actually remaining flat or at an upward incline. They also found the reverse—people prepared for more "exertion" to go uphill in the VR environment even though the treadmill remained flat or was pointing downhill.

The researchers showed that purely visual cues caused people to adjust their movements to compensate for predicted gravity-based changes (i.e., braking in anticipation of a downhill gravity boost and exertion in anticipation of uphill gravitational resistance). However, while participants initially relied on their vision, they quickly adapted to the real-life treadmill conditions using something called a "sensory reweighting mechanism" that reprioritized body-based cues over visual ones. In this way the participants were able to overcome the sensory mismatch and keep walking.

"Our findings highlight multisensory interactions: the human brain usually gets information about forces from "touch" senses; however, it generates behavior in response to gravity by "seeing" it first, without initially "feeling" it," says Dr. Plotnik.

Dr. Plotnik also states that the study is an exciting application of new and emerging VR tech as "many new digital technologies, in particular virtual reality, allow a high level of human-technology interactions and immersion. We leveraged this immersion to explore and start to disentangle the complex visual-locomotor integration achieved by human sensory systems."

The research is a step towards the broader goal of understanding the intricate pathways that people use to decide how and when to move their bodies, but there is still work to be done.

Dr. Plotnik states that "This study is only a 'snapshot' of a specific task involving transitioning to uphill or downhill walking. In the future we will explore the neuronal mechanisms involved and potential clinical implications for diagnosis and treatment."

More information: Desiderio Cano Porras et al, Seeing Gravity: Gait Adaptations to Visual and Physical Inclines – A Virtual Reality Study, *Frontiers in Neuroscience* (2020). DOI: 10.3389/fnins.2019.01308