Visual clues we use during walking and when we use them

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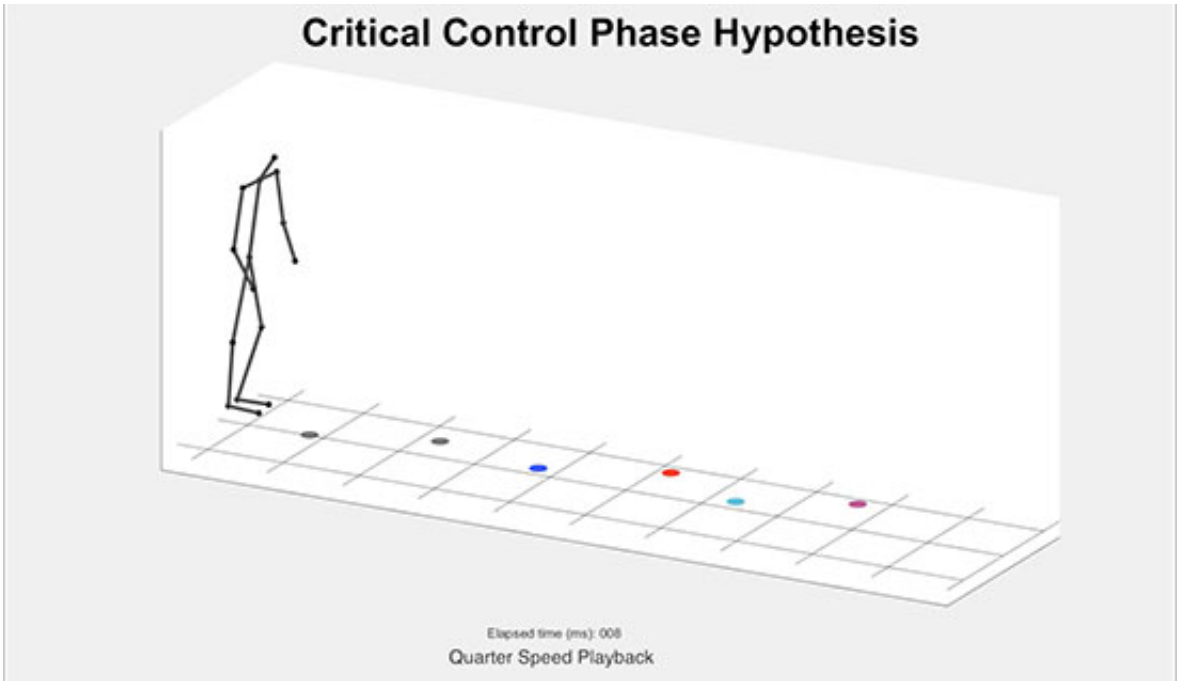

(Medical Xpress)—A trio of researchers with the University of Texas and Rensselaer Polytechnic Institute has discovered which phase of visual information processing during human walking is used most to guide the feet accurately. In their paper published in *Proceedings of the National Academy of Sciences*, the group describes experiments they carried out with volunteers who walked a controlled course and what the researchers found by doing so.

Scientists have noted that despite the frequency of trips and falls, humans are very sophisticated walkers. We have to be, because walking on two legs leaves us constantly open to falling if we make a mistake. Prior research has shown that humans walk forward by lifting one foot, moving it forward, setting it back down onto the ground in front of us and then essentially falling onto it. Doing this repetitively leads to walking in a reasonably smooth fashion. But how do we make judgments and corrections about obstacles in time to keep from stumbling? In this new effort, the researchers enlisted the assistance of 44 volunteers between the ages of 18 and 22 and asked them to walk across a flat surface with illuminated targets for the volunteers to step on.

The researchers varied when the targets were illuminated and also how long they stayed visible, creating a variety of challenges for the volunteers. As the volunteers went through their paces, the researchers noted which challenges they faced and took measurements regarding how well they solved them, such as how much time transpired during each step.

The researchers found that the accuracy of the volunteers was greatest when they were able to make a stride adjustment during the last one and a half steps. In other words, rather than keeping track of all of the obstacles coming up, the brain mostly focused on just the few feet in front of the person, making corrections quickly on the fly. They also found that the brain did note upcoming obstacles—the volunteers did better when they could see two obstacles in sequence. They suggest that their results show that visual cues confer the ability to walk over complex terrain with efficiency.

More information: The critical phase for visual control of human walking over complex terrain, *Proceedings of the National Academy of Sciences* (2017). DOI: 10.1073/pnas.1611699114 ,

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Abstract

To walk efficiently over complex terrain, humans must use vision to tailor their gait to the upcoming ground surface without interfering with the exploitation of passive mechanical forces. We propose that walkers use visual information to initialize the mechanical state of the body before the beginning of each step so the resulting ballistic trajectory of the walker's center-of-mass will facilitate stepping on target footholds. Using a precision stepping task and synchronizing target visibility to the gait cycle, we empirically validated two predictions derived from this strategy: (1) Walkers must have information about upcoming footholds during the second half of the preceding step, and (2) foot placement is guided by information about the position of the target foothold relative to the preceding base of support. We conclude that active and passive modes of control work synergistically to allow walkers to negotiate complex terrain with efficiency, stability, and precision.