Stimulation of the semicircular canals can artificially control human walking and balance

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By applying electrical currents across the heads of people while they walk, researchers have improved our understanding of how our vestibular system helps us maintain upright posture; at the same time, the researchers found that the stimulus could be applied in a way that allowed a person who was walking straight ahead to be steered by "remote control" without her balance being affected.

The findings are reported by Richard Fitzpatrick and Jane E. Butler of the Prince of Wales Medical Research Institute and the University of New South Wales, Australia, and Brian L. Day of University College London in the August 8th issue of *Current Biology*, published by Cell Press.

To investigate how the body's ability to sense head movements can contribute to balance control and guidance control--two critical aspects of bipedal locomotion--the researchers stimulated nerves that normally communicate signals from the so-called semicircular canals, structures that are part of the vestibular system that assists in orientation and balance. The researchers found that artificial stimulation of semiciruclar canal nerves afforded "remote control" that was accurate enough to keep subjects on pathways and avoiding obstacles while walking blindfolded through botanical gardens. The researchers also found that with a subject's head in another position, exactly the same stimulus could be used to disturb upright balance, causing the subject to lean in one direction or the other, but without having any effect on steering his walking.

Known as bipedalism, our habitual upright posture is unique in the animal kingdom and has arisen through specific complementary adaptations of the body and brain. It has been believed that the key to human balance has come from a precise sense of--and ability to align the body to--the direction of gravity.

However, the semicircular canals that the researchers stimulated to control walking and balance detect rotational movements of the head, not the direction of gravity. These findings therefore show that sensing movement is crucial for our upright posture.

The findings support interpretations made from fossil evidence of an evolutionary change in the development of the human semicircular canals. These evolutionary changes would allow for enhanced movement detection, and therefore also indicate that that controlled movement, rather than alignment to gravity, has been important for the development of modern human bipedalism.

This new work has important implications for understanding how the brain processes sensory signals.

According to the researchers, the findings indicate that from the single sensory organ that signals the movement of the head, the brain makes instant complex "mathematical" calculations to discard the parts not important to balance or steering, such as the movements we make when looking around, and then transforms the remaining signal into two components. One component is used to control steering, and the other to control balance. In a more practical view, this ability to produce illusions of movement, and then steer and balance the body by external control, leads the researchers to expect that stimulation techniques developed from the approach used in the new study will lead the way to diagnostic, therapeutic, and virtual-reality applications.

Source: Cell Press

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