Movement's sixth sense

January 5 2006

Have you ever tried to balance on one foot with your eyes closed? No problem, you think? Well, just try it.

As it happens, closing your eyes makes it very difficult to balance on one foot, because it removes some very important sensory information. Balancing is an activity that requires the proprioceptors - sensors in the muscles, tendons, and skin. These sensors detect touch, force, and changes in a muscle's length in order to sense movement or sense the position of your limbs. Your ability to maintain the position of your body relies on the normally subconscious ability to combine sensory information from the proprioceptive, visual, and vestibular (the system in the middle ear which senses movements of the head) systems.

"Proprioception is like a sixth sense for the production of movement," explains Heritage Scholar Dr. Kelvin Jones. He investigates the role this sixth sense plays when people must relearn basic movements and motor behaviours after brain injury.

In his investigation, Jones, a University of Alberta professor of biomedical engineering, uses a virtual reality system where the visual and force feedback resulting from movement can be separately altered. Using this system, a task such as moving the hand to the right might result in a completely opposite on-screen movement. "The motor command that the brain puts out no longer gives the subjects the output visually that they're sensing from their movements," Jones said of the experiments. "The brain has to figure out how to reprogram the movements of the arm in order to get the desired outcome. The big

problem is that the proprioceptive system and the visual system are giving conflicting information."

To study the adaptation that occurs when people do tasks of this sort, Jones records the neural activity coming from the proprioceptor sensors in the muscles. He expected to find that the brain makes the sensors fire a lot faster when learning this type of challenging task that separates the visual and proprioceptive systems. In fact, he discovered the opposite: that those people who can quickly "turn off" their proprioception learn the task more quickly. Meanwhile, those rare people who have lost their proprioceptive fibres due to disease have no problem whatsoever with the tasks because there is no conflict between their visual and their proprioceptive sensory systems.

In another branch of his research, Jones works on a computer-based tool to help diagnose ALS (amyotrophic lateral sclerosis, also known as Lou Gehrig's disease), a neurodegenerative disease in which motor nerve cells gradually die. Some of Jones' interest in restoring movement stems from his days as a graduate student, when the case of ALS patient Sue Rodriguez was in the media and before the courts.

Faced with the gradual wasting away of her muscles and the certainty of her eventual death, Rodriguez sought the legal right to assisted suicide. She lost the right-to-die battle in the courts, but ultimately took her own life anyway, with the help of a doctor.

"It was a real bioethics awakening in me in terms of what it would mean to a person who was losing the ability to move," said Jones. "Sue's case had a real impact on me."

Source: University of Alberta