Joint Department of

BIOMEDICAL ENGINEERING

UNC CHAPEL HILL | NC STATE UNIVERSITY

Coulter Seminar Series Presents

Rehabilitation Engineering

"It's the Wrong Hand!" Why treat the *good hand* in Stroke Patients?

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Bob Sainburg the *Dorothy Foehr Huck and J. Lloyd Huck Distinguished Chair* in Kinesiology and Neurology at Penn State University in the Huck Institute of Life Sciences. He manages two laboratories, the Movement Neuroscience laboratory at Penn State University, department of Kinesiology on the main campus and the Neurorehabilitation Research Laboratory at Penn State College of Medicine, department of Neurology. His research program is fundamentally translational, focusing on understanding basic neural mechanisms that underlie control, coordination, adaptation, and learning of voluntary movements in humans. A major theme of his research has been neural lateralization for motor control. His research in patient populations addresses the functional neuroanatomy underlying lateralized processes of motor control, and the deficits that occur due to neuronal damage to the associated structures. His research has led to a model of neural lateralization that attributes different aspects of control to each hemisphere, such that each hemisphere contributes unique control mechanisms to both sides of the body. This bi-hemispheric model of motor control has been able to predict hemisphere-specific deficits in both arms of unilaterally lesioned stroke patients. Most importantly, this work has led to a mechanistic understanding of non-paretic arm (ipsilesional) motor deficits in stroke patients. His current research along with Collaborator Carolee Winstein PT PhD at USC is exploring occupational therapy and physical therapy based clinical intervention that uses virtual reality and real-world training to ameliorate these deficits and improve functional independence in stroke patients.

ABSTRACT Our research on motor lateralization has suggested that the apparent "dominance" of one hand is not simply due to practice, but stems from differences in how each side of the brain controls movement. Motor lateralization indicates that one side of the brain does things that the other side doesn't, requiring both sides of brain to contribute to the control of each arm. Our findings have suggested that the dominant hemisphere/hand is best at predictive aspects of executing an accurately aimed and smooth movement, but not so much at responding to unpredictable conditions. The non-dominant hand is very good at countering unpredictable forces, through control of limb impedance, but not so good at making smooth, straight movements. To test our hypothesis that each hemisphere might be specialized for these two aspects of control, we studied individuals who suffered an ischemic stroke in one side of the brain and as a result had severe movement deficits in the opposite arm and hand. While conventional wisdom suggested that the "good hand" would be unaffected by the stroke, our results showed otherwise. In patients with right-hemisphere damage, the right hand did badly on tests of how accurately it could stabilize at the end of a reaching movement, while in patients with left-hemisphere damage, the left hand did badly on making straight and accurately aimed movements. Most importantly, our studies indicated that these hemisphere specific movement deficits in the "good hand" of stroke patients substantially limited their functional independence in patients with severe paresis of their 'bad hand". This is because 1) these patients rely exclusively on their good hand for activities of daily living and 2) Ipsilesional (good hand) deficits vary with the severity of contralesional (bad hand) paresis. Taking these findings into account, we designed and tested an intervention study to improve functional independence by focusing on control and coordination of the 'good' hand in stroke patients. Our pilot study (recently published) showed strong positive results that led to a large multi-center intervention study that we are currently conducting. We expect that the results of this study will lead to more comprehensive approaches to rehabilitation.

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