



Mark L. Latash

The Pennsylvania State University

Presentation Title:

Synergic control of movement: From single muscles to the whole body

Abstract:

Within his multi-level scheme for the construction of movement, Nikolai Bernstein defined synergies as neural organizations of elements with two functions: (1) To group elemental variables and alleviate the problem of redundancy; and (2) To ensure dynamical stability of salient performance variables. This definition has led to the emergence of two toolboxes, matrix factorization methods and analysis of co-variation, in particular, within the uncontrolled manifold hypothesis. Over the past years, these methods have been applied to identify and quantify synergies across spaces of elemental variables, tasks, and populations. The concept of synergy is readily compatible with the idea of movement control using neural variables that define spatial referent coordinates (RCs) for the effectors at different levels of the presumed hierarchy, from whole-body movements, to limb movements, to actions of individual muscles, and to individual motor units. This chapter reviews studies of healthy persons and patients with various neurological disorders and demonstrates that the introduced framework is inherently rich and able to account for a variety of known facts as well as predict new non-trivial findings. Studies of synergies offer a potentially powerful toolbox to explore early

impairments in the control of action stability, effects of treatment, and the role of supraspinal and spinal circuitry in stability of action.

Short CV:

Mark Latash is a Distinguished Professor of Kinesiology and Director of the Motor Control Laboratory at the Pennsylvania State University. He was trained in Physics, Physics of Living Systems, and Physiology in the Moscow Physics and Technology Institute and Rush University in Chicago. His research is focused on the control and coordination of human voluntary movements and movement disorders. He is the author of “Control of Human Movement” (1993), “The Neurophysiological Basis of Movement” (1998, 2008, 2022), “Synergy” (2008), “Fundamentals of Motor Control” (2012), “Biomechanics and Motor Control: Defining Central Concepts” (with Vladimir Zatsiorsky, 2016), and “Physics of Biological Action and Perception” (2019). In addition, he translated and edited two books by Nikolai Bernstein, “On Dexterity and Its Development” (1996) and “On the Construction of Movements” (2020), edited ten books and published over 450 papers in refereed journals. Mark Latash served as the Founding Editor of the journal “Motor Control” (1996-2007) and as President of the International Society of Motor Control (2001-2005). He has served as Director of the annual Motor Control Summer School series since 2004. He is a recipient of the Bernstein Prize in motor control.