



Professor Mark Latash

Professor Mark Latash is one of the most renowned authors contributing to the development of the Journal of Human Kinetics. He has published several significant papers in the area of motor control throughout the past years. His personality and enormous knowledge have inspired many young scientists from the Academy of Physical Education in Katowice to undertake research in motor control and motor learning. Professor Latash helped in the development of several scientists from our Academy by providing scholarships at Penn State University and new research ideas. Acknowledging all his achievements and the partnership with our Academy which is the publisher of Journal of Human Kinetics we would like to present his short scientific biography, followed by one more of his excellent papers entitled: Motor Control: In Search of Physics of the Living Systems

Curriculum Vitae

Mark Latash started his research career in 1974 when he, an undergraduate student in the Moscow Physico-Technical Institute, joined the Laboratory of Victor Gurfinkel in the Institute for Problems of Information Transmission in Moscow. His first studies were related to the effects of reflex reversal, that is reflex muscle contractions that could be seen in different muscle groups in response to a standard stimulus. The observed reversals of the tonic vibration reflex allowed to link the spinal mechanisms of this reflex to a spinal locomotor generator. His first journal paper was published in 1976 in "Human Physiology" (Fiziologija Cheloveka). Further, in the 1970-s, Mark Latash explored the role of mono-synaptic and polysynaptic loops in the tonic vibration reflex and effects of vibration on postural control. Three papers were written at that time, accepted for publication by "Human Physiology", and ultimately published only about 13 years later. The delay was due to the application of Mark Latash and his family for emigration, which made then enemies of the Soviet Union. The application was refused for 8 years, Mark Latash lost his job and was forced to find other occupations. Those included working as an archaeologist for 6 years and as an engineer in the Moscow Spinal Cord Trauma Center for 3 years. Over the same time, Mark Latash started to work

with Anatol Feldman, the founder of the equilibrium-point hypothesis. Their early collaboration resulted in three papers published in 1982 in *Biological Cybernetics*, *Journal of Motor Behavior*, and *Neuroscience Letters*, which developed the equilibrium-point hypothesis to account for phenomena of kinesthetic perception and illusions. In 1987 Mark Latash emigrated to the USA as a political refugee and started his second scientific career in the Laboratory of Gerry Gottlieb at Rush-Presbyterian St.Luke's Medical Center in Chicago. Mark Latash spent eight years in Chicago, defended a Ph.D. in Kinesiology and was ultimately appointed Associate Professor in the Department of Physical Medicine and Rehabilitation. While at Rush Medical Center, Mark Latash was involved in both clinical and basic studies of motor control. The clinical studies involved the first double-blind study of the effects of intrathecal baclofen to treat spasticity, which demonstrated the effectiveness of this treatment for suppressing spastic signs and unmasking better voluntary movements. Other studies addressed the feed-forward control of vertical posture and multi-joint movements in patients with Parkinson's disease, fatigue in patients with multiple sclerosis, and motor coordination and its changes with practice in persons with Down syndrome. During that time, Mark Latash organized two Conferences "Motor Control in Down Syndrome", in 1989 and in 1994, and published his first

book "Control of Human Movement" in 1993. Basic studies involved several directions. In particular, a new method was developed for the experimental reconstruction of hypothetical control variables within the framework of the equilibrium-point hypothesis. The hypothesis was developed to account for electromyographic patterns during voluntary movements and for the phenomena of motor variability. Experimental studies of the wrist-elbow coordination led to the first formulation of the notion of synergy as a neural mechanism that ensures stability of specific movement variables. One of the less known, but maybe most exciting, studies of that period addressed relativistic effects during single-joint voluntary movements. In 1995, Mark Latash moved to the Pennsylvania State University, where he currently is appointed as a Distinguished Professor of Kinesiology. At Penn State, Mark Latash founded the Motor Control Laboratory and has been working as its Director since. He started a very productive collaboration with a famous biomechanist, Prof. Vladimir Zatsiorsky. Over the past 15 years, Zatsiorsky and Latash co-authored over 110 journal papers and also co-edited a book "Classics in Movement Science". While at Penn State, research of Mark Latash continued to explore a broad variety of issues in motor control. In particular, his studies addressed the control of vertical posture, the coordination of joints in reaching tasks, and the coordination of digits in multi-digit pressing and prehensile tasks. All these studies were based on what can be called "physical approach" to motor control, an approach that uses the language and tools of physics and neurophysiology to explore the role of the central nervous system in the production of natural movements. Research of Mark Latash has been based on two major theories, the equilibrium-point hypothesis (or, more exactly, on its development in the form of the referent configuration hypothesis) and on the theory of motor synergies based on a particular approach to the problem of motor redundancy called the principle of abundance. Within the latter approach, Mark Latash contributed to the development of the apparatus of the uncontrolled manifold hypothesis and used it to explore and quantify multi-element synergies in a

variety of motor tasks. Major advances in that direction involved the development of a novel method for analysis of multi-muscle synergies, the discovery of a new phenomenon called anticipatory synergy adjustments, the formulation and experimental confirmation of the principle of superposition for prehensile tasks, and the exploration of synergies within hierarchical systems. Most recently, a series of studies linked the two main theories, the referent configuration hypothesis and the theory of synergies, into a single coherent scheme of control of multi-element systems that participate in voluntary movements. In parallel, Mark Latash continued to perform applied studies using the tools developed in the basic studies. In particular, he used the framework of the uncontrolled manifold hypothesis to quantify abnormal multi-finger synergies in persons with Down syndrome and changes in such synergies with practice. He also studied changes in finger interaction and hand function that occur in the process of healthy aging and the effects of strength training on multi-finger synergies and accuracy of performance. Other studies explored changes in motor synergies with practice in young persons and changes in corticospinal mechanisms explored with transcranial magnetic stimulation. Currently, research in the Motor Control Laboratory addresses such diverse issues as relations between anticipatory postural adjustments and anticipatory synergy adjustments, differences between synergies involved in discrete and cyclic tasks, equilibrium-point control of passive and active movements, relations between optimization principles and synergic control of the hand, and even natural speech production. This line of research has received non-stop support from the National Institutes of Health of the USA in the total amount of over 5 million US\$. During his tenure at Penn State, Mark Latash organized a series of International Conferences currently known as "Progress in Motor Control", started a new journal *Motor Control* and served as its editor for 10 years, initiated the creation of the International Society of Motor Control and served as its first President for 4 years, and started a series of Motor Control Summer Schools (run annually over the past 7 years).