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Presentation Title:

Exploring to learn synergies and its applications in rehabilitation after stroke and in upper limb prosthetics

Abstract:

People with an injury or movement disorder (e.g., stroke or limb amputation) need to learn to perform tasks in daily life in a different way than before. This is an important focus of rehabilitation. Performing a task in daily life in a goal-directed manner requires coordination of the abundant degrees of freedom in the movement system. We assume that to this end degrees of freedom are coordinated in synergies, defined as temporary functional organizations of degrees of freedom that stabilize task performance. This implies that to learn a task, most likely new synergies need to be formed. This process entails searching for synergies in the space created by the degrees of freedom relevant for that task. This exploration for synergies entails variability in the coordinative patterns of degrees of freedom. Variability in degrees of freedom that does affect task performance might be considered as exploration for a new synergy, whereas variability in degrees of freedom that does not affect task performance might be exploration to meet more task

constraints. In this presentation we discuss several aspects of those explorative processes and its relevance to translation of motor learning principles. We describe the search for new synergies in two experimental tasks. In one set of studies participants learned a new redundant mapping between joint angles and an avatar on the screen, requiring novel synergies. The experiments manipulated different types of variability and the degree of redundancy of the task. In an other sest of studies participants learned a new redundant mapping between muscle activations and an avatar on the screen comparing intuitive and non-intuitive mappings. The results of these findings will be discussed with respect to the translation to rehabilitation trainings in stroke and in prosthetic use of people after a hand or arm amputation, respectively.

Short CV:

Raoul Bongers received his PhD from the Radboud University Nijmegen in the area of developmental psychology. For 20 years he works at the Department of Human Movement Sciences of the University Medical Center Groningen, University of Groningen. His research focuses on motor coordination and motor learning from an action-perception perspective. He is interested in fundamental issues in motor learning, in particular how people learn to coordinate their degrees of freedom in new synergies. He applies these insight to develop rehabilitation strategies in upper limb prosthesis for more than 15 years and recently also to stroke rehabilitation.