



Time for Action: An Introduction to the Special Issue

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In May of 2018, the Psychonomic Society Leading Edge Workshop titled “*Time for Action: Reaching for a Better Understanding of the Dynamics of Cognition*” was held in Amsterdam. The overarching goal of the workshop was to share and discuss data and theoretical perspectives that advance the understanding of how cognition and action systems are integrated and operate synergistically. This knowledge is critical for generating a complete understanding of human behavior and will help shape the design of everyday objects and technologies as well as training and working environments. Videos of the lectures are available via the following link on the Psychonomic website: <https://www.psychonomic.org/general/custom.asp?page=2018workshop>. On the basis of the interest shown during this workshop and the timely importance of the topic, we have organized this companion special issue in *Attention, Perception, & Psychophysics*.

To effectively interact with objects and people within very complex environments, humans must be able to prioritize, select, integrate, and interpret a subset of the vast amount of available sensory information. Historically, the transformation of sensory inputs into action has been treated as a set of relatively unidirectional serial processing events, with the results of low-level sensory and earlier perceptual processes informing higher-order cognitive processes until a decision is made to respond. Once the decision is made, the motor system receives its instructions and the goal-directed action is executed. Given this approach and conceptualization of the human sensori-cognitive-motor system, it may not be too surprising that there has been relatively little interaction

between researchers in cognitive and motor domains. Researchers in cognitive psychology have focused on how humans perceive the world and solve complex problems, whereas researchers in motor control have largely focused on the underlying neurophysiological, anatomical, sensory, and related mechanisms that enable action planning and control. As a consequence of these conventional serial processing approaches, however, a deeper understanding of human behavior has been hindered because little attention has been paid to the broader context of action and how action processes are embedded in the larger canvas of cognitive processes including perception, prioritization, memory, learning, decision-making, and interpersonal interaction.

Although it is clear that the products of cognitive processing are expressed through action, there are strong indications that the motor system is not only a receiver of the output of sensory and cognitive processing, but an active contributor to that processing. There is mounting evidence that the context of the action and the processes of action planning can influence and shape sensory and cognitive processes. Thus, there appears to be a bi-directional interaction between cognition and action, with cognitive processes shaping the manner in which one executes actions and action demands shaping the way one perceives and thinks about the world. The Leading Edge Workshop and the present special issue were developed to disseminate past and current work on the interactions between cognition and action, and to chart a course forward for future knowledge generation and translation in this area. To achieve these goals, we sought contributions from researchers across multiple areas, including, but not limited to, psychology, neuroscience, kinesiology, and human-computer interactions, to share and critically evaluate their theoretical, empirical, and translational work.

The result of these calls are a workshop and a special issue that contains a broad scope of talks and papers encompassing experimental, theoretical, computational, and clinical studies, as well as methodological approaches. We sincerely thank all presenters and authors for their efforts and intellectual contributions. Below we provide a very small summary of the main

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themes and topics covered in this special issue. We hope that readers find this work as enlightening and inspiring as we do.

The special issue opens with a series of papers that set the theoretical and historical context and provide evidence for the interactions of cognition and action that has emerged from both behavioral and neuroscience fields. These papers contain critical reviews of research and models generated across the fields of cognitive psychology and neuroscience (Rosenbaum, 2019 [this issue]; Hommel, 2019 [this issue]; Hubbard, 2019 [this issue]; Anzulewicz et al., 2019 [this issue]; Cole et al., 2019 [this issue]; Glass, 2019 [this issue]; Flindall & Gonzalez, 2019 [this issue]; Grossberg, 2019 [this issue]). The final two papers of this section outline ways of re-conceptualizing sensori-cognitive-motor interactions and aim to inspire new approaches to understanding human behavior (Cisek, 2019 [this issue]; Hommel et al., 2019 [this issue]).

The second section of the special issue provides reports of new experimental evidence that advances our understanding of human behavior. This research, which has emerged in multiple fields in parallel, converges thematically in that it reveals and emphasizes the possible bi-directional interactions between motor and cognitive processes. The papers in this section address the relation between mechanisms of prioritization, selection, cognitive dynamics, and decision-making and goal-directed actions. One set of papers reports evidence of the interaction between the motor system and diverse processes as perception (Agauas & Thomas, 2019 [this issue]; Dotov et al., 2019 [this issue]; Buckingham & Donald, 2019 [this issue]), visual search (Meghanathan et al., 2019 [this issue]; Smith et al., 2019 [this issue]), agency (Potts & Carlson, 2019 [this issue]), music (London et al., 2019 [this issue]; Greenspon & Pfordresher, 2019 [this issue]), recognition of object-directed actions (Decroix & Kalénine, 2019 [this issue]), cognitive load (VonderHaar et al., 2019 [this issue]), and learning and memory (Wakefield et al., 2019 [this issue];

Halvorson et al., 2019 [this issue]; Zhou & Mou, 2019 [this issue]). A second set of papers employ motion capture and other technologies to record the trajectories and patterns of movements to generate new understanding of the dynamics of cognitive processes such as language (Lins & Schöner, 2019 [this issue]), social cues (Yoxon et al., 2019 [this issue]), and symbolic cues (Swansburg & Neyedli, 2019 [this issue]). Finally, given the growth in using different types of movement and motion-capture systems in studies of sensori-cognitive-motor systems, we conclude the special issue with a set of papers that address both theoretical and methodological issues (Ruitenberg et al., 2019 [this issue]; Grage et al., 2019 [this issue]; Moher & Song, 2019 [this issue]). We hope that including this work will help plot the course for future research in these areas and establish consistent and valid methods (or at minimum sensitive people) that will help get all researchers there.

Taken together, we envision that the outcomes of this special issue will contribute to theoretical advancements gained by real-time read-out of internal perceptual and cognitive dynamics and enable the field to further understand how the mind synergistically operates to achieve adaptive behaviors in the complex real world.

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