SPECIAL ISSUE
THE CONSTRUCTION OF ACTION:
NEW PERSPECTIVES IN MOVEMENT SCIENCES
PART 1
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Meyer & Meyer Sport
INTERNATIONAL JOURNAL
OF SPORT AND EXERCISE PSYCHOLOGY
VOLUME 2 – NUMBER 3 – SEPTEMBER 2004

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PERCEPTUAL AND COGNITIVE CONTROL IN ACTION –
A PREFACE

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The debate surrounding the dichotomy of two main approaches in movement science has been dominating discussions in sport psychology and movement science for more than two decades. Whereas the more ecologically oriented approach (perception-action coupling; the action approach) defines movement coordination in non-linear dynamic and synergetic terms; the motor approach focuses on the motor system and, frequently, motor programs. Some years ago, the discussion over valid approaches in the field of motor control and learning was described as a paradigm crisis (Abemethy & Sparrow, 1992). Nowadays, the debate between these two competing perspectives finally seems to be more settled, “with both sides agreeing to disagree” (Summers, 1998).

A closer inspection, however, reveals the emergence of a class of new approaches. These show remarkable similarities with one another but cannot be aligned with either side in the traditional debate. These new approaches have many views in common. They emphasize the goal-directedness of actions, the importance of anticipated perceptual effects, and the crucial role of mental representations in action control. Traditionally, the primary problem of motor control has to organize the correct pattern of muscular activation. The perceptual-cognitive approaches, in contrast, propose that the crucial step is constructing the appropriate mental representations, because these representations primarily govern the tuning of motor commands and muscular activity patterns. Hence, such approaches are characterized by the common idea that voluntary movements might basically be planned, performed, and stored in memory by way of representations of anticipated effects. An increasing number of studies in sport psychology (e.g., Schack & Tenenbaum, 2004), general psychology (e.g., Nattekemper & Ziessler, 2004), and neuropsychology (e.g., Jeannerod, 2004) seem to support this idea.

Perceptual-cognitive control might act on many levels, spanning the range from simple perceptual-motor interactions to sophisticated goal planning and movement construction processes. As a result, a number of psychological and neuropsychological papers share the opinion that actions establish a cognitive structure and are subject to perceptual-cognitive control. The perceptual-cognitive approach to movement control means a renaissance and revitalization of classic ideas such as the “ideomotor” approach adopted by James (1890) and Lotze (1852) in the 19th century or the model-theory studies on the construction of movement presented by Bernstein in the middle of the 20th century (Bernstein, 1947). Actually, this perspective never disappeared completely; it seems to have become eclipsed by the dominant controversy between the motor and action approaches. Nowadays, as the strong limitations of these approaches become increasingly obvious, the notion is emerging that a perceptual-cognitive framework might well be the way to overcome them. Obviously, there is still much to
be done. However, a growing body of new insights and the high level of experimental and theoretical work investigating the perceptual-cognitive approach make a very promising impression. The emerging perceptual-cognitive perspective is of particular significance for sport psychology, because it can be applied to complex movements. This makes it possible to consider vital questions on action control in a new light. The goal of this Special Issue is to compile a selection of current work highlighting a perceptual-cognitive approach, and thus to open up a field for new perspectives and discussions.

The Construction of Action: New Perspectives in Movement Science is divided into two special issues: Part I is the current issue and contains papers that can be classified under the topic of Perceptual and Cognitive Control in Action, and provides an introduction to the perceptual-cognitive perspective, assembling the building blocks to form a foundation of statements. Part II, Representation and Planning, will be published in Number 4/2004.

The papers were written by highly regarded scientists working in the fields of general psychology, neuropsychology, bioengineering, and sport psychology in order to map out those fields and perspectives in research that can be grouped together to form a perceptual-cognitive approach. These papers from various scientific disciplines and laboratories address different aspects of the construction of action, each contributing its own building blocks that may fit together with the others. The papers are organized into two main groups.

The first section of the current issue “Perceptual and Cognitive Control” is concerned with Perceptual-Cognitive Constraints in Coordination. In the first paper, Franz Mechsner questions the long-dominant assumption in the movement sciences that the symmetry tendency in bimanual coordination originates at a motor command level. He presents various experiments supporting the hypothesis that bimanual coordination is guided and controlled by perceptual-cognitive representations. This opens up a new field for discussions and perspectives. The second paper in this section, written by Rebecca Spencer, Eliot Hazeltine, Andras Semjen, and Richard Ivry, deals with the role of movement goals during the performance of bimanual movements. This paper supplements Mechsner’s statements with a further important aspect. It becomes clear that task goals have a major impact on the representation of movement patterns, thus influencing the control of movements.

The next section addresses the Interaction of Perceptual and Cognitive Components in Sensorimotor Control. Karl-Theo Kalveram uses a biocybernetic perspective to consider how perceptual goals, planning processes, representation, and other perceptual and cognitive components of action interact to produce sensorimotor control. Kalveram takes a traditional approach that integrates physical processes into the sensorimotor domain, and he develops an inverse model of movement control. In this paper, he tries to find an interface to the construction of action through a biologically plausible model of movement control that functions on the basis of perceptual goals.

The third section deals with Cognitive Control and Perceptual Search Behavior in Sport and presents approaches to a perceptual-cognitive perspective in complex movements and discusses selected components of a construction of action. Sue McPherson and Joan Vikkers address Cognitive Control in Motor Expertise. They focus on the contribution of problem

Part II of the special issue will build on Part I with additional sections. The section Anticipatory Control and Representation will feature a paper from Joachim Hoffmann, Christian Stoecker, and Wilfried Kunde on Anticipatory Control of Action as well as a paper from Iring Koch, Peter Keller, and Wolfgang Prinz on The Ideomotor Approach to Movement Control: Implications for Skilled Performance. This will be followed by a section on The Construction of Representations in Action with a paper from Marc Jeannerod on Action From Within and Thomas Schack on Cognitive Architecture of Complex Movement. The second part will conclude with a section on Action Planning containing a paper by David Rosenbaum, Jonathan Vaughan, and Ruud Meulenbroek entitled What is the Point of Motor Planning?

REFERENCES


Authors’ Note

We gratefully acknowledge the contributions of the following reviewers of this special issue: Joachim Hoffmann, Christian Stoecker, Marc Jeannerod, Joan Vikkers, Karl-Theodor Kalverom, Mark Williams, Gershon Tenenbaum, Rebekka Spencer, Wilfried Kunde, Iring Koch, Thomas Schack, and Ruud Meulenbroek.

We would like to thank Eva Geburzi (German Sport University Cologne) for supporting our editorial work.