



Multisensory integration in action control

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Edited and reviewed by:

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Keywords: human information processing, perception, tool use, recalibration, reference frame, vision, haptic, acoustics

The integration of multisensory information is an essential mechanism in perception and action control. Research in multisensory integration is concerned with how the information from the different sensory modalities, such as the senses of vision, hearing, smell, taste, touch, and proprioception, are integrated to a coherent representation of objects (for an overview, see e.g., Calvert et al., 2004). The combination of information from the different senses is central for action control. For instance, when you grasp for a rubber duck, you can see its size, feel its compliance and hear the sound it produces. Moreover, identical physical properties of an object can be provided by different senses. You can both see and feel the size of the rubber duck. Even when you grasp for the rubber duck with a tool (e.g., with tongs), the information from the proximal hand, from the effective part of the distal tool and from the eyes are integrated in a manner to act successfully (for limitations of this integration see Sutter et al., 2013).

Over the recent decade a surge of interest in multisensory integration and action control has been witnessed, especially in connection with the idea of a statistically optimized integration of multiple sensory sources. The human information processing system is assumed to adjust moment-by-moment the relative contribution of each sense's estimate to a multisensory task. The sense's contribution depends on its variance, so that the total variance of the multisensory estimate is lower than that for each sense alone. Accordingly, the validity of a statistically optimized multisensory integration has been demonstrated by extensive empirical research (e.g., Ernst and Banks, 2002; Alais and Burr, 2004; Reuschel et al., 2010), also in applied setting such as tool-use (e.g., Takahashi et al., 2009; in the present research topic: Takahashi and Watt, 2014).

For this perspective to mature it will be helpful to delve deeper into the multisensory information processing mechanisms and their neural correlates, asking about the range and constraints of these mechanisms, about its localization and involved networks. The contributions to the present research topic range from how information from different senses and action control are linked and modulated by object affordances (Garrido-Vásquez and Schubö, 2014), by task-irrelevant information (Juravle et al., 2013; Wendker et al., 2014; for a review see Wesslein et al., 2014), by temporal and spatial coupling within and between senses (Cameron et al., 2014; Mueller and Fiehler, 2014; Rieger et al., 2014; Sugano et al., 2014) to childhood development of multisensory mechanisms (Jovanovic and Drewing, 2014).

Correspondences between the information from different senses play an important role for multisensory integration.

Integration does, for instance, not take place when vision and touch are spatially separated (e.g., Gepshtein et al., 2005). However, cognitive approaches on action effect control assume that information from different senses is still coded and represented within the same cognitive domain, when the information concerns the same action (e.g., Müsseler, 1999; Hommel et al., 2001). The present research topic also addresses the corresponding issue of modality-specific action control (Boutin et al., 2013; Grunwald et al., 2014).

Overall, the present research topic broadens our view on how multisensory mechanisms add to action control. We thank all authors and all reviewers for their valuable contributions.

ACKNOWLEDGMENT

This research was supported to by a grant from the Deutsche Forschungsgemeinschaft (DFG, German Research Foundation) to Christine Sutter and Jochen Müsseler (DFG MU 1298/10).

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Conflict of Interest Statement: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Received: 16 May 2014; accepted: 16 May 2014; published online: 10 June 2014.

Citation: Sutter C, Drawing K and Müsseler J (2014) Multisensory integration in action control. *Front. Psychol.* 5:544. doi: 10.3389/fpsyg.2014.00544

This article was submitted to *Cognition*, a section of the journal *Frontiers in Psychology*.

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