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COMMENTARY ON WULF

GOALS, ATTENTION, AND THE DYNAMICS OF SKILL ACQUISITION: COMMENTARY ON WULF

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Gabriele Wulf betont in ihrem Forschungsüberblick die Rolle der Aufmerksamkeit für das motorische Lernen. Wenngleich die empirische Befundlage deutlich zeigt, dass der Aufmerksamkeitsfokus von Bedeutung ist, bleiben die zugrunde liegenden Mechanismen noch weitestgehend unverstanden. Zukünftige Theoriearbeit sollte auf die Aufschlüsselung möglicher Kosten eines internalen Fokus und möglicher Gewinne eines externalen Fokus sowie auf die zeitliche Dynamik des Fertigkeitserwerbs gerichtet sein.

Schlüsselwörter: Aufmerksamkeitsfokus, interne Bewegungsrepräsentation, antizipative Verhaltenskontrolle, Verhaltenswirkung, Forschungsmethodologie

Gabriele Wulf discusses an interesting line of research and rightly emphasizes the importance of the attentional set in learning motor skills. However, while the empirical evidence clearly suggests that the attentional focus matters, the way how it does so is not yet well understood. Future theorizing needs to disentangle the possible costs of adopting an internal focus from the possible benefits of adopting an external focus, and to consider the temporal dynamics of skill acquisition.

Keywords: attentional focus, internal movement representation, anticipatory behavior control, behavioral effect, research methodology

Wulf's (2007) target article provides a thought-provoking overview of an impressively rich and creative line of research with important practical implications. Even though more research is certainly necessary to extend the theoretical approach to more, and especially more complex skills, it is fair to say that it already does a good job in accounting for a number of findings and for stimulating research in an interesting domain. But, as I will explain, there is both room and need for further improvement. My commentary targets three related issues with regard to that such improvement is necessary to make the theoretical approach more coherent, applicable, and useful.

First, the suggested constrained action hypothesis claims that adopting an external focus benefits motor learning by drawing (presumably unnecessary) attention away from movement-coordination processes and thus allowing them to operate in a more efficient automatic mode. Even though this is an interesting and attractive hypothesis, it remains unclear how the proposed mechanism actually works. Take the finding of Wulf, McNevin, and Shea (2001) that an external focus allows for faster probe reaction times than an internal focus. If we consider these reaction times as a measure of attentional capacity not absorbed by motor learning, we would need to conclude that external focusing is easier than internal focusing. However, this is little more than the learning data suggest anyway: If learning is easier (for whatever reason) it makes sense that it draws on lesser attentional resources. Whether this has anything to do with automaticity we simply do not know. It could just as well be that external focusing is more natural for subjects and therefore less interfering with the learning process.

More importantly, the way the constrained action hypothesis is presented suggests that there is nothing special about adopting an external focus in facilitating motor learning. All that is necessary to allow coordination processes to operate in an automatic mode would be to prevent learners from attending to their own body movements. Asking them to adopt an external focus would be one way to achieve that, but giving them a mental calculation task or asking them to think of or even report about their last vacation should work just as fine. This is by no means a far-fetched suggestion: Olivers and Nieuwenhuis (2005) were able to demonstrate that some cognitive processes indeed benefit from engaging subjects in distracting concurrent mental activities, such as free association on a task-irrelevant theme or listening to music. The important theoretical question thus is whether adopting an external focus is good, as is sometimes suggested, or whether adopting an internal focus is bad – which seems to be what the constrained action hypothesis suggests.

Second, it is possible that motor learning does not, or not only, benefit from preventing the adoption of an internal focus but (also) from inducing an external focus. In other words, focusing on distal action effects may be good for motor learning. This is actually the gist of Prinz's (1990) common coding hypothesis. His approach draws on ideo-motor logic in the tradition of Lotze (1852) and James

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(1890), who suggested that actions are represented in terms of their reafferent effects (Hommel, 1997). If one further considers that perceptual representations also comprise of the actions they afford, it makes sense to assume that perceived and produced events are cognitively coded in the same format and in the same way (Hommel, Müsseler, Aschersleben, & Prinz, 2001). Numerous experimental studies have supported this assumption and demonstrated that the preparation and selection of actions is mediated by representations of action effects (for an overview, see Hommel & Elsner, in press). This means that attentional focusing on the distal effects of actions is necessary for the processing of action-related stimuli up to the selection of specific responses. This renders it likely that the same kind of focus is also beneficial for acquiring the motoric means necessary to carry out the selected responses, that is, motor learning.

One of the attractive features of ideo-motor theories is that they provide a mechanism that explains how goals translate into actions (namely, by priming of the action whose anticipated distal effects overlaps most with the sensory representation of the goal). Indeed, goals are usually directly related to the distal effects of an action but bear little relationship to exactly how these effects were achieved (i.e., the proximal means). Indeed, almost all examples in Wulf's review refer to tasks and situations where the task goal and the distal action effects attended in the external-focus condition were indistinguishable. If so, the manipulation of external versus internal focus can thus be taken to reflect a manipulation of attention directed to versus away from the action goal, which makes the outcome of the studies somewhat less surprising. In the absence of decisive data, this is just one of several possibilities, but it needs to be investigated – ideally independently of possible negative effects of internal focusing.

Third, almost all studies Wulf discusses were looking into rather short training sessions of a few hundred trials. It is impressive what focus manipulations can achieve in such a short time already, but we must not forget that real skill acquisition takes months or years. Accordingly, one wonders whether the optimal focus changes with experience and increasing level of skill. As Wulf points out in her conclusions, skills are likely to be cognitively represented in a hierarchical fashion, and it makes sense to assume that increasing learning experience moves the optimal focus from lower to higher, more integrative levels. Indeed, if ballet dancers integrate complex step patterns into a single dance figure and pianists chunk long sequences of finger movements into only a few sections, it is likely that this will drive their preferred attentional focus towards more abstract characteristics of their motor performance – presumably to a degree that makes it difficult to focus back on the local elements (Schwarz, 1927). However, shifts of the attentional focus may be more frequent and flexible than that. Even in a single training session, the optimal focus may vary, and it seems interesting to analyze and model the dynamics of this variability. It has also been suggested that success or failure in a single trial may change the focus, going more global after success and more local after failure (Vallacher & Wegner, 1985). Taking such dynamics into consideration is likely to help explaining empirical inconsistencies and tailoring training programs to the individual and his or her level of proficiency.

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