



## COMMENTARY ON WULF

## ATTENTIONAL FOCUS AND MOTOR LEARNING: NOTES ON SOME PROBLEMS OF A RESEARCH PARADIGM

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*Die Aufmerksamkeitsforschung zum motorischen Lernen scheint die Überlegenheit der Fokussierung distaler Effekte im Vergleich zur internalen Fokussierung schlüssig zu belegen. Weitergehende Befunde lassen jedoch Zweifel an der Generalität dieser Aussage aufkommen. Ferner mangelt es den theoretischen Erklärungsansätzen an Überzeugungskraft, wobei insbesondere (funktionale) Relationen zwischen Aufmerksamkeitsfokus und Aufgabenanforderungen berücksichtigt werden sollten.*

Schlüsselwörter: Aufmerksamkeitsfokus, Verhaltenswirkung, Automatismus, funktionale Kopplung, Forschungsmethodologie

*Research on attentional focus and motor learning seems to be conclusive: Directing attention to distal effects of movements is superior to an internal focus. However, looking at further evidence raises doubts about this general statement. On the other hand, the theoretical explanation of attentional effects is not convincing. Rather the (functional) relationship of attentional focus and task demands should be reconsidered.*

Keywords: attentional focus, behavioral effect, automaticity, functional coupling, research methodology

In her target article, Wulf (2007) provides a concise and comprehensive review of research on attentional focus and motor learning available in English language. In our comment on the article we focus first on the studies and data and then on the theory.

Looking at the data, Wulf presents at first sight conclusive evidence for the beneficial effects of an external relative to an internal focus of attention. However, there are some shortcomings and open questions due to the design of the studies or, more general, due to the research paradigm. On some of these points, further studies, which are discussed later in this text, offer additional insights concerning methods and findings.

First of all, it is important to note that all studies reviewed by Wulf used indirect or behavioral treatments to manipulate the learner's attentional focus, mainly instructions or feedback. However, in some cases this information is rather vague (e.g., 'focus on how the model scored a basket'; Al-Abood, Bennett, Hernandez, Ashford, & Davids, 2002) or address not the effect of the movement, but a (perceptual) target (e.g., the rim of the basket; Zachry, Wulf, Mercer, & Bezodis, 2005).

Furthermore, the "basic instructions" given to all participants prior to the practice phase might "pre-constitute" a certain focus, which is then interacting congruently or incongruently with the attentional focus induced by the treatment instructions. Finally, it is also possible that some of the experimental tasks by themselves lead to the adoption of a certain attentional focus, for example due to their (proximal or distal) outcomes or the perceptual conditions. Given all this, it is not clear which focus of attention the participants really adopt and the need for a validation of the focus-generating treatment becomes apparent.

Zentgraf (2005) validated her focus instructions by using a video-based three-dimensional movement analysis. She found that participants who were given external focus instructions on a juggling skill (e.g., "toss the balls to the same height"), in fact, showed significantly more consistent throws than those who were given internal focus instructions. On the other hand, internally focused learners (e.g., "keep your body still") did not demonstrate less postural sway while juggling than externally focused learners. Further options for a treatment validation are the application of questionnaires or interviews and, relating to future research, methods of Virtual or Augmented Reality.

An interesting, but still unanswered question is whether the effects of attentional focus are either (temporary) performance effects or (permanent) learning effects or both. In her review, Wulf (2007) postulates both short-term and long-term effects. However, a closer look at the results leads to a different (and more differentiated) view. A vote-counting of those attentional focus studies that (1) were mentioned by Wulf and (2) include practice sessions and retention/transfer sessions shows that the direction of attentional focus seems to affect rather the retention, or learning, of a motor skill than the practice: In 7 of 10 studies that have used instructions to induce an attentional focus, advantages of an external focus were only found in retention or transfer tests, but not during prac-

tice. Only in 3 studies the external focus groups were superior to the internal focus groups already during practice. However, in 2 of these studies (Totsika & Wulf, 2003; Wulf, Lauterbach, & Toole, 1999) the group differences already occurred during the first trial(s) or trial block; thus, it is possible that they are not caused by the attentional focus instructions, but simply are the result of a sample bias. Surprisingly, in all studies in which no retention test was conducted, benefits of an external relative to an internal focus were observed already in the practice phase. The inconsistency of the findings shows that further research is needed on the problem under which conditions the effect occurs immediately or delayed. It is notable that the advantage of an external focus is frequently observed only during retention, when no focus information is given. Among other things, a theory of attentional focus has to address this point.

To explain the superiority of an external focus, Wulf proposes the constrained action hypothesis which assumes that external focus may provoke an automatic mode of movement control. This view is confirmed by three lines of evidence (faster RT under dual-task conditions, higher frequency of motor adjustments, and reduced EMG activity when adopting an external focus). We think that this explanation is not completely convincing, at best half of the truth. Generalizing this hypothesis leads to the expectation that any experimental treatment forcing subjects to adopt automatic control may lead to better learning. Why should this (unspecific) effect be associated with external focus? And why should it be superior in subjects learning a new skill? Research using the dual-task paradigm tells us that under dual-task conditions, there is a decrease in performance, particularly in early stages of practice.

Rather than assuming an unspecific control effect, the relationship of attentional focus and task should be (re-)examined in more detail (e.g., Hänsel & Seelig, 2003). Distal effects are normally much more closely related to the desired outcome, for example, keeping balance and hitting a target.

This might be the reason why an external focus can be more informative to learners than an internal focus. On the other hand, if an internal focus can be adopted that closely corresponds to the task demands, this focus should be equivalent or superior to an external focus that shows a lower correspondence. For example, in a pedalo learning experiment, Körndle (1983) found that fast learners concentrate on concrete items representing an internal focus, like "bending forward", "keeping the trunk quiet" or "tensing the muscles of the thigh". Therefore, the functional relationship of attentional focus and task may be more important than the mode of control.

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