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Simply distracting learners is not enough: More evidence for the learning benefits of an external focus of attention

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Simply Distracting Learners Is Not Enough: More Evidence for the Learning Benefits of an External Focus of Attention

Gabriele Wulf and Nancy H. McNevin

This experiment followed up on previous studies showing learning benefits of instructions directing the performers' attention to the effects of their movements (external focus) relative to instructions directing attention to the movements themselves (internal focus). The main purpose was to determine whether similar advantages could be achieved by preventing learners from focusing on their movements through the use of an attention-demanding secondary task. Participants practiced balancing on a stabilometer. External and internal focus group participants were instructed to focus on markers attached to the balance platform or on their feet, respectively. A third group was required to shadow a story presented to them while balancing. In addition, a control group without attentional focus instructions or a secondary task was included. The external focus group showed more effective balance learning than the other groups. The results provide evidence for the learning benefits of external focus instructions. In addition, they show that similar advantages cannot be achieved by simply preventing learners from focusing on the task to be learned.

Key Words: motor learning, attentional focus, stabilometer, shadowing

Key Points:

1. Previous studies have shown learning benefits of directing learners' attention to the effects of their movements (external focus) relative to directing attention to the movements themselves (internal focus) or control conditions.
2. We used a balance task to examine whether similar learning advantages could be achieved by simply preventing learners from focusing on their movements.
3. The results showed that learning advantages could not be achieved by preventing learners from focusing on their movements.
4. Only the adoption of an external focus resulted in learning benefits.

Introduction

When acquiring a new motor skill, learners are assumed to go through different stages of learning (e.g., 2, 12, 14). The early stage, where the learner is trying to

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figure out what to do and how to produce the correct movement, is typically attention demanding and characterized by conscious and effortful information processing. The subsequent stage is dedicated to the refinement of the skill. The goal for the learner is to get a "feel" for the correct movement and to develop the error-detection-and-correction capabilities that will eventually enable her or him to make appropriate adjustments in the absence of extrinsic feedback. After extensive practice, the skill is performed almost automatically, and little or no attention and effort is required to control the action. In fact, performance often suffers when the performer starts to think about and consciously tries to control the movements (e.g., 6, 13, 28).

Traditionally, it has been assumed that learning that occurs during the early stages is enhanced by making learners aware of their movements and of how they are performing in relation to the goal movement (e.g., 2, 11, 12, 25, 27). Therefore, to facilitate the learning process, instructions and feedback are typically given that direct the learners' attention to various aspects of their movement coordination. That such instructions promote the use of conscious modes of control is not viewed as problematic but as a necessary phase that the learner must go through in order to reach the autonomous stage where movement control is more or less automatic. Recent approaches question this view, however (e.g., 21, 30, 31, 35). In fact, findings suggest that learning can be enhanced if the utilization of conscious control processes can somehow be circumvented and if the use of automatic control processes is facilitated even in novices.

For example, in Singer's Five-Step approach (30, 31), novice performers simulate the automatic movement execution typically seen in experts. In Step 3 of this approach ("Focusing"), learners are instructed to concentrate on one relevant cue (e.g., the seams of a tennis ball or dimples of a golf ball). The purpose of this step is to *prevent* performers from attending to their movements while they are executing the skill. This attentional strategy has indeed been shown to be more effective than "awareness" strategies, where participants are instructed to think about their performance and to be aware of their movements (e.g., 19, 32, 33).

Masters (21, 23) went even further by suggesting that instructions given to performers attempting to learn a new skill should be reduced to a minimum. According to Masters, when given too many instructions, learners are more likely to adopt a controlled mode of information processing and tend to become preoccupied with thoughts about how they are executing the skill, which is assumed to be detrimental to performance. Therefore, making learners aware of their movements (or inducing an explicit mode of learning) should be avoided as much as possible. By letting the learner acquire the skill implicitly, he or she is less likely to engage in conscious thought processes that could interfere with the automatic execution of the movement. This is assumed to be especially advantageous under stressful conditions—for example, in a competition where performers tend to "reinvest" controlled processing (22), with the result that performance suffers because the automatic functioning of the movement is disrupted (e.g., 6–8, 16, 28).

To examine the effectiveness of "implicit" versus "explicit" modes of learning, Masters (21; see also 15) used a golf-putting task. In order to prevent participants from developing (too much) explicit knowledge, Masters had one group perform a secondary task while practicing the primary golf-putting task. This secondary task required participants to generate random letters concurrent with the performance of the golf-putting task. [In a more recent study, Maxwell et al. (23)

used tone counting as a secondary task that had to be performed concurrently with the golf-putting task.] By loading their "articulatory loop" (5) through the letter generation task, learners were expected to develop less explicit knowledge about golf putting and therefore to show no, or at least smaller, performance decrements under stressful conditions compared to learners with explicit instructions about the correct technique. Indeed, when participants were placed under stress (by informing them that their performance would be evaluated), learners who had practiced with the distraction of the secondary task showed a further performance improvement relative to the end of practice, while explicit learners either showed a slight performance decrement (21) or no change in performance (15).

More recently, evidence for the relative ineffectiveness of directing learners' attention to their own actions has been provided in a series of studies by Wulf and colleagues (e.g., 29, 35, 36; for a review, see 39). Importantly, these studies demonstrated that directing learners' attention to the *effects* of their movements on the environment (e.g., implement, apparatus) is more beneficial for learning than directing their attention to the movements themselves. For example, Wulf et al. (35, Experiment 2) manipulated the attentional focus of participants attempting to balance on a stabilometer. One group was instructed to focus on keeping their feet horizontal ("internal" focus of attention), whereas another group was instructed to focus on keeping two markers attached to the stabilometer platform directly in front of their feet ("external" focus) horizontal. Thus, while the actual locus of attention differed only minimally between groups, in the former case attention was directed towards the performer's body movements (feet), whereas in the latter case it was directed towards the effects of the performer's actions on the platform. On a retention test performed after 2 days of practice, the external focus group showed superior balance learning relative to the internal focus group.

Learning advantages of directing attention to the movement effect as compared to attention directed at the movements themselves have been shown for a variety of motor tasks in the last few years, including a ski-simulator task (35, Experiment 1), golf (36), soccer and volleyball skills (37; for a review, see 39). Wulf and colleagues (38–40) suggested that, while an internal attentional focus constrains the motor system by interfering with natural control processes, an external focus of attention allows automatic control processes to regulate the movements, resulting in enhanced performance and learning.

Overall, the studies reviewed above provide converging evidence that making learners aware of their actions by asking them to attend to their movements during movement execution is not very effective. On the contrary—and in contrast to traditional views (e.g., 2, 11, 25)—learning is often enhanced if the learner is *prevented* from focusing on his or her own movements. While these newer approaches (e.g., 21, 31, 35) agree on the view that directing the performers' attention to their movements (during movement execution) is not advantageous, they also differ in an important respect. In the studies by Singer et al. (e.g., 19, 32, 33), learners were distracted and prevented from focusing on their actions by instructing them to focus on a relevant external cue, and Masters (21, 23; see also 15) prevented learners from developing too much explicit knowledge about the task by having them perform an attention-demanding secondary task. In the Wulf et al. (e.g., 35, 36, 38) studies, on the other hand, learners were instructed to focus on the effects of their movements on the apparatus or implement. Thus, in contrast to other approaches (e.g., 21, 30), the learners' attention was directed to something that was related to the movement—that is, the outcome of their actions—rather than to something unrelated to the movement or its outcome.

The main purpose of the present study was, therefore, to compare the relative effectiveness of preventing learners from focusing on their movements by having them perform an attention-demanding secondary task versus instructing them to focus on the movement effect. If *not* focusing on the movements per se is critical, one would expect to see no difference between these two manipulations—or perhaps an advantage for learners practicing with a secondary task—as the distraction from the movement may be more complete than for learners focusing on the movement effect [although Maxwell et al. (23) did not find learning advantages of practice under secondary-task conditions]. However, if there is an advantage to focusing on the movement effect, relative to focusing on non-movement related cues or other tasks, the former condition should lead to more effective learning. To examine this question, we used the stabilometer task that has been used in previous studies to examine the effects of internal versus external attentional foci on learning (e.g., 29, 35, 38, 40). The participant's task was to balance on the stabilometer platform and to keep it in a horizontal position for as long as possible over the duration of a trial. To prevent learners from focusing on their actions, one group of participants had to continuously shadow (repeat out loud) a story presented to them while engaged in the primary task of balancing on the stabilometer. Shadowing is a verbal suppression technique that disrupts the conscious (verbal) mediation strategies that underlie the early stages of skill acquisition (e.g., 10). The technique serves a similar role as the letter generation task used by Masters (21) or the tone counting task used by Maxwell et al. (23). However, because balancing on a stabilometer is a continuous task (unlike the discrete golf putting task used by Masters and Maxwell et al.), we chose a secondary task that would pose a constant challenge to the attentional resources devoted to balancing. The effectiveness of the shadowing condition was compared to that of external and internal focus conditions, similar to those used in previous studies (e.g., 29, 35, 38, 40). In the external focus group participants were instructed to focus on keeping markers attached to the stabilometer platform horizontal (i.e., to focus on the effects of their movements), whereas in the internal focus group participants were instructed to focus on keeping their feet horizontal (i.e., to focus on their movements).

Another purpose of this study was to determine the effectiveness of internal and external attentional foci relative to a control condition with no attentional focus instructions. Until now, the only study that included such a control group was the study by Wulf et al. (35, Experiment 1) using the ski-simulator task.[2] In this case, internal focus and control conditions had similar learning effects, and both were less effective than an external focus condition. It therefore seemed important to replicate these findings with a different task, as this would increase our confidence in the conclusion that an external focus is *beneficial*, rather than an internal focus being detrimental, to learning. All groups practiced the stabilometer task for 2 days under their respective treatment conditions. Learning was assessed on day 3, with no instructions or reminders given to participants (and without secondary-task performance).

Method

Participants

Fifty-five university students of both genders volunteered to participate in this experiment, with approximately an equal number of males and females in each group. None of the participants had prior experience with the task; therefore, participants were not screened for their balance abilities. Balance skills appear to be very specific, and little transfer from other balance skills was expected (e.g., 4). Also, all participants were naive to the purpose of the experiment, and all gave their informed consent before the experiment.

Apparatus and Task

The primary task required participants to balance on a stabilometer. The stabilometer consists of a 65- × 105-cm wooden platform, with the maximum possible deviation of the platform to either side being 30°. The task was to remain in balance—that is, to keep the platform in a horizontal position—for as long as possible during each 90-s trial. Two markers (2- × 2-cm) were placed on the platform, 9 cm from the front edge and 23 cm from the midline of the platform. Participants were instructed to place their feet behind these markers. In addition to these markers, two lines (6 × 2 cm) were attached to the platform to the left and right of the sagittal axis of the platform. The movements of the platform were monitored by a potentiometer (Novotechnik P4501, 5 kΩ resistance, and 0.1% linearity) that was linked to the platform. To analyze stabilometer performance, an analog signal from the potentiometer was recorded (50 Hz, 12-bit resolution) for the whole duration of each trial.

For the shadowing task, the narrative "Shakespeare in the Bush" (9) was recorded in a male voice at a rate of approximately 130 words per minute. Sound was recorded by microphone into a mono-format at a sampling rate of 48 kHz to 16-bit resolution as supported by the *Goldwave* 3.03 digital signal processing package. The whole narrative lasted 34 min. The sound was reproduced free field at an intensity that was both loud and comfortable at the location of the stabilometer.

Procedure

All participants were informed that the task was to keep the platform in the horizontal position for as long as possible during each 90-s trial. In addition, all participants were asked to put their feet on the platform such that each foot was placed behind one of the markers in the middle of the platform, with the tips of the feet touching the markers. Each trial started with the left side of the platform on the ground. Approximately 15 s before the start of a trial, the experimenter asked the participant to step on the platform and to keep the left side down until the experimenter gave the start signal. At the start signal, the participant attempted to move the platform, and data collection began as soon as the platform crossed the horizontal.

Participants were randomly assigned to one of four conditions: the internal focus, external focus, shadowing, and control conditions (with 14 participants in each of the internal, external, and control conditions, and 13 participants in the shadowing condition). Under internal focus conditions, participants were instructed to focus their attention on their feet and to keep them horizontal. Participants in the external focus group were instructed to focus on the markers attached to the platform. These conditions were basically the same as those used in the Wulf et al. study (35). Rather than using markers attached to the platform directly in front of the feet, as in the Wulf et al. study (35), the markers used here were placed at a distance of about 22 cm from the participant's feet. As McNevin, Shea, and Wulf (24) have shown that the effects of external (markers) relative to internal attentional foci can be enhanced by increasing the distance of the external focus from the body, more distant markers were used here to maximize any effects of attentional focus. It should be pointed out that participants were instructed not to look at their feet or the lines, respectively, but rather to look straight ahead and to concentrate on the movements of the feet or markers. Before each practice trial, they were reminded to focus on their feet or the markers, respectively. Participants in the shadowing group were instructed to shadow the story replayed to them while balancing on the stabilometer.[1] The importance of shadowing correctly was emphasized to them and, if necessary, they were reminded by the experimenter. The control group participants were only given the general instructions regarding the task goal—that is, to keep the platform in a horizontal position for as long as possible.

There were 2 days of practice consisting of seven 90-s stabilometer trials each. A retention test, also consisting of seven 90-s trials, was performed on day 3. Retention conditions were the same for all participants in that no instructions or reminders were given. Also, no shadowing was required in retention.

Dependent Variables and Data Analysis

The potentiometer data were transformed into degrees out of balance. Consistent with previous studies utilizing the stabilometer, participants' proficiency in performing the task was measured by root-mean-square error (RMSE) in degrees, with the 0° position (platform in horizontal) as the criterion. RMSE during practice was analyzed in a 4 (group) × 2 (days) × 7 (trials) analysis of variance (ANOVA) with repeated measures on Days and Trials. The retention data were analyzed in a 4 (groups) × 7 (trials) ANOVA with repeated measures on Trials.

Results

Practice

All groups demonstrated a consistent improvement across the 2 days of practice (see Figure 1). On average, the shadowing group had the largest errors, whereas the external focus group demonstrated the fewest errors throughout practice. The internal and control groups displayed similar error scores, which were between those of the shadowing and external focus groups. On day 2, the performance advantages of the external focus group tended to increase, while the three other groups showed similar performances. The main effects of both Day, $F_{1, 51} = 251.21$, $p < .001$, and Trial, $F_{6, 306} = 230.05$, $p < .001$, as well as the Day × Trial interaction, $F_{6, 306} = 88.96$, $p < .001$, indicating relatively greater improvements on day 1 than on day 2, were significant. The main effect of Group was also significant, $F_{3, 51} = 2.88$, $p < .05$. A Student-Newman-Keuls (SNK) post hoc test revealed that RMSEs for the external focus group were significantly smaller than those for the shadowing group ($p < .05$). In addition, the Trial × Group interaction, $F_{18, 306} = 2.38$, $p = .001$, was significant. None of the other interactions were significant.

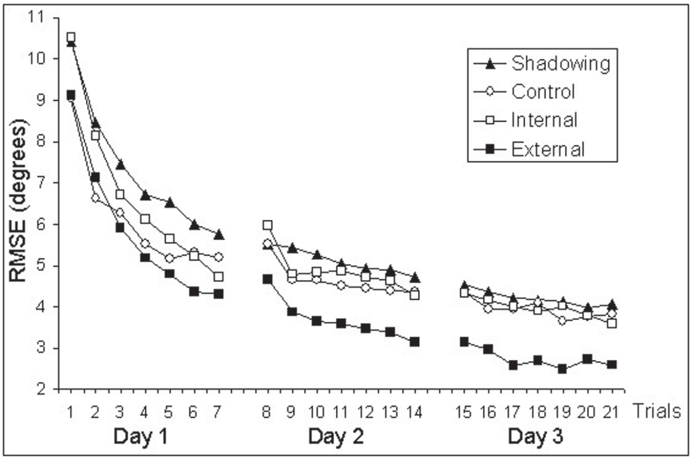

Figure 1 — Stabilometer performance (RMSE) of the internal focus, external focus, shadowing, and control groups during practice (days 1 and 2) and retention (day 3).

Retention

On the retention test administered on day 3, there was a further general reduction in errors across trials. The external focus group produced smaller errors than the other three groups, which showed very similar performances (see Figure 1, right panel). The main effects of both Trial, $F_{6, 306} = 8.77$, $p < .001$, and Group, $F_{3, 51} = 5.12$, $p < .01$, were significant. Post hoc tests (SNK) confirmed that the external focus group was significantly more effective than all other groups (*p*s < .05). There was no Group × Trial interaction, $F_{3, 51} < 1$.

Discussion

The present study was motivated by a series of recent findings showing that directing learners' attention to something other than their body movements can enhance the learning of motor skills, relative to directing attention to the movements themselves (e.g., 21, 32, 35). An important question in this regard was whether it was sufficient to prevent learners from focusing on the control of their movements (e.g., 32) or whether it would actually be more beneficial to direct their attention to the effects of their movements (e.g., 29, 35, 36). Therefore, in the present experiment, we used a shadowing task to prevent learners from directing their (entire) attentional resources to balancing and compared their performance to those of learners instructed to focus on markers attached to the balance platform (movement effect). If the main reason that the external focus of attention induced by the latter manipulation was effective in previous studies was that it distracted learners from focusing on their movements, no differences between the external focus group and the shadowing group would be expected. The present results, however, showed that the external focus group was more effective than the shadowing group. This was not only the case for performance during practice, where one might expect the shadowing requirement to degrade balance performance while it was present. Rather, the shadowing group was also less effective than the external focus group during retention. This suggests there were no “hidden” learning advantages of having to perform a distracting task that would manifest themselves when this task was removed during retention testing. Rather, the results suggest that there is, in fact, an advantage of focusing on the movement effect.

One might argue that the shadowing task might not have completely prevented performers from directing some attentional resources to the balance task. No attempts were made to assess performance on the shadowing task (e.g., by asking participants in post-experimental interview to report the “gist” of the story; cf. 18) and thus to verify that they directed all or most of their attention to the shadowing task. Future studies should therefore include such a manipulation check. Yet, the experimenter continuously monitored shadowing performance and reminded participants, if necessary, to shadow correctly. (There were hardly any instances where this was the case, however.) Thus, we are reasonably confident that the shadowing task was successful at directing performers’ attention away from the balancing task. This is corroborated by the relatively poor performance of the shadowing group during practice. Several studies have shown that balance requires the utilization of at least some attentional resources, especially if the task is relatively demanding (e.g., 3, 17; for a review, see 34). Given that the present task was quite difficult (as indicated by the substantial performance improvements across practice), it is perhaps not too surprising that balance performance tended to be negatively affected by the secondary task. However, the important point is that the shadowing group did not show a sudden performance improvement when the secondary task was removed in retention and that the external focus condition resulted in clearly superior retention performance (i.e., learning). Nevertheless, it would be interesting to use other, perhaps less demanding secondary tasks in future studies that are less detrimental to performance during practice while at the same time directing attention away from the primary task (see 20).

The external focus advantage was not only seen in relation to the shadowing group but also in relation to the internal focus and control groups (see also 35). The beneficial effects of an external relative to an internal focus of attention have been explained by different control mechanisms used when performers focus on the effects of their movements rather than on the movements themselves. McNevin, Shea, and Wulf (24; see also 39) have argued that focusing on the movement effects promotes the use of automatic control processes. Performance mediated by these unconscious processes results in faster movement adjustments, and therefore enhances performance and learning, compared to situations where performers focus on their limb movements and actively try to intervene in the control processes. Such conscious control attempts are assumed to result in the disruption of relatively automatic processes. McNevin et al. (24; see also 40) provided evidence for this view by showing that the frequency characteristics (Fast Fourier Transformation; FFT) of the platform movements differed for participants balancing on the stabilometer under external or internal focus conditions. External focus participants demonstrated higher-frequency and lower-amplitude movements than internal focus participants. High-frequency components are generally seen as an indication of the exploitation and integration of the available neuro-motor degrees of freedom and as a characteristic of skilled performance (24). The low-frequency, high-amplitude movements seen under internal focus conditions seem to indicate that the motor system is constrained or compromised by active intervention in the control processes underlying performance.

Recent results (38) support the view that an external focus promotes the utilization of more automatic control processes than an internal focus does. The authors argued that greater movement automaticity should be reflected in reduced attention demands (e.g., 1). Therefore, in their study, probe reaction times (RTs) were taken as a measure of the attention demands required under external versus internal attentional focus conditions while participants balanced on the stabilometer. External focus participants indeed demonstrated lower probe RTs than internal focus participants, indicating reduced attentional demands associated with an external focus and corroborating the view that an external focus promotes more automatic performance.

A result that might appear to be at odds with the findings of Masters (21) and Hardy et al. (15) is the fact that the shadowing group was no more effective than the internal focus group (and the control group) in retention. In these previous studies, participants who were required to perform a distracting task while practicing a motor task showed a performance increase under stress conditions relative to the last block of practice trials, whereas participants who were given specific instructions about the correct technique demonstrated no such improvement under stress. This was interpreted as support for the view that preventing learners from acquiring explicit knowledge about how to perform the task—as a results of their attending too much to their own movements—results in more effective learning.

Several points make a direct comparison between these groups and the shadowing and internal focus groups used in the present study difficult, however. First, the nature of the tasks differed in that the putting task used by Masters and Hardy et al. involved a discrete, short duration movement whereas, in the present study, a continuous, long-duration task was used. Even though there is no a priori reason to assume that the nature of the task is a qualifying factor, this needs to be determined in future studies. Second, the shadowing group did not show significantly poorer performance during practice than the internal focus group, as the secondary-task groups did in other studies relative to explicit learning groups (21, 23; cf. 15). Thus, the shadowing task did not appear to be as detrimental to performance, and therefore no increase in performance was observed when it was removed in retention. Third, the post-test used by Masters (21) and Hardy et al. (15) included a stress condition, while the retention test used in the present study did not. Whether practice with a distracter (shadowing) task has specific advantages for performance under stressful conditions should be determined in future studies. Fourth, Masters and Hardy et al. did not report the exact instructions given to their explicit learning groups. Even though it appears likely that the instructions "on how to putt a golf ball" (21: p. 347) induced an internal focus of attention, this cannot be determined conclusively. In addition, their instructions were presumably more complex than the internal focus instructions given in the present study, which might be more detrimental to learning than instructions to focus on a particular body part (see also 41). Finally, the conclusions reached by Masters and Hardy et al. were based on analyses that included performances on the last acquisition block and on the stress test. Due to the different performance levels reached by various groups at the end of acquisition, however, these analyses confounded the remaining room for improvement with stress test performance. In fact, the explicit group tended to outperform the implicit groups on this test. Also, in the study by Maxwell et al. (23), no differences were found between implicit and explicit learning groups in a retention test after extensive practice trials with or without a secondary tone-counting task, respectively. At any rate, independent of whether distracting learners can be more effective than inducing an internal focus, the important result of the present study is that simply distracting learners from focusing on their movements (e.g., 21, 31) was clearly less effective than directing their attention to the external effects of their movements.

Another important issue we wanted to address in this study was the effectiveness of external and internal focus conditions relative to a control condition without attentional focus instructions. Among the previous studies that have compared external versus internal focus effects on learning (e.g., 29, 35, 36, 40), only one included a control group (35, Experiment 1). In this study, in which a ski-simulator task was used, the control group showed similar performance in retention as the internal focus group, and both were outperformed by the external focus group. It seemed important to replicate these findings with a different task in order to verify that an external focus of attention is actually more advantageous for learning than internal focus and control conditions, as opposed to an internal focus being detrimental compared to external focus and control conditions. The present results indeed replicated the findings of Wulf et al. (35, Experiment 1) and therefore provide further evidence for the *benefits* of an external focus. An internal focus, on the other hand, does not seem to degrade learning relative to no instructions—perhaps because learners spontaneously direct their attention to the coordination of their movements when confronted with a novel motor skill.

It should also be pointed out that in previous studies on attentional focus, internal focus participants were instructed to focus on one particular aspect of the movement, such as the position of their feet (stabilometer; e.g., 35, Experiment 2), the force exerted by their feet (ski-simulator; 34, Experiment 1), or the angle of their elbows (golf; 36). It is possible that, if the instructions given to performers include more than one aspect of the movement that requires attention, or if the instructions are less specific, learning might actually be degraded compared to no instructions and discovery learning. The results of Wulf and Weigelt (41) seem to suggest that this might be the case. They found that instructing learners (on the ski-simulator) to exert force on the platform after it had passed the center of the apparatus was detrimental to learning compared to no instructions at all. While these instructions presumably induced an internal focus, they did not clearly specify *how* to exert force. Thus, it is possible that the "neutral" effects of internal focus instructions, relative to a control condition, found here and in the Wulf et al. (35, Experiment 1) study could be compounded by imprecise instructions, resulting in learning decrements compared to control conditions. Further research will be needed to clarify this issue. This seems to be important both for theory, by providing further insight into the effect of mental processes on motor control, and practice, by using instruction to direct one's attention to a single aspect of movement at a time.

In summary, the present results provide further evidence for the beneficial effects of instructions that induce an external focus by directing the learners' attention to the effects of their movements. Specifically, the present findings replicate previous results by showing that an external attentional focus results in more effective skill learning than an internal focus or no attentional focus instructions. In addition, they extend previous findings by demonstrating that these advantages are not simply due to attention directed *away* from the body movements. In this case, preventing learners from focusing on these movements through the use of a secondary task should have yielded similar beneficial effects; however, this was not the case. Rather, focusing on the movement outcome seems to have the advantage of directing a performer's attention to the primary task while allowing automatic control processes to regulate, effectively and efficiently, the movements required to achieve the outcome. The present results add to a growing line of evidence that learning is enhanced through instruction or feedback that induces an external focus of attention.

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Note

[1]The narrative was played continuously. That is, it continued to play during the 90-s breaks between trials, although the sound was turned off. The reason for this was that the recording could not be paused and, if stopped, would start from the beginning. On the second day of practice, the replay would begin 90 s after the actual beginning of the recording so that participants never shadowed parts that they had already shadowed on the previous day.

[2]Another recent study by Wulf and colleagues (42) also included a control group. That study examined the influence that the attentional focus on a supra-postural task had on postural performance.

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