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Adopting an External Focus of Attention Enhances Musical Performance

Adina Mornell[1] and Gabriele Wulf[2]

Abstract

Two experiments are reported in which skilled musicians playing different instruments performed a piece of their choice under various attentional focus conditions. In the external focus condition, they were asked to focus on playing for the audience and the expressive sound of the music. In the internal focus condition, they were asked to focus on the precision of their finger movements (or lip movements for singers) and correct notes. In the control condition, they were asked to play the way they normally did. Expert raters evaluated the musicians' performances for both musical expression and technical precision. In Experiment 1, external focus instructions enhanced musical expression relative to both internal focus and control conditions. There was no effect on technical precision. In Experiment 2, raters were given more detailed evaluation criteria. An external focus again led to superior musical expression compared with internal focus and control conditions. In addition, technical precision was higher within the external relative to the internal focus condition. The findings show that the advantages of focusing on the intended movement effect (i.e., externally) generalize to experienced musicians. Music teachers could offer their students specific recommendations for focus of attention during training and in concert situations to optimize learning and performance.

Keywords

attentional focus, music, motor learning, expertise

Music can produce intense pleasure in humans (Salimpoor, Benonvoy, Larcher, Dagher, & Zatorre, 2011), especially when they are watching live performances in which the

[1]University of Music and Performing Arts Munich, Germany
[2]University of Nevada, Las Vegas, NV, USA

Corresponding Author:
Adina Mornell, University of Music and Performing Arts Munich, Arcisstrasse 12, Munich 80333, Germany.
Email: adina.mornell@hmtm.de

auditory experience is enhanced by the observation of the extraordinary skills exhibited by musicians (Platz & Kopiez, 2012). Musicians arguably perform some of the most complex motor skills (Altenmüller, 2009; Jourdain, 1997). For musicians, performing in the presence of an audience can be motivationally beneficial, but it can also add to the difficulty of musical performance. Pressure to perform well, which is often experienced in public settings, can result in attempts at managing emotions and thoughts that can interfere with motor performance and lead to performance decrements (Mesagno, Mornell, & Quinn, 2016). Less than perfect performance in turn is likely to lead to a more conscious type of movement control that has been shown to hamper performance (see Lewthwaite & Wulf, 2010; Wulf & Lewthwaite, 2016). The potential consequence is a downward spiral of nonoptimal performance; increasing effort to regulate thoughts, emotions, and movements; and further performance decrements. In the performing arts, the concept of "stage fright" is well known. Musicians' choice of coping strategies favors those that aim to alleviate the physiological symptoms of arousal rather than address cognitive processes such as attention (Mesagno et al., 2016), even though cognitions are widely believed to contribute to the fear-feeds-fear feedback loop (Lehrer, 1984; see also Lang, 1971). The interconnectedness of multiple influences on performance makes musical performance a prime example of what has been called social-cognitive-affective-motor behavior (Lewthwaite & Wulf, 2010).

The challenges of performing complex motor skills, particularly under pressure, have often been addressed (e.g., Beckmann, Gröpel, & Ehrlenspiel, 2013; Beilock, 2011; Gray, 2004), including in music-related studies (Hallam, 2000; Oudejans, Spitse, Kralt, & Bakker, 2016; Peynircioglu, Brandler, Hohman, & Knutson, 2014; Wan & Huon, 2005). Multiple lines of inquiry have identified self-focused attention as detrimental to performance (e.g., self-focus, Baumeister, 1984; explicit monitoring, Beilock & Carr, 2001; skill-focused attention, Gray, 2004; internal focus of attention, Wulf, 2013). It has been suggested that self-consciousness resulting, for example, from the presence of an audience (e.g., Wallace, Baumeister, & Vohs, 2005) causes performers to become overly cautious, thereby disrupting the fluidity of well-learned and typically automatic motions (see also Beilock & Carr, 2001). How easily the self is accessed and the immediate negative consequences for motor performance, have been demonstrated experimentally (McKay, Wulf, Lewthwaite, & Nordin, 2015).

An important question for musicians and those who train musicians is how performance can be optimized and how high performance levels can be maintained even under pressure. In the motor learning literature, numerous studies over the past two decades have shown that the performer's focus of attention plays a significant role in this respect. Specifically, if attention is directed to the intended movement effect (a so-called external focus of attention) rather than body movements (internal focus or self-focus), performance is more effective (for reviews, see Wulf, 2013; Wulf & Lewthwaite, 2016). Since the first demonstration of external focus advantages for motor skill learning (Wulf, Höß, & Prinz, 1998), numerous studies have demonstrated for a wide variety of motor skills that directing attention to the intended movement effect results in more effective performance than internal focus or control conditions. With an internal focus on their own movements, performers tend to constrain their motor system by using conscious control processes that interfere with automatic control mechanisms (Wulf, McNevin, & Shea, 2001). In contrast, with an external focus, automatic (i.e., unconscious, fast, reflexive) processes are utilized—with the result that motor performance is both more effective (e.g., accurate) and efficient. The benefit of an external focus is especially pronounced when the skills are complex (e.g., Wulf, Töllner, & Shea, 2007). Importantly, instructions promoting an external focus have also been found to enhance the performance of experienced performers (e.g., Wulf & Su, 2007) and in situations that involved pressure (e.g., Bell & Hardy, 2009; Totsika & Wulf, 2003).

Only a few studies so far have examined attentional focus effects on musical performance (Atkins, 2017; Atkins & Duke, 2013; Duke, Cash, & Allen, 2011). In one study, Duke et al. (2011) asked music majors to play a 13-note sequence consisting of alternating eighth notes (A, F, A, F . . .) as evenly as possible under four different focus conditions (i.e., fingers, piano keys, piano hammers, sound produced). On a transfer test using the reverse sequence (F, A, F, A . . .), temporal consistency was highest when participants concentrated on the hammers or sounds as opposed to their fingers or the piano keys. This finding is in line with the results of previous studies (Bell & Hardy, 2009; McNevin, Shea, & Wulf, 2003) demonstrating that distal external foci, that is, foci that are at a greater distance from the body, are often more effective than proximal external foci (e.g., piano keys) or internal foci. Atkins and Duke's (2013) study also included different focus conditions, under which participants (untrained singers) sang a three-note pattern (Eb, F, Eb) using a continuous [α] vowel. Expert ratings revealed that the singers' tone quality was higher when they were asked to focus on the sound they produced (i.e., on directing the sound to fingers on their nose, a microphone, or a point on the wall) compared with a focus on vibrations of their throat. Finally, Atkins (2017) asked trained singers to sing with different attentional foci, including an internal focus (i.e., soft palate) and several external foci that varied in terms of the distance from the body (i.e., consistent vibrato, tripod 18 inches from mouth, chair in the center of the performance hall 24 ft in front of them, back wall at a distance of 40 ft, filling the room with their sound). Atkins found that more distal foci, in particular imagining filling the room, resulted in enhanced tone quality compared with internal or more proximal foci of attention. Thus, there is some evidence that musical performance can be enhanced by instructions that promote an external focus, in particular a more distal focus.

Given the potential implications for the training of musicians, we wanted to expand on these findings and determine their generalizability in various ways. This approach is similar to how attentional focus research has developed in other areas (e.g., sport skills) over the years: from early studies using laboratory tasks (e.g., balancing, Wulf et al., 1998) to those using real-life skills (e.g., discus throwing, Zarghami, Saemi, & Fathi, 2012); from novice (e.g., hitting a golf ball, Wulf, Lauterbach, & Toole, 1999) to expert participants (e.g., golf; Bell & Hardy, 2009); from between-participant designs assessing the learning of new skills (e.g., riding a Pedalo, Totsika & Wulf, 2003) to within-participant designs assessing immediate effects on the performance of rehearsed skills (e.g., running, Schücker, Hagemann, Strauss, & Völker, 2009); from objective performance measures (e.g., dart throwing accuracy, Lohse, Sherwood, & Healy, 2010) to expert ratings of movement quality (e.g., gymnastics skill, Abdollahipour Wulf, Psotta, & Palomo Nieto, 2015); from simple and brief focus instructions (e.g., Wulf et al., 1998) to multiple and more complex instructions (e.g., Wulf, McConnel, Gärtner, & Schwarz, 2002); and so on. Irrespective of these variations, the findings of about 180 studies have been remarkably consistent, with external focus conditions generally resulting in more effective performance than internal focus (and control) conditions (for reviews, see Wulf, 2013; Wulf & Lewthwaite, 2016).

Thus, we conducted two experiments that followed up on previous music-related studies (Atkins, 2017; Atkins & Duke, 2013; Duke et al., 2011) but differed from them in a number of respects. First, in both experiments, participants were skilled musicians who specialized in various instruments (e.g., piano, cello, violin, percussion, clarinet). Thus, a variety of instruments were used in an attempt to broaden the generalizability of previous findings. Second, participants played complex pieces of music for several minutes rather than producing tones for a few seconds (Atkins, 2017; Atkins & Duke, 2013; Duke et al., 2011). While most studies on attentional focus have used relatively short duration tasks (e.g., throwing, jumping, hitting a golf ball), external focus benefits have also been found of longer duration tasks (e.g., 10-minute running, Schücker et al., 2009; 90-minute rowing, Parr & Button, 2009). This suggests that performers are able to maintain their focus despite possible temporary distractions or deviations from the instructed foci. Third, participants performed a well-rehearsed advanced piece of their choice under internal focus, external focus, and control conditions. In contrast to previous studies (Atkins, 2017; Atkins & Duke, 2013), we counterbalanced the order of conditions to control for potential confounding effects of task order. Fourth, expert raters evaluated performances in terms of both technical precision and musical expression. The internal focus instructions (i.e., precision of finger or lip movements) were more related to technical precision, whereas the external focus instructions (i.e., sound of the music) were more related to musical expression. We assumed that the instructed attentional focus would impact these two aspects of performance. Specifically, we hypothesized that an external focus would lead to enhanced performance relative to internal focus and control conditions.

Experiment 1

This first experiment was an initial investigation of the influence of different attentional foci on the performance of expert musicians. All participating musicians had experience with public concert performances. They were asked to play a piece (sonata movement, concert étude, etc.) that they had technically and musically mastered and performed prior to the experiment. We asked whether external focus instructions focus would be able to enhance technical precision or musical expression or both.

Method

Participants. Twenty-three classically trained musicians (17 females, 6 males) with an average age of 25.8 years ($SD = 3.4$) participated in the present study. They were either graduate or undergraduate students majoring in performance and/or instrumental pedagogy at the University of Music and the Performing Arts in Graz, Austria. Participants had an average of 14.5 years (SD = 5.2) of experience playing their respective instrument or singing. There were 6 guitarists, 3 pianists, 2 violinists, 2 hornists, 2 accordion players, 1 clarinetist, 1 flutist, 1 saxophonist, 1 tuba player, and 4 singers. Participants were not aware of the specific purpose of the study. They were informed that the study was related to performance under stress conditions. The study was approved by the university's institutional review board.

Task and Procedure. When signing up for the experiment (i.e., after they had agreed to participate), participants were asked to prepare a piece of music of their choice of approximately 3-minute duration that they could play proficiently and by heart, preferably one that they had previously performed in concert. Examples of pieces of music performed by participants included an exposition of the first movement of Beethoven's Op. 57 ("Appassionata") piano sonata, the "Chaconne" from J. S. Bach's Partita No. II BWV 1004 for violin, and "Impromptu I" by Richard Rodney Bennett for guitar. Participants were asked to bring a copy of the score for the experimenter (that would be used by the raters later). A grand piano was available for the pianists; otherwise, participants played their own instruments. Participants' performances were videotaped for later evaluations.

After signing the consent form, participants tuned their instruments in one room and were then led into the "performance room," where they were awaited by a second experimenter. To create somewhat of a pressure situation, a video camera and microphone were set up in that room, chairs were arranged in a semi-circle, and curtains around the walls created a concert-like atmosphere. Two experimenters remained in the room as "audience members." Participants first performed their piece under the control condition without specific focus instructions. The order of the subsequently provided attentional focus instructions was counterbalanced. Participants were randomly assigned to performing in the order internal-external (n = 12) or external-internal (n = 11). In the internal focus condition, participants were asked to focus on the precision of their finger movements (or lip movements for singers) and correct notes. In the external focus condition, they were asked to focus on playing for the audience and the expressive sound of the music.

Ratings and Reliability. Two expert raters, who were blinded to the focus conditions, rated participants' performance based on the video recordings. One rater was a guitarist and the other a pianist. Both raters had professional performance careers and years of experience as jurors in music competitions, judging not only their own but multiple instruments. They were professors who taught at the university. The raters were not informed of the focus instructions received by the participants. The order of videos (conditions) presented to the raters was randomized. Raters scored each performance on each of two criteria, technical precision and musical expression, on a scale from 1 (*unsatisfactory*) to 9 (*excellent*). The raters were also asked to rank the three trials (focus conditions) with respect to both technical precision and musical expression (1 = best trial, 3 = worst trial). To determine agreement between the two raters, we

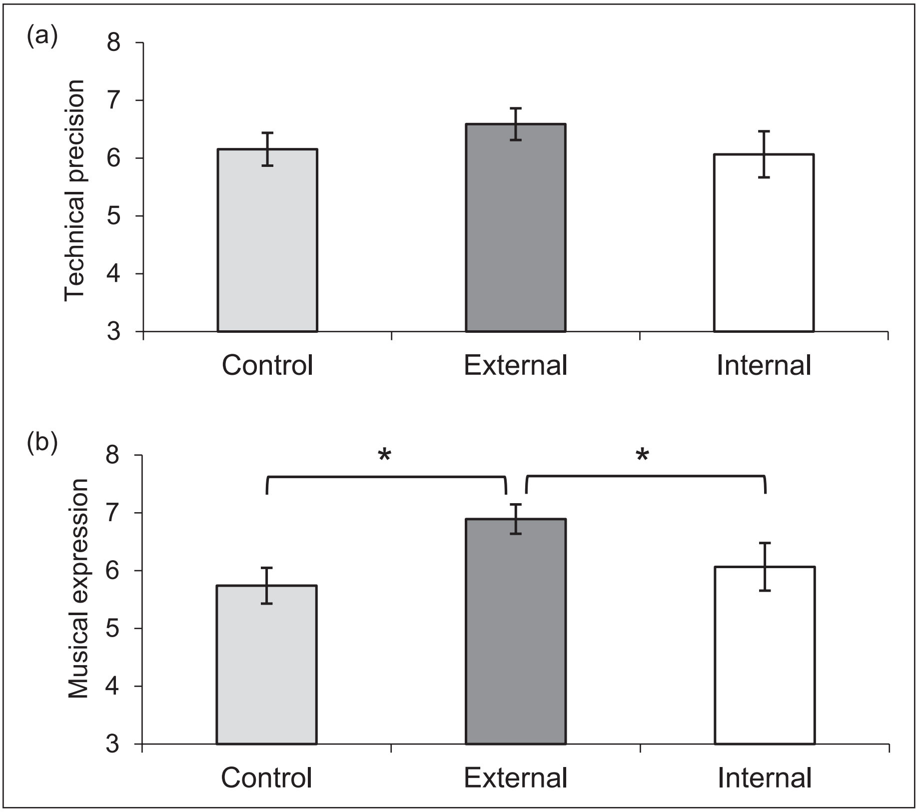

Figure 1. Scores for (a) Technical Precision and (b) Musical Expression in the Control, External Focus, and Internal Focus Conditions in Experiment 1.
Note: Scores were based on a scale from 1 to 9. Error bars represent stand errors.

used those rank orders. For technical precision, the agreement between raters was 78%, and for musical expression, there was 85% agreement.

Data Analysis. The raters' scores for technical precision and musical expression were averaged across raters. For each aspect of performance, the scores were analyzed in repeated-measures analyses of variance on attentional focus (control, external, internal).

Results

Technical Precision. Scores for technical precision can be seen in Figure 1a. Participants' scores were similar when they adopted an external focus ($M = 6.59$, $SD = 1.32$) or internal focus ($M = 6.07$, $SD = 1.91$) or were not given focus instructions (control condition) ($M = 6.15$, $SD = 1.36$). The main effect of attentional focus was not significant, $F(2, 44) = 1.73$, $p > .05$.

Musical Expression. Musical expression was enhanced with an external focus ($M = 6.89$, $SD = 1.22$) relative to an internal focus ($M = 6.07$, $SD = 1.98$) or no particular focus (control condition) ($M = 5.74$, $SD = 1.48$) (see Figure 1b). The main effect of attentional focus was significant, $F(2, 44) = 12.48$, $p < .001$, $\eta_p^2 = .362$. Post hoc tests showed that the external focus condition was significantly different from both the internal focus, $p < .05$, and control conditions, $p < .001$, while the latter two did not differ from each other, $p > .05$.

Discussion

The findings of Experiment 1 showed that musicians' focus of attention affected the quality of their performance. When participants focused on playing for the audience and the expressive sound of the music (external focus), their musical expression was rated significantly higher than when they focused on the precision of their finger movements and correct notes (internal focus) or under control conditions. Interestingly, the internal focus instructions did not actually lead to greater precision. In fact, the highest numerical scores for technical precision were seen in the external focus condition as well, although the effect of attentional focus was not significant for technical precision. Thus, adopting an external focus resulted in superior musical expression with no detrimental effects on technical precision.

We wanted to follow up on these findings in a second experiment for a number of reasons. First, we deemed it important to replicate the results with different musicians and instruments. Second, and more important, we made several improvements to the methods. Specifically, raters were given more detailed instructions for scoring performances in an attempt to create more sensitive and reliable measures of performance. Finally, in contrast to Experiment 1 in which the control condition was performed first, all experimental conditions (control, internal focus, external focus) were counterbalanced.

Experiment 2

Similar to the first experiment, experienced musicians performed pieces of their choice under different focus conditions in a performance simulation setting. All three attentional focus conditions were counterbalanced so that each condition was performed first, second, or third an equal number of times, thereby eliminating possible effects of order (e.g., practice, fatigue). Three experienced raters were provided with detailed criteria for performance evaluation, including items related to technical precision (notes, rhythm, phrasing, dynamics, fluency of movement) and musicality (expression, tempo variations, interpretation, mannerisms, stage presence).

Method

Participants. Eighteen classically trained musicians (8 females, 10 males) with an average age of 23.9 years ($SD = 3.39$) participated in the present experiment. Participants were undergraduate or graduate students at the University of Music and Performing

Arts in Munich, Germany, all of whom had passed a rigorous musical performance examination. They had an average of 16.0 years (SD = 3.94) of experience playing their respective instrument. The average number of hours per week they were currently practicing was 25.8 hours (SD = 12.76). There were 5 pianists, 6 percussionists, 4 violinists, 2 cellists, and 1 clarinetist. None of the participants were aware of the purpose of the study. The university's institutional review board had approved the study.

Task and Procedure. As in Experiment 1, participants were asked to choose a piece of music of approximately 3-minute duration that they could play proficiently and by heart, preferably one that they had previously performed in concert. Participants brought their own instruments, with the exception of the pianists. A studio-concert atmosphere was created using curtains around the walls and the video equipment. After signing the consent form, each participant was asked to play their selected piece once as a warm-up for the experimental trials. The order of the subsequently provided attentional focus instructions (internal, external, control) was counterbalanced. Participants were randomly assigned to one of six possible orders (control-internal-external, control-external-internal, internal-external-control, internal-control-external, external-internal-control, or external-control-internal). In the internal focus condition, participants were asked to focus on the precision of their finger movements and correct notes. In the external focus condition, they were asked to focus on playing for the audience and the expressive sound of the music. In the control condition, they were asked to play the way they normally did. As a manipulation check, participants were asked to what extent, on a scale from 0 (*not at all*) to 10 (*completely*), they focused on their fingers or the musical expression after each attentional focus condition. Finally, a brief exit interview was conducted in which participants were asked about any distractions they might have experienced, whether they perceived the experiment as "practice" or a serious performance, and whether they felt they had performed the way they normally did.

Ratings and Reliability. Three experts rated participants' performance based on the video recordings. The raters, two pianists (one of the pianists also served as a rater in Experiment 1) and one percussionist, were music professors. All three had active music careers on stage. In addition, they had national and international experience in judging musicians of all kinds in competitions as well as on performance exams at the university. Thus, they were familiar with rating techniques. The raters were advised in an information sheet that they would be grading five technical and five musical parameters as well as overall impression on a 7-point scale from *unsatisfactory* (1) to *excellent* (7). Items were selected from the Performance Evaluation Report (Wrigley & Emmerson, 2011) and adapted for use in the present context. Items in the technical category included notes (accuracy, security, mastery), rhythm (accurate, secure, stable control), phrasing (clear and well articulated), dynamics (clearly identifiable and varied appropriately), and fluency of movement (motion smooth, well-executed). Items in the musicality category included expression (mood and emotions well conveyed),

Table 1. Participants' Average Ratings in Response to the Questions, "To What Extent Did You Focus on Your Fingers/the Musical Expression?" on a Scale From 0 (*not at all*) to 10 (*completely*) for Each Condition in Experiment 2.

Reported Foci	Control Condition	External Focus Condition	Internal Focus Condition
Fingers	5.03 (*SD* = 2.47)	3.49 (*SD* = 2.63)	5.94 (*SD* = 2.48)
Musical expression	5.33 (*SD* = 2.28)	7.43 (*SD* = 1.88)	4.53 (*SD* = 2.82)

tempo variations (convincing, fluid), interpretation (convincing, deeply understood and appropriate in style), mannerisms (visual impression of the congruency between artist and work in the form of expressive gestures), and stage presence (confident, convincing). The order of trials was randomized prior to presentation to the raters so that they did not hear the performances in any systematic order. Similar to Experiment 1, agreement among raters was assessed by determining each rater's rank order of performances (overall impression) in the various focus conditions. Agreement was 67% for Raters A and B, 75% for Raters B and C, and 69% for Raters A and C. Overall agreement among raters was 70.3%.

Data Analysis. Each rater's technical and musicality scores were highly and significantly correlated, with average correlations of .644 (technical category) and .597 (musicality category) for Rater A, .743 and .750 for Rater B, and .811 and .806 for Rater C. Therefore, scores in each category were averaged across items for each rater. Also, for ease of presentation, we averaged scores across raters in each category. Average performance scores in the external focus, internal focus, and control conditions were analyzed in a repeated-measures ANOVA.

Results

Manipulation Check and Exit Interview. The results of the manipulation check can be seen in Table 1. In the control condition, participants reported focusing to about the same extent on their fingers and musical expression. In the external focus condition, they mostly focused on musical expression (as instructed). In the internal focus condition, their focus was more on their fingers (as instructed) than musical expression, although they also focused on musical expression to a relatively high degree. In the exit interviews, participants reported no distractions during the experiment that might have interfered with their performance. The majority of participants ($n = 16$) perceived the experiment as serious performance rather than practice ($n = 2$). All of them indicated that they had performed the way they normally did.

Technical Categories. Performance was rated highest when participants adopted an external focus ($M = 5.13$, $SD = 0.50$). Performance scores were lower in the internal focus condition ($M = 4.78$, $SD = 0.71$) or when participants were not given focus

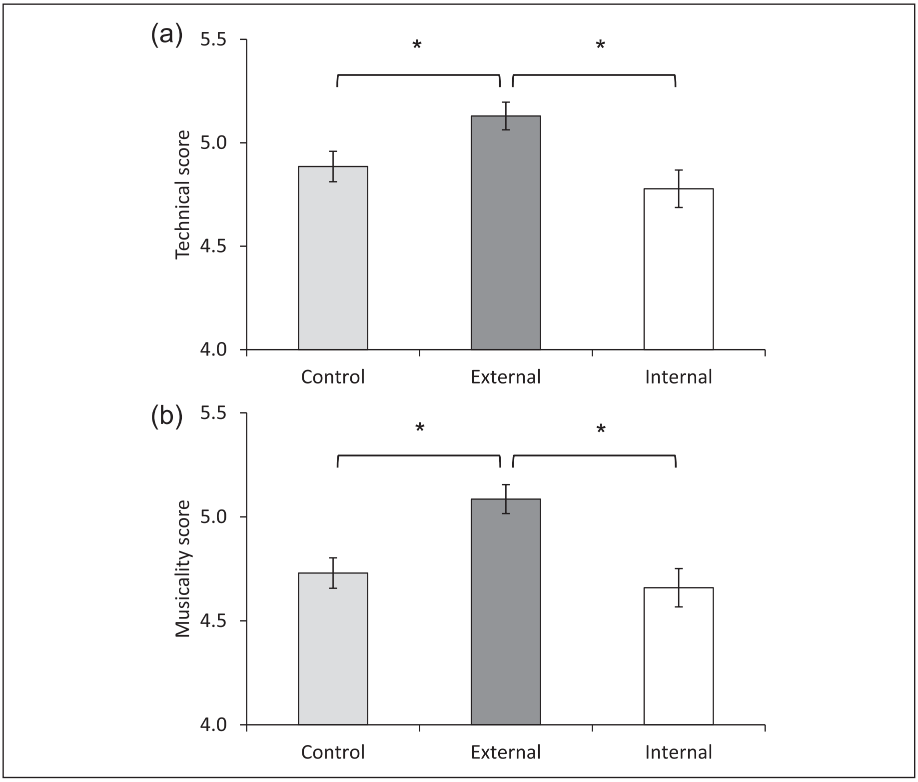

Figure 2. Average Scores for Items in (a) Technical Category and (b) Musicality Category in the Control, External Focus, and Internal Focus Conditions in Experiment 2.
Note: Scores were based on a scale from 1 to 7. Error bars represent stand errors.

instructions (control condition) (M = 4.88, SD = 0.57) (see Figure 2a). The main effect of attentional focus was significant, $F(2, 34) = 3.52$, $p = .041$, $\eta_p^2 = .17$. Post hoc tests showed that the difference between the external and internal focus conditions was significant ($p = .02$) and the difference between external focus and control conditions was on the borderline of significance ($p = .05$). There was no difference between internal focus and control conditions, $p = .49$.

Musicality Categories. Performance was again superior with an external focus (M = 5.09 SD = 0.59 relative to an internal focus (M = 4.66, SD = 0.78) or no particular focus (control condition) (M = 4.73, SD = 0.62) (see Figure 2b). The main effect of attentional focus was significant, $F(2, 34) = 4.16$, $p = .024$, $\eta_p^2 = .20$. Post hoc tests indicated that the external focus condition was significantly different from both the internal focus, $p = .024$, and control conditions, $p = .027$, while the latter two did not differ from each other, $p = 0.66$.

Discussion

Performances received the highest ratings when participants focused on playing for an audience and the expressive sound of the music (external focus). The external focus instruction resulted in superior performance in terms of both technical aspects and musicality compared with the instruction to focus on the precision of their finger movements and correct notes (internal focus). Thus, a focus on precise physical movements did not actually enhance precision. Rather, technical precision, which included accurate execution of phrasing and adherence to dynamics as written in the score, was also enhanced by a focus on musical expression. In addition, performance with an external focus was superior to that in the control condition with respect to both technical precision and musicality. Thus, the musicians' performance was immediately improved with the instructions to focus on the effects of their movements (e.g., on what they expected the audience to hear).

The manipulation check employed in Experiment 2 revealed that participants mostly followed the attentional focus instructions (see Table 1). However, in the internal focus condition, they reported focusing on musical expression (external focus) to a relatively large extent as well. In the control condition, participants' responses suggested that they focused on their fingers (i.e., internally) or musical expression (i.e., externally) to about the same degree. These results are similar to those of previous studies in which manipulation checks were used (e.g., Bell & Hardy, 2009; Kearney, 2015; Land, Tenenbaum, Ward, & Marquardt, 2013; Marchant, Clough, Crawshaw, & Levy, 2009; Pascua, Wulf, & Lewthwaite, 2015; Porter, Nolan, Ostrowski, & Wulf, 2010). Those studies also showed that participants generally adopted the instructed foci, although they did not use them 100% of the time, particularly on longer duration tasks. For example, in a study by Schücker, Anheier, Hagemann, Strauss, and Völker (2013) involving a 10-minute running task, participants reported using the respective foci 60% and 79% of the time. Our numbers seem to be in line with those percentages. Despite the partial overlap in attentional foci in the various experimental conditions of the present study, the external focus resulted in the typically seen advantages.

General Discussion

In both experiments, skilled musicians playing various instruments (or singers) performed a short piece of music under different focus conditions. Despite variations within and between experiments—including participants' level of experience, the piece of music they performed, or the instrument they played—and the general challenges of rating of experts' musical performance, the results of both experiments were remarkably consistent. Even though in Experiment 1 technical precision was not significantly affected by the instructed attentional foci, musical expression was enhanced with an external focus relative to both an internal focus and no instructed focus (control condition). In Experiment 2, in which raters were given more detailed evaluation criteria, an external focus resulted in greater technical precision than internal focus and control conditions. Also, musical expression was again enhanced relative to both internal focus and control conditions. The advantages for performance when individuals adopted an external focus are in line with those observed in numerous other studies (see Wulf, 2013). This pattern of results has also been seen in experienced performers before (e.g., Wulf & Su, 2007), including immediate benefits of external focus instructions on movement quality (e.g., Abdollahipour et al., 2015). Yet, the present study showed that the quality of musical performance in skilled musicians playing a familiar piece can be enhanced relatively easily by directing their attention externally.

It is interesting to note that, as in the many previous studies (e.g., Abdollahipour et al., 2015; Wulf et al., 1998; Wulf & Su, 2007), performances under internal focus and control conditions did not differ from each other, perhaps because performers spontaneously tend to focus on their own movements when they are not instructed otherwise (Land et al., 2013; Pascua et al., 2015). Performers' inclination to focus on their movements in situations that require the execution of motor skills—especially in evaluative settings or the presence of an audience (e.g., Wallace et al., 2005)—may be the result of previous instructions they received or simply a reflection of humans' tendency to become self-conscious in public settings. In fact, in the control condition of the present study, *all* participants reported focusing on their finger movements to some extent. Even temporary and minor internal foci are apparently sufficient to result in less than optimal performance (e.g., Wulf, Dufek, Lozano, & Pettigrew, 2010).

A focus, or concentration, on body movements (e.g., finger, hand, arm) has been demonstrated to produce superfluous muscular activity ("noise"), including co-contractions of agonists and antagonists, and even activity in unrelated muscle groups that interfere with fluid, precise, and automatically controlled movements that typically characterize skilled performance (Lohse et al., 2010; Wulf et al., 2010; Zachry, Wulf, Mercer, & Bezodis, 2005). In contrast, an external focus leads to greater automaticity, as demonstrated, for example, by a high frequency of movement corrections, suggesting an increased use of (automatic) reflexes (e.g., McNevin et al., 2003). An external focus also frees up attentional capacity (e.g., Kal, van der Kamp, & Houdijk, 2013; Lohse, 2012; Wulf et al., 2001) that can be used to focus on other aspects of performance such as artistic expressions in the performing arts. Overall, there is consistent evidence that an external focus promotes movement effectiveness and efficiency, resulting in enhanced movement quantity and quality (for a review, see Wulf, 2013). The present findings show that musical performance is no exception to this rule.

Instructions to adopt an external focus, or a performer's own decision to do so, seems to have a double advantage: A concentration on the intended movement effect (e.g., on the audience) keeps the focus *on the task goal* and directs attention *away from the self* (Wulf & Lewthwaite, 2016). In other words, an external focus on the task goal tends to suppress self-focused or off-task attention, thereby buffering the performer from these hindrances to optimal performance. In the OPTIMAL theory of motor learning (Wulf & Lewthwaite, 2016), an external focus is seen as an important contributor to *goal-action coupling*. The coupling of performers' goals to their actions during task performance is characterized by temporal linkages between spatially distinct neural networks (so-called functional connectivity) that is often seen in expert performers (e.g., Kim et al., 2014; Kim, Han, Kim, & Han, 2015). By directing performers with relative clarity toward their movement goal, an external focus likely promotes functional connectivity. Maintaining an external focus would obviously be particularly important in pressure situations—such as musicians' performance on stage—in which individuals are likely to revert to a self-focus, with detrimental effects on performance.

The present findings have important practical implications. The pressure of performing in front of an audience can promote worries and distracting thoughts (Oudeans et al., 2016), deficit-oriented thoughts about mistakes that *could* be made (Peschke & Georgi, 2015), or catastrophizing about the consequences of failure (Steptoe, 1989). Directing one's attention toward the music and away from oneself ("covert self-regulation," McPherson & Zimmerman, 2011) is necessary for optimal performance. Moreover, instructions inducing an external focus speed the learning process, as numerous studies have shown (see Wulf, 2013). Practice with an external focus will likely facilitate musicians' ability to keep their attention focused on the effects of their actions while on stage as well. Finally, perceived movement success with an external focus may increase performers' self-efficacy (Pascua et al., 2015) or confidence in their ability to perform effectively on stage, thereby breeding further success.

The limitations of this study are tied to its strengths. The musicians who participated were proficient, both technically and musically, and they performed highly complex pieces of music. Thus, it is perhaps not too surprising that there was less than perfect agreement among raters. It is a reflection of the subjective character of evaluation in the arts. Yet, the findings of both experiments were remarkably consistent—even though they included different musicians who played different pieces of music on different musical instruments and different raters (who were blind to the experimental conditions). Music teachers and musicians as well as others in the performing arts (Guss-West & Wulf, 2016) should examine the benefits provided by external focus instructions and consider incorporating focus strategies into their repertoire of performance training techniques. Teachers who employ both concentration and attention exercises in their lessons are likely to see their students less afraid of making mistakes and more focused on making expressive music. Musicians who learn to deliberately adopt a focus on or avoid shifts from the sound of the music will enjoy more reliable performances in the presence of an audience.

Declaration of Conflicting Interests

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References

Abdollahipour, R., Wulf, G., Psotta, R., & Palomo Nieto, M. (2015). Performance of a gymnastics skill benefits from an external focus of attention. *Journal of Sports Sciences*, *33*, 1807–1813. doi:10.1080/02640414.2015.1012102

Altenmüller, E. (2009). Apollo's gift and curse: Brain plasticity in musicians. *Karger Gazette*, *70*, 8–10.

Atkins, R. L. (2017). Effects of focus of attention on tone production in trained singers. *Journal of Research in Music Education*, *64*, 421–434.

Atkins, R. L., & Duke, R. A. (2013). Changes in tone production as a function of focus of attention in untrained singers. *International Journal of Research in Choral Singing*, *4*, 28–36. doi:10.1177/0022429416673842

Baumeister, R. F. (1984). Choking under pressure: Self-consciousness and paradoxical effects of incentives on skillful performance. *Journal of Personality and Social Psychology*, *46*, 610–620. doi:10.1037/0022-3514.46.3.610

Beckmann, J., Gröpel, P., & Ehrlenspiel, F. (2013). Preventing motor skill failure through hemisphere-specific priming: Cases from choking under pressure. *Journal of Experimental Psychology: General*, *142*, 679–691. doi:10.1037/a0029852

Beilock, S. (2011). *Choke: What the secrets of the brain reveal about getting it right when you have to*. New York, NY: Simon & Schuster.

Beilock, S. L., & Carr, T. H. (2001). On the fragility of skilled performance: What governs choking under pressure? *Journal of Experimental Psychology: General*, *130*, 701–725. doi:10.1037/0096-3445.130.4.701

Bell, J. J., & Hardy, J. (2009). Effects of attentional focus on skilled performance in golf. *Journal of Applied Sport Psychology*, *21*, 163–177. doi:10.1080/10413200902795323

Duke, R. A., Cash, C. D., & Allen, S. E. (2011). Focus of attention affects performance of motor skills in music. *Journal of Research in Music Education*, *59*, 44–55. doi:10.1177/0022429410396093

Gray, R. (2004). Attending to the execution of a complex sensorimotor skill: Expertise differences, choking, and slumps. *Journal of Experimental Psychology: Applied*, *10*, 42–54. doi:10.1037/1076-898X.10.1.42

Guss-West, C., & Wulf, G. (2016). Attentional focus in classical ballet: A survey of professional dancers. *Journal of Dance Medicine & Science*, *20*, 23–29. doi:10.12678/1089-313X.20.1.23

Hallam, S. (2000). *The development of performance planning strategies in musicians*. Paper presented at the Sixth International Conference on Music Perception & Cognition, Keele, Staffordshire.

Jourdain, R. (1997). *Music, the brain, and ecstasy: How music captures our imagination*. New York, NY: William Morrow and Company, Inc.

Kal, E., van der Kamp, J., & Houdijk, H. (2013). External attentional focus enhances movement automatization: A comprehensive test of the constrained action hypothesis. *Human Movement Science*, *32*, 527–539. doi:10.1016/j.humov.2013.04.001

Kearney, P. E. (2015). A distal focus of attention leads to superior performance on a golf putting task. *International Journal of Sport and Exercise Psychology*, *13*, 371–381. doi:10.1080/1612197X.2014.993682

Kim, J. H., Han, J. K., Kim, B.-N., & Han, D. H. (2015). Brain networks governing the golf swing in professional golfers. *Journal of Sports Sciences*, *33*, 1980–1987. doi:10.1080/02640414.2015.1022570

Kim, W., Chang, Y., Kim, J., Seo, J., Ryu, K., Lee, E., . . . Janelle, C. M. (2014). An fMRI study of differences in brain activity among elite, expert, and novice archers at the moment of optimal aiming. *Cognitive & Behavioral Neurology*, *27*,173–182. doi:10.1097/WNN.0000000000000042

Land, W. M., Tenenbaum, G., Ward, P., & Marquardt, C. (2013). Examination of visual information as a mediator of external focus benefits. *Journal of Sport and Exercise Psychology*, *35*, 250–259. doi:10.1123/jsep.35.3.250

Lang, P. J. (1971). The application of psychophysiological methods to the study of psychotherapy and behavior modification. In A. E. Bergin & S. L. Garfield (Eds.), *Handbook of psychotherapy and behavior change: An empirical analysis* (pp. 75–125). New York, NY: John Wiley & Sons, Inc.

Lehrer, P. M. (1984). The causes and cures of performance anxiety: A review of the psychological literature. In F. L. Roehmann & F. R. Wilson (Eds.), *Biology of music making* (pp. 32–46). Denver, CO: MMB Music Inc.

Lewthwaite, R., & Wulf, G. (2010). Grand challenge for movement science and sport psychology: Embracing the social-cognitive-affective-motor nature of motor behavior. *Frontiers in Psychology, 1* (Article 42), 1–3. doi:10.3389/fpsyg.2010.00042

Lohse, K. R. (2012). The influence of attention on learning and performance: Pre-movement time and accuracy in an isometric force production task. *Human Movement Science*, *31*, 12–25. doi:10.1016/j.humov.2011.06.001

Lohse, K. R., Sherwood, D. E., & Healy, A. F. (2010). How changing the focus of attention affects performance, kinematics, and electromyography in dart throwing. *Human Movement Science*, *29*, 542–555. doi:10.1016/j.humov.2010.05.001

Marchant, D. C., Clough, P. J., Crawshaw, M., & Levy, A. (2009). Novice motor skill performance and task experience is influenced by attentional focus instructions and instruction preferences. *International Journal of Sport and Exercise Psychology*, *7*, 488–502.

McKay, B., Wulf, G., Lewthwaite, R., & Nordin, A. (2015). The self: Your own worst enemy? A test of the self-invoking trigger hypothesis. *Quarterly Journal of Experimental Psychology*, *68*, 1910–1919. doi:10.1080/17470218.2014.997765

McNevin, N. H., Shea, C. H., & Wulf, G. (2003). Increasing the distance of an external focus of attention enhances learning. *Psychological Research*, *67*, 22–29. doi:10.1007/s00426-002-0093-6

McPherson, G. E., & Zimmerman, B. J. (2011). Self-regulation of musical learning: A social cognitive perspective on developing performance skills. In R. Colwell & P. R. Webster (Eds.), *MENC handbook of research on music learning. Volume 2: Applications* (pp. 130–175). New York, NY: Oxford University Press.

Mesagno, C., Mornell, A., & Quinn, A. L. (2016). Choking under pressure in sport and music: Exploring the benefits of theory transfer across domains. In A. Mornell (Ed.), *Art in motion III. Performing under pressure* (pp. 23–57). Frankfurt: Peter Lang.

Oudejans, R. R. D., Spitse, A., Kralt, E., & Bakker, F. C. (2016). Exploring the thoughts and attentional focus of music students under pressure. *Psychology of Music*, *45*, 216–230. doi:10.1177/0305735616656790

Parr, R., & Button, C. (2009). End-point focus of attention: Learning the "catch" in rowing. *International Journal of Sport Psychology, 40*, 616–635.

Pascua, L., Wulf, G., & Lewthwaite, R. (2015). Additive benefits of external focus and enhanced performance expectancy for motor learning. *Journal of Sports Sciences*, *33*, 58–66. doi:10.1080/02640414.2014.922693

Peschke, S., & von Georgi, R. (2015). The competence of performance: Mental aspects of succeeding and failing in musicians. In J. Ginsborg, A. Lamont, M. Phillips, & S. Bramley (Eds.), *Proceedings of the Ninth Triennial Conference of the European Society for the Cognitive Sciences of Music* (pp. 17–22). Manchester, UK: European Society for the Cognitive Sciences of Music.

Peynircioglu, Z. F., Brandler, B. J., Hohman, T. J., & Knutson, N. (2014). Metacognitive judgments in music performance. *Psychology of Music*, *42*, 748–762. doi:10.1177/0305735613491999

Platz, F., & Kopiez, R. (2012). When the eye listens: A meta-analysis of how audio-visual presentation enhances the appreciation of music performance. *Music Perception*, *30*(1), 71–83. doi:10.1525/MP.2012.30.1.71

Porter, J. M., Nolan, R. P., Ostrowski, E. J., & Wulf, G. (2010). Directing attention externally enhances agility performance: A qualitative and quantitative analysis of the efficacy of using verbal instructions to focus attention. *Frontiers in Psychology, 1* (Article 216), 1–7. doi:10.3389/fpsyg. 2010.00216

Salimpoor, V. N., Benonvoy, M., Larcher, K., Dagher, A., & Zatorre, R. J. (2011). Anatomically distinct dopamine release during anticipation and experience of peak emotion to music. *Nature Neuroscience*, *14*, 257–262. doi:10.1038/nn.2726

Schücker, L., Anheier, W., Hagemann, N., Strauss, B., & Völker, K. (2013). On the optimal focus of attention for efficient running at high intensity. *Sport, Exercise, and Performance Psychology, 2*, 207–219.

Schücker, L., Hagemann, N., Strauss, B., & Völker, K. (2009). The effect of attentional focus on running economy. *Journal of Sport Sciences*, *12*, 1242–1248. doi:10.1080/02640410903150467

Steptoe, A. (1989). Stress, coping and stage fright in professional musicians. *Psychology of Music, 17*, 3–11.

Totsika, V., & Wulf, G. (2003). The influence of external and internal foci of attention on transfer to novel situations and skills. *Research Quarterly for Exercise and Sport*, *74*, 220–225. doi:10.1080/02701367.2003.10609084

Wallace, H. M., Baumeister, R. F., & Vohs, K. D. (2005). Audience support and choking under pressure: A home disadvantage? *Journal of Sports Sciences*, *23*, 429–438. doi:10.1080/02640410400021666

Wan, C. Y., & Huon, G. F. (2005). Performance degradation under pressure in music: An examination of attentional processes. *Psychology of Music*, *33*, 155–172. doi:10.1177/0305735605050649

Wrigley, W. J., & Emmerson, S. B. (2011). Ecological development and validation of a music performance rating scale for five instrument families. *Psychology of Music*, *41*, 97–118. doi:10.1177/0305735611418552

Wulf, G. (2013). Attentional focus and motor learning: A review of 15 years. *International Review of Sport and Exercise Psychology*, *6*, 77–104. doi:10.1080/1750984X.2012.723728

Wulf, G., Dufek, J. S., Lozano, L., & Pettigrew, C. (2010). Increased jump height and reduced EMG activity with an external focus of attention. *Human Movement Science*, *29*, 440–448. doi:10.1016/j.humov.2009.11.008

Wulf, G., Höß, M., & Prinz, W. (1998). Instructions for motor learning: Differential effects of internal versus external focus of attention. *Journal of Motor Behavior*, *30*, 169–179.

Wulf, G., Lauterbach, B., & Toole, T. (1999). Learning advantages of an external focus in golf. *Research Quarterly for Exercise and Sport*, *70*, 120–126. doi:10.1080/02701367.1999.10608029

Wulf, G., & Lewthwaite, R. (2016). Optimizing Performance Through Intrinsic Motivation and Attention for Learning: The OPTIMAL theory of motor learning. *Psychonomic Bulletin & Review*, *23*, 1382–1414. doi:10.3758/s13423-015-0999-9

Wulf, G., McConnel, N., Gärtner, M, & Schwarz, A. (2002). Enhancing the learning of sport skills through external-focus feedback. *Journal of Motor Behavior*, *34*, 171–182. doi:10.1080/00222890209601939

Wulf, G., McNevin, N., & Shea, C. H. (2001). The automaticity of complex motor skill learning as a function of attentional focus. *Quarterly Journal of Experimental Psychology Section A: Human Experimental Psychology*, *54*, 1143–1154. doi:10.1080/713756012

Wulf, G., & Su, J. (2007). An external focus of attention enhances golf shot accuracy in beginners and experts. *Research Quarterly for Exercise and Sport*, *78*, 384–389. doi:10.1080/02701367.2007.10599436

Wulf, G., Töllner, T., & Shea, C.H. (2007). Attentional focus effects as a function of task difficulty. *Research Quarterly for Exercise and Sport*, *78*, 257–264. doi:10.1080/02701367.2007.10599423

Zachry, T., Wulf, G., Mercer, J., & Bezodis, N. (2005). Increased movement accuracy and reduced EMG activity as a result of adopting an external focus of attention. *Brain Research Bulletin*, *67*, 304–309. doi:10.1016/j.brainresbull.2005.06.035

Zarghami, M., Saemi, E., & Fathi, I. (2012). External focus of attention enhances discus throwing performance. *Kinesiology*, *44*, 47–51.

Author Biographies

Adina Mornell is professor of instrumental and vocal music education at the University of Music and Performing Arts Munich, Germany. Her research interests include music learning and performance, attentional processes, stress responses, and strategies for anxiety prevention.

Gabriele Wulf is a Distinguished Professor at the Department of Kinesiology and Nutrition Sciences, University of Nevada, Las Vegas. Her research interests include motor skill learning and performance.

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