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Additive benefits of external focus and enhanced performance expectancy for motor learning

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Abstract
The authors examined the individual and combined influences of 2 factors that have been shown to benefit motor learning: an external focus of attention and enhanced performance expectancies. Another purpose of this study was to gain further insight into the mechanisms underlying these variables. In a factorial design, participants learning a novel motor skill (i.e., throwing with the non-dominant arm) were or were not given external focus instructions, and were or were not provided bogus positive social-comparative feedback to enhance their expectancies. This resulted in 4 groups: external focus, enhanced expectancy, external focus/enhanced expectancy and control. External focus instructions and enhanced expectancies had additive benefits for learning: the external focus/enhanced expectancy group demonstrated the greatest throwing accuracy on both retention and transfer tests, while the accuracy scores of the external focus and enhanced expectancy groups were lower, but higher than those of the control group. Furthermore, self-efficacy was increased by both external focus and enhanced expectancy, and predicted retention and transfer performance. Positive affect was heightened in the enhanced expectancy and external focus/enhanced expectancy groups after practice and predicted transfer performance. The findings suggest that the learning benefits of an external focus and enhanced expectancies mediate learning through partially different mechanisms.

Keywords: *focus of attention, self-efficacy, positive affect*

Over the past few years, 2 variables with reliable effects on motor learning have emerged in the literature: the learner's focus of attention (see Wulf, 2013, for a review) and his or her performance expectancies (e.g., Clark & Ste-Marie, 2007; McKay, Lewthwaite, & Wulf, 2012; Stoate, Wulf, & Lewthwaite, 2012; Wulf, Chiviacowsky, & Lewthwaite, 2012). With respect to the first factor, numerous studies have demonstrated that instructions that invoke an external focus of attention (i.e., a focus on the movement effect) facilitate the learning process relative to internal focus instructions directing attention to body movements or no focus instructions (e.g., Wulf, Höß, & Prinz, 1998). Using various experimental designs – learning paradigms with different groups or within-participant designs to assess immediate effects on motor performance – studies have shown that, independent of the type of skill, skill level, age or (dis)ability, adopting an external focus has consistently resulted in greater movement effectiveness (e.g., accuracy and balance) and efficiency (e.g., muscular activity, oxygen consumption and heart rate). An external focus has been shown to promote automaticity in movement control (e.g., Kal, van der Kamp, & Houdijk, 2013; Lohse, 2012; Wulf, McNevin, & Shea, 2001), thereby effectively speeding up the learning process (Wulf, 2007). Evidence for greater automaticity includes reduced probe reaction times (Wulf, McNevin, et al., 2001) and high-frequency movement corrections, suggesting reflexive adjustments (e.g., McNevin, Shea, & Wulf, 2003), increased functional variability (Lohse, Jones, Healy, & Sherwood, 2014), reduced costs of cognitive (dual) tasks and greater movement fluidity (Kal et al., 2013).

With regard to the second factor, enhanced performance expectancies, converging evidence from somewhat more diverse lines of research suggests that manipulating learners' performance expectancies can affect learning. Expectancies have been influenced in various ways – from providing positive or negative social-comparative feedback suggesting to the performer that he or she is performing above

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or below average, respectively (e.g., Ávila, Chiviacowsky, Wulf, & Lewthwaite, 2012; Hutchinson, Sherman, Martinovic, & Tenenbaum, 2008; Lewthwaite & Wulf, 2010), providing performance feedback (e.g., knowledge of results) after successful trials rather than less successful trials (e.g., Chiviacowsky & Wulf, 2007; Saemi, Porter, Ghotbi-Varzaneh, Zarghami, & Maleki, 2012), video feedback showing only good rather than good and poor performances (e.g., Clark & Ste-Marie, 2007) to simple statements, suggesting that peers typically do well on the task to be learned (Wulf et al., 2012, Experiment 2). In addition to improved movement outcomes (e.g., accuracy, balance and movement form), enhanced expectancies have also been found to be associated with less-constrained movement patterns, or greater behavioural flexibility and adaptability (Slobounov, Yukelson, & O'Brien, 1997), and high-frequency movement adjustments that are seen as an indicator of automaticity (Lewthwaite & Wulf, 2010).

Thus, both an external focus and enhanced expectancies have been shown to facilitate motor performance and learning, as well as automatic control. An interesting question is: What are the underlying factors that contribute to those learning benefits? More specifically, do both variables make different contributions or do they share common mechanisms? Would combining them "double" the learning advantage or are they simply different ways to affect a common learning mediator, neither adding additional value to the other's effect? The goal of the present study was to elucidate some of these issues. In a factorial design, we crossed external focus instructions versus no focus instructions with enhanced expectancies versus no enhanced expectancies. Thus, 1 group (external focus/enhanced expectancy) was provided with both treatments, whereas 2 other groups received only 1 of the treatments (external focus or enhanced expectancy) or none (control). This design allowed us to determine to what extent each factor contributes to learning (i.e., retention and/or transfer performance) relative to the other, and whether the combination of external focus and enhanced expectancy has additive effects.

We were also interested in the mechanisms underlying the effectiveness of each variable. Enhancing performers' expectancies, in this case through positive social-comparative feedback, should be reflected in measures of self-efficacy (e.g., Bandura, 1993; Hutchinson et al., 2008). In a number of recent studies, positive (social-comparative) feedback has been found to be associated not only with enhanced performance or learning, but also with increases in self-efficacy or self-confidence (Badami, VaezMousavi, Wulf, & Namazizadeh, 2012; Saemi et al., 2012) and perceived competence (Ávila et al., 2012; Badami, VaezMousavi, Wulf, & Namazizadeh, 2011), as well as reduced learner concerns about their performance and ability, and decreased nervousness (Wulf et al., 2012, Experiment 1). Increased confidence in, or reduced concerns about, one's ability presumably promote a more automatic type of control and thereby facilitate learning and performance (e.g., Lewthwaite & Wulf, 2010; Slobounov et al., 1997). In contrast to enhanced expectancies, it is not clear whether an external focus of attention would have an effect on self-efficacy. To our knowledge, the relationship between attentional focus and self-efficacy has not previously been examined. Given that performance advantages resulting from external focus compared with internal or no focus instructions are often seen during the practice phase (e.g., Wulf & Su, 2007; Wulf et al., 1998), and that participants tend to become aware of these advantages (e.g., Marchant, Clough, Crawshaw, & Levy, 2009; Wulf, Shea, & Park, 2001), one might expect to find increased self-efficacy in participants with an external focus. Therefore, we hypothesised that self-efficacy would be increased under both enhanced expectancy (resulting from positive social-comparative feedback and effective performance) and external focus conditions (resulting from effective performance). Given the relation between self-efficacy and motor performance (e.g., Feltz, Chow, & Hepler, 2008; Moritz, Feltz, Fahrbach, & Mack, 2000), increased self-efficacy resulting from (presumed) good performance might further promote learning.

Successful performance may also increase positive affect. In a study by Clark and Ste-Marie (2007), self-modelling (i.e., providing edited videos that only showed learners' best performances) increased participants' satisfaction with their performance. Social-comparative feedback indicating better-than-average performance has also been found to increase positive affect in runners (Stoate et al., 2012). Positive affect is associated with phasic increases in dopamine discharge that strengthen neural connections (Ashby, Turner, & Horvitz, 2010). Thus, it is believed to play a critical role in consolidating motor memories (Trempe, Sabourin, & Proteau, 2012). We hypothesised an increase in positive affect as a function of favourable social-comparative feedback (enhanced expectancy, external focus/enhanced expectancy groups) and perhaps as a consequence of effective performance with an external focus.

To examine learning, self-efficacy and positive affect as a function of an external focus and enhanced expectancy, participants in the present study were asked to practice a novel motor task (i.e., throwing at a target with their non-dominant arm). An external focus of attention was induced by instructing performers to direct their attention to the centre of the target (external focus, external focus/enhanced expectancy groups). Participants' performance expectancies were enhanced by providing them with bogus social-comparative feedback, suggesting to them that their performance was above average (enhanced expectancy, external focus/enhanced expectancy groups). Learning was assessed by a delayed retention test as well as by a transfer test that involved a novel target distance. Neither focus instructions nor social-comparative feedback were given on either test. Self-efficacy was measured by participants' ratings of their confidence on a scale from 1 (not confident at all) to 10 (extremely confident) that they would be able to achieve certain average scores. To measure affect, we used the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS consists of adjectives that describe positive and negative feelings or emotions, and participants are asked to rate them on a scale from 1 (very slightly or not at all) to 5 (extremely), depending on how they feel at the present moment. Both self-efficacy and positive affect were assessed before the practice phase (i.e., after a pre-test) and at the end of practice, as well as before the retention and transfer tests on Day 2. In addition to assessing group differences in self-efficacy and positive affect, we performed regression analyses to determine whether self-efficacy ratings or positive affect would predict retention and/or transfer performance.

Methods

Participants

Fifty-two undergraduate students (21 men and 31 women), with a mean age of 21.5 years (*s*: 1.22) participated in this study. None of them were ambidextrous (43 right-handed and 9 left-handed), and all confirmed that they had no prior experience throwing with their non-dominant arm. Participants gave their informed consent. The study was approved by the university's institutional review board.

Task and apparatus

The experiment was conducted on an indoor racquetball court. Participants were asked to throw tennis balls overarm at a target that was hung in a net (2.1 × 2.1 × 1.4 m; Atec Catch Net; Sparks, NV, USA). The target consisted of 8 concentric circles. The centre of the bull's eye was 1 m above the ground. The smallest circle of the "bull's eye" had a diameter of 7.5 cm, and each following circle had a radius that was 7.5 cm larger than the previous one. The largest circle had a diameter of 60 cm. Eight points were given for hitting the centre circle, 7 points for hitting the 15-cm circle and so forth. One point was awarded for the 60-cm circle and 0 points for complete misses of the target. The distance from which participants threw was 7.5 m during the pre-test, practice phase and retention test, and 8.5 m for the transfer test.

Procedure

All participants were given basic instructions regarding the execution of an overarm throw with their non-dominant arm, which included a demonstration by the experimenter. Participants were randomly assigned to 1 of the 4 groups: external focus and enhanced expectancy (external focus/enhanced expectancy), external focus, enhanced expectancy or a control group. In the groups that included an external focus (external focus, external focus/enhanced expectancy), participants were asked to focus on the target. These instructions were given prior to each 10-trial block during the practice phase. The enhanced performance expectancy (enhanced expectancy, external focus/enhanced expectancy groups) was elicited via the use of social-comparative feedback that was provided in addition to their veridical average score after each 10-trial block, which all groups received during practice. The social-comparative feedback was a bogus score that was 20% lower than the participant's actual score (cf. Lewthwaite & Wulf, 2010; Wulf et al., 2012). Participants were told that this score was the average score that previous participants had achieved, leading them to believe that their performance was above average. Control group participants received only veridical feedback and no external focus instructions. On Day 1, all participants performed a pre-test consisting of 5 trials and the practice phase that included 6 10-trial blocks, with 2-min rest periods between blocks. One day later, retention and transfer tests were performed, each consisting of 10 trials without instructions or feedback.

After the pre-test, at the end of the practice phase and prior to the retention test, participants filled the questionnaires. These questionnaires included questions related to self-efficacy, positive and negative affect (PANAS; Watson et al., 1988), and, as a manipulation check after the practice phase, their attentional focus ("What did you mostly focus your attention on while throwing the balls?"). To assess self-efficacy, participants rated their confidence that they would be able to achieve an average score of 3, 4, 5 or 6 on a scale from 1 (not confident at all) to 10 (extremely confident). Those ratings referred to "on the last 10 trials today" (after the pre-test), "tomorrow" (after practice) or "today" (before the retention test). The PANAS includes words that describe positive and negative feelings or emotions, and participants are asked to rate them on a scale from 1 (very slightly or not at all) to 5 (extremely), depending on how they feel at the present moment. For the present study, 7 words that clearly described positive feelings (interested, excited, strong, enthusiastic, proud, inspired and determined) were selected. (The descriptors alert, attentive and active were excluded because they tap states that are not strictly affective in nature and are in common with words characteristic of attentional constructs, potentially providing circular support for a linkage that might not exist.)

Data analysis

The throwing accuracy scores on the pre-test were averaged across all 5 trials and analysed in a 2 (external focus: yes, no) × 2 (enhanced expectancy: yes, no) analysis of variance (ANOVA). The practice data were averaged across blocks of 10 trials and analysed in a 2 (external focus) × 2 (enhanced expectancy) × 6 (block) ANOVA with repeated measures on the last factor. The retention and transfer data were each averaged across all 10 trials and analysed in a 2 (external focus) × 2 (enhanced expectancy) ANOVA. The average self-efficacy and positive PANAS scores were analysed separately in 2 (external focus) × 2 (enhanced expectancy) ANOVAs. Regression analyses were used to determine whether ratings of self-efficacy or positive affect, at the end of Day 1 or the beginning of Day 2, would predict retention and/or transfer performance. Finally, the answers to the attentional focus question ("What did you mostly focus your attention on while throwing the balls?") were classified into those that indicated an external (i.e., target-related) focus or internal (i.e., movement-form related) focus, or both. The number of responses that clearly reflected a focus on the target (external focus) or movement form was submitted to a chi-square test.

Results

Attentional focus

In the groups that received external focus instructions (external focus, external focus/enhanced expectancy), more participants indicated that they focused on the target (N = 16) than on movement form (N = 4), whereas in the groups without external focus instructions, more participants focused on movement form (N = 17) than on the target (N = 5). (Six participants in the external focus/enhanced expectancy and external focus groups and 4 participants in the enhanced expectancy and control groups reported that they focused on both the target and movement form.) A chi-square test that included participants who focused on one or the other showed that there was a significant association between external focus instructions and the reported attentional focus, X^2 (2, N = 42) = 13.75, $P < .001$.

Throwing performance

On the pre-test, there were no differences among groups (see Figure 1). The main effects of external focus and enhanced expectancy were not significant, Fs(1, 48) < 1, η_p^2 = .007 and .001, respectively. Also, there was no interaction between external focus and enhanced expectancy, F(1, 48) < 1, η_p^2 = .003.

During the practice phase, all groups improved their throwing performance across blocks. The external focus/enhanced expectancy group had the highest accuracy scores, followed by the enhanced expectancy and external focus groups that performed similarly. The control group produced the least accurate throws during practice. The main effect of block, F(5, 240) = 17.89, $P < .001$, η_p^2 = .271, was significant. Also, the main effects of both external focus, F(1, 48) = 22.80, $P < .001$, η_p^2 = .322, and enhanced expectancy, F(1, 48) = 14.93, $P < .001$, η_p^2 = .237, were significant. There was no

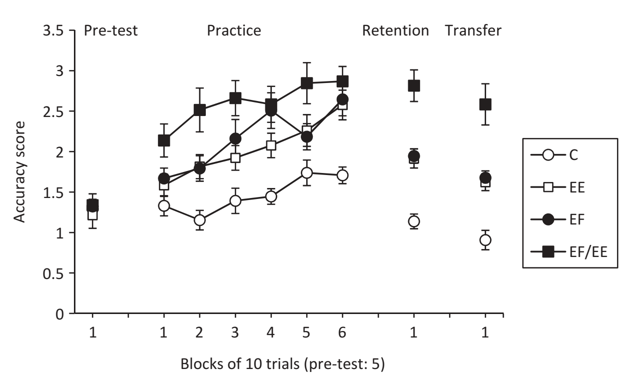

Figure 1. Throwing performance of the control (C), enhanced expectancy (EE), external focus (EF) and external focus/enhanced expectancy (EF/EE) groups on the pre-test, during practice (Day 1), and on the retention and transfer tests (Day 2).

Note: Error bars indicate standard errors.

interaction of external focus and enhanced expectancy, $F(1, 48) < 1$, $\eta_p^2 = .006$. Also, none of the other interactions were significant, $Fs(5, 240) < 1$. [We also analysed the practice data in a 4 (groups) × 6 (blocks) ANOVA to evaluate differences between the external focus/enhanced expectancy group and the external focus and enhanced expectancy groups, respectively, as well as differences between the latter groups and the control group. The main effect of group was significant, $F(3, 48) = 12.67$, $P < .001$, $\eta_p^2 = .44$. Tukey post hoc tests showed that the external focus/enhanced expectancy group differed from the enhanced expectancy group, $P < .05$, but not from the external focus group, $P > .05$. The enhanced expectancy and external focus groups differed from the control group, $Ps < .05$.]

The external focus/enhanced expectancy group also outperformed the other groups on the retention test. The enhanced expectancy and external focus groups had very similar scores, and their performances were between those of the enhanced expectancy and control groups. The main effects of both external focus, $F(1, 48) = 42.85$, $P < .001$, $\eta_p^2 = .427$, and enhanced expectancy, $F(1, 48) = 39.82$, $P < .001$, $\eta_p^2 = .453$, were significant. There was no significant interaction between external focus and enhanced expectancy, $F(1, 48) < 1$, $\eta_p^2 = .003$. [When analysed in a univariate ANOVA, the group effect was significant, $F(3, 52) = 27.60$, $P < .001$, $\eta_p^2 = .63$. The external focus/enhanced expectancy group differed significantly from both the enhanced expectancy and external focus groups, $Ps < .001$. Also, the enhanced expectancy and external focus groups differed from the control group, $Ps < .001$.]

A similar pattern of results was observed for the transfer test with a novel (greater) target distance. The main effects of external focus, $F(1, 48) = 30.76$, $P < .001$, $\eta_p^2 = .391$, and enhanced expectancy, $F(1, 48) = 27.05$, $P < .001$, $\eta_p^2 = .360$, were significant, while the interaction of the 2 factors was not significant, $F(1, 48) < 1$, $\eta_p^2 = .008$. [In a univariate ANOVA, the group effect for the transfer test was significant, $F(3, 52) = 19.40$, $P < .001$, $\eta_p^2 = .55$. The external focus/enhanced expectancy group differed significantly from the enhanced expectancy and external focus groups, $Ps < .001$, and the 2 latter groups differed from the control group, $Ps < .001$.]

Finally, it is interesting to note that the external focus/enhanced expectancy group appeared to maintain their level of performance from the end of practice to the retention and transfer tests, whereas all other groups showed a performance decrement. We conducted 2 (external focus) × 2 (enhanced expectancy) × 2 (last practice block versus retention or transfer test) ANOVAs with repeated measures on block to further examine this effect as it may indicate differential rates of memory consolidation. Interaction effects of external focus and enhanced expectancy were indeed found for both retention, $F(1, 48) = 5.22$, $P < .05$, $\eta_p^2 = .098$, and transfer, $F(1, 48) = 5.44$, $P < .05$, $\eta_p^2 = .102$. Post hoc tests with Bonferroni adjustments revealed that that the external focus/enhanced expectancy group's retention or transfer performance did not differ from the last practice block, $Ps > .05$, whereas all other groups demonstrated lower accuracy scores in retention and transfer, all $Ps < .01$.

Self-efficacy

There were no group differences immediately after the pre-test for self-efficacy (see Figure 2). The main effects of external focus, $F(1, 48) = 1.81$, $P > .05$, $\eta_p^2 = .036$ and enhanced expectancy, $F(1, 48) = 1.37$, $P > .05$, $\eta_p^2 = .028$, were not significant, and there was no interaction between external focus and enhanced expectancy, $F(1, 48) = 1.12$, $P > .05$, $\eta_p^2 = .023$.

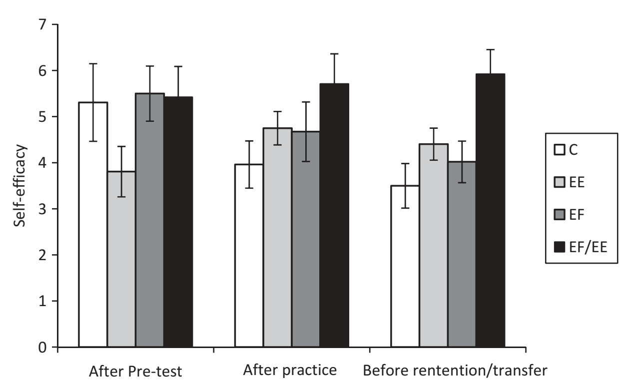

Figure 2. *S*elf-efficacy scores of the control (C), enhanced expectancy (EE), external focus (EF) and external focus/enhanced expectancy (EF/EE) groups after the pre-test, after practice (Day 1), and before retention and transfer (Day 2).

Note: Error bars indicate standard errors.

After the practice phase, the external focus/enhanced expectancy group tended to show the highest self-efficacy scores, while the external focus and enhanced expectancy groups had scores that were between the external focus/enhanced expectancy and control groups. However, the main effects of external focus, $F(1, 48) = 2.27$, $P > .05$, $\eta_p^2 = .045$, and enhanced expectancy, $F(1, 48) = 2.70$, $P > .05$, $\eta_p^2 = .053$, were not significant. Also, the interaction between external focus and enhanced expectancy was not significant, $F(1, 48) < 1$, $P > .05$, $\eta_p^2 = .001$.

Before the retention and transfer tests on Day 2, the external focus/enhanced expectancy group reported the highest self-efficacy (M = 5.92, s = 1.92), while the external focus (M = 4.02, s = 1.63) and enhanced expectancy (M = 4.4, s = 1.25) groups' scores were between those of the external focus/enhanced expectancy group and control group (M = 3.5, s = 1.74). The main effect of external focus was significant, $F(1, 48) = 4.94$, $P < .05$, $\eta_p^2 = .093$, as was the main effect of enhanced expectancy, $F(1, 48) = 9.37$, $P < .01$, $\eta_p^2 = .163$. There was no significant interaction between external focus and enhanced expectancy, $F(1, 48) = 1.19$, $P > .05$, $\eta_p^2 = .024$.

Simple linear regression analyses were conducted to determine whether self-efficacy after the practice phase (Day 1) or before the retention and transfer tests (Day 2) was a significant predictor of learning. Self-efficacy on Day 1 predicted both retention, $F(1, 50) = 4.90$, $P < .05$, adjusted $R^2 = .071$, $\beta = .299$, and transfer performance, $F(1, 50) = 5.85$, $P < .05$, adjusted $R^2 = .087$, $\beta = .324$. Also, self-efficacy on Day 2 was a significant predictor of both retention, $F(1, 50) = 9.37$, $P < .01$, adjusted $R^2 = .141$, $\beta = .397$, and transfer performance, $F(1, 50) = 6.21$, $P < .05$, adjusted $R^2 = .093$, $\beta = .332$.

Positive affect

After the pre-test, all groups were similar in terms of positive affect (see Figure 3). The main effects of enhanced expectancy, $F(1, 48) < 1$, $\eta_p^2 = .003$, and external focus, $F(1, 48) = 1.97$, $P > .05$, $\eta_p^2 = .039$, and the interaction of external focus and enhanced expectancy, $F(1, 48) = 1.65$, $P > .05$, $\eta_p^2 = .033$, were not significant.

After the practice phase, however, the 2 groups with an enhanced expectancy treatment (enhanced expectancy, external focus/enhanced expectancy) had higher positive affect ratings (M = 3.82, $s_{\bar{x}}$ = .18) than the other 2 groups (M = 3.29, $s_{\bar{x}}$ = .18). The main effect of enhanced expectancy was significant, $F(1, 48) = 4.49$, $P < .05$, $\eta_p^2 = .085$. There was no significant main effect of external focus, $F(1, 48) < 1$, $\eta_p^2 = .000$, and no interaction of external focus and enhanced expectancy, $F(1, 48) < 1$, $\eta_p^2 = .012$. On Day 2, before the retention and transfer tests, there were no significant main effects of external focus, $F(1, 48) < 1$, $\eta_p^2 = .010$, or enhanced expectancy, $F(1, 48) < 1$, $\eta_p^2 = .022$, and no interaction of external focus and enhanced expectancy, $F(1, 48) = 3.13$, $P > .05$, $\eta_p^2 = .061$, was found.

Positive affect at the end of practice did not predict retention, $F(1, 50) = 1.23$, $P > .05$, but did predict transfer performance, $F(1, 50) = 5.00$, $P < .05$, adjusted $R^2 = .073$, $\beta = .302$. Positive affect at the beginning of Day 2 predicted neither retention, $F(1, 50) < 1$, nor transfer performance, $F(1, 50) = 2.74$, $P > .05$.

Discussion

We examined the individual and combined influences of providing learners with external focus instructions and enhancing their performance expectancies. The findings showed that the benefits of each factor for learning were similar and that their combination yielded additive effects. On both tests of learning (i.e., retention and transfer), the external focus/enhanced expectancy group outperformed all other groups. The external focus and enhanced expectancy groups showed almost identical

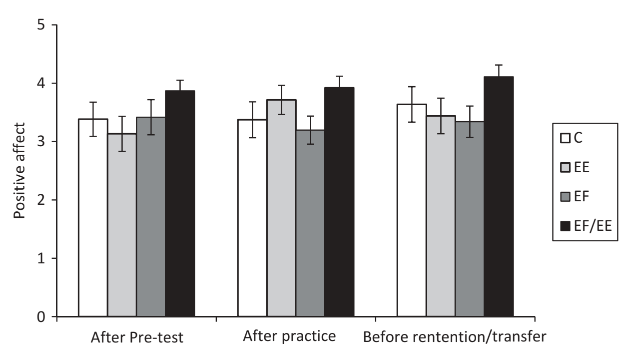

Figure 3. Positive affect scores of the control (C), enhanced expectancy (EE), external focus (EF), and external focus/enhanced expectancy (EF/EE) groups after the pre-test, after practice (Day 1), and before retention and transfer (Day 2).

Note: Error bars indicate standard errors.

performances, with their throwing accuracy scores being about equidistant from those of the external focus/enhanced expectancy and control groups. Interestingly, the external focus/enhanced expectancy group was also the only group that maintained their performance from the end of the practice phase to the retention and transfer tests on the following day, whereas all other groups' performance decreased. The "double advantage" of focusing on the intended movement effect and believing that one's performance was above average suggests that the mechanisms underlying each variable may be at least partially independent.

An external focus of attention, or a concentration on the movement effect, has consistently been found to be a precondition for optimal motor performance and learning. An external focus has been shown to not only increase movement accuracy but also to facilitate movement efficiency (see Wulf, 2013, for a review). Aside from keeping the focus "on target," focusing externally presumably prevents the performer from focusing on their own body movements. Our manipulation check confirmed that the majority of participants who were given external focus instructions indicated that they focused on the target, whereas the majority of participants without those instructions focused on their body movements. An internal focus on body movements and associated conscious control attempts have been demonstrated to lead to superfluous muscular activity, or "noise" in the motor system, that is detrimental to performance (e.g., Lohse & Sherwood, 2012; Zachry, Wulf, Mercer, & Bezodis, 2005). By responding to or adopting an external focus, the performer appears to take advantage of the motor system's self-organising capabilities (e.g., Lohse et al., 2014) and automatic control processes, which ensure that the planned outcome is achieved, uninterrupted by self-related processing (Wulf & Lewthwaite, 2010). Interestingly, groups without attentional focus instructions, such as the enhanced expectancy and control groups in the present study, typically show similar learning effects as groups with internal focus instructions (see Wulf, 2013). It has therefore been suggested that learners may spontaneously focus on their body movements – unless instructed otherwise (Wulf, 2007). The enhanced expectancy and control group participants' responses seem to confirm this notion (see also, Land, Tenenbaum, Ward, & Marquardt, 2013; but see Porter, Nolan, Ostrowski, & Wulf, 2010). Thus, adopting an external focus – on the intended movement effect and away from body movements – appears to be an essential ingredient for optimal performance and learning.

Presumably as a consequence of their effective performance with an external focus, external focus and external focus/enhanced expectancy participants' self-efficacy tended to be higher at the end of practice and was significantly increased before the retention and transfer tests, relative to those without external focus instructions. Confidence in their ability to do well, in turn, may have further benefitted participants' performance and learning (e.g., Stevens, Anderson, O'Dwyer, & Williams, 2012). Thus, it appears that an external focus has *direct* benefits for learning by keeping the performer's focus on the movement goal and might have *indirect* benefits by increasing performers' self-efficacy. In fact, enhanced personal expectations (i.e., self-efficacy) may be one key effect of an external focus and a candidate mechanism for the learning and performance advantage of an external focus of attention.

Self-efficacy was also increased in participants whose performance expectancies were enhanced by providing them with positive social-comparative feedback (enhanced expectancy, external focus/enhanced expectancy groups), which is in line with the previous findings (Saemi et al., 2012; Stoate et al., 2012). The bogus information about the average score of other performers, which led participants to believe that their performance was superior to that of their peers, increased confidence in their ability. This effect tended to become evident at the end of practice, and it was significant before the beginning of the retention and transfer tests. Previously, positive social-comparative feedback was found to reduce performers' nervousness and concerns about their performance (Wulf et al., 2012), and was associated with facilitation of learning outcomes and automatic movement control (e.g., Lewthwaite & Wulf, 2010). Learners' self-efficacy may act as a self-fulfilling prophecy, such that confidence in their ability to perform well enables them to perform well. Some support for this notion comes from the present finding that self-efficacy at the end of Day 1 as well as at the beginning of Day 2 predicted both retention and transfer performance (i.e., learning). Conversely, the positive relationship between self-efficacy and retention performance may be a reflection of the fact that relatively good performers both perform well and feel better about their performance at the end of the acquisition period and continue their good performance, with confidence, during the retention test. Feltz and colleagues (2008) controlled for the influences of self-efficacy on performance and performance on self-efficacy and demonstrated that the causal effect of self-efficacy on performance can be stronger as practice progresses.

The positive normative feedback provided to the enhanced-expectancy groups also increased the positive affect experienced by those participants. At the conclusion of the practice phase, positive affect was significantly greater in the enhanced expectancy and external focus/enhanced expectancy groups than in the external focus and control groups. The role of positive affect in the learning process is increasingly being recognised. Positive affect is thought to have, or to reflect, a memory strengthening or cementing role in the learning process (Ashby et al., 2010). Even though the effect of the enhanced expectancy manipulation in the present study did not carry over to the second day, positive affect at the end of Day 1 predicted transfer performance. Overall, the learning advantages resulting from positive (social-comparative) feedback are associated with increased self-efficacy – which presumably helps to "free" the motor system of constraints imposed by self-concern and related conscious control efforts and facilitates automaticity – and perhaps also with the memory-consolidating effects of positive emotional experiences associated with positive feedback. While enhanced expectancies *per se* did not prevent or reduce forgetting from Day 1 to Day 2, the combination of enhanced performance expectancies with an external focus of attention (external focus/enhanced expectancy) enabled learners to maintain their performance level across the retention interval – in addition to leading to the highest levels of performance and learning. This finding also highlights the importance of both factors for learning.

The goal of the present study was to elucidate the contribution of 2 factors that have been found to reliably promote learning – an external attentional focus and enhanced performance expectancies. Our findings demonstrated that both have additive effects and that they seem to be mediated by partially different mechanisms. Our understanding of motor learning will benefit from continued efforts to explore with behavioural and neural methods the relative effectiveness of, and the processes underlying, other key learning variables – and eventually lead to much needed theoretical advances.

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