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Enhanced expectancies facilitate golf putting

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ABSTRACT

Objectives: To examine the influence of enhanced expectancies on motor learning, we manipulated learners' expectancies by providing criteria for "success" that were relatively easy or difficult to meet.
Design: Experimental design with two groups.
Method: Two groups of non-golfers practiced putting golf balls to a target from a distance of 150 cm. The target was surrounded by a large (14 cm diameter) and a small circle (7 cm diameter) during practice. The groups were informed that balls coming to rest in the large circle (large-circle group) or small circle (small-circle group), respectively, constituted a "good" trial. One day later, the circles were removed. Participants putted from the same distance (retention) and a greater distance (transfer: 180 cm).
Results: On both retention and transfer tests, accuracy was greater for the large-circle compared with the small-circle group.
Conclusions: Enhancing expectancies by providing a relatively "easy" performance criterion led to more effective learning.

Over the past several years, there has been converging evidence that motor skill learning is facilitated if learners' performance expectancies are enhanced. This can be accomplished in various ways. In some studies, providing learners with feedback on trials with relatively small errors resulted in more effective learning than providing feedback on trials with larger errors (e.g., Badami, VaezMousavi, Wulf, & Namazizadeh, 2012; Chiviacowsky & Wulf, 2007; Chiviacowsky, Wulf, Wally, & Borges, 2009; Saemi, Porter, Ghotbi-Varzaneh, Zarghami, & Maleki, 2012). In those studies, feedback was given after blocks of trials, and participants who received feedback on more accurate practice trials, unbeknownst to them, demonstrated more effective learning (i.e., retention performance) than those who received feedback on less accurate trials. Thus, enhanced expectancies resulting from feedback highlighting relatively successful rather than unsuccessful performance benefited learning. Also, edited video feedback showing only learners' successful performances, such as a sequence of well-executed swim stroke, has been demonstrated to be more effective for learning than showing learners their actual (unedited) performance (e.g., Clark & Ste-Marie, 2007). In other studies, (false) social-comparative feedback was provided in addition to veridical feedback. Learners who were led to believe that their performance (Ávila, Chiviacowsky, Wulf, & Lewthwaite, 2012; Lewthwaite & Wulf, 2010; Wulf, Chiviacowsky, & Lewthwaite, 2012) or improvement (Wulf, Chiviacowsky, & Lewthwaite, 2010) was superior relative to that of others demonstrated more effective learning than did learners without social-comparative feedback (control groups), or those who assumed their performance was below average. In one study, a simple statement informing learners that their peers typically do well on the task to be learned was sufficient to enhance their expectancies and result in learning advantages (Wulf et al., 2012; Experiment 2). Also, visual illusions affecting the perceived size of a target can influence performance accuracy. As first demonstrated by Witt, Linkenauger, and Proffitt (2012), when the golf hole appeared larger because it was surrounded by small circles, participants produced more successful putts than when the hole was surrounded by larger circles and therefore appeared smaller. Interestingly, not only performance but also learning, that is, retention performance without visual illusions, has been found to be superior after practice with a perceived larger hole compared with a smaller-looking hole (Chauvel, Wulf, & Maquestiaux, 2015). Overall, it is striking how easily performance and learning can be facilitated by enhancing performers' expectancies.

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The expectancy effects are consistent with the placebo effect (i.e., the effect of a substance that is solely due to an individual's expectation; for reviews, see Jubb & Bensing, 2013; Price, Finniss, & Benedetti, 2008) or, more broadly, the influence of suggestions on emotions, thoughts, and behavior (see Michael, Garry, & Kirsch, 2012). For instance, people with Parkinson's disease are known to respond well to placebos or suggestions by showing improvements in motor performance (e.g., Pollo et al., 2002). Expectations of enhanced outcome have been found to activate dopamine response in this population (Lidstone et al., 2010). The role of dopamine in the expectation of reward is now well established (Jubb & Bensing, 2013). An explanation of dopamine's role in learning is proceeding on many fronts, including its association with behaviors such as approach/task engagement and elicitation of effort, and, neurophysiologically with a "stamping in" of memories through modulation of synaptic plasticity (e.g., Costa, 2007; Shohamy & Adcock, 2010; Wise, 2004).

Self-efficacy expectations have likewise been shown to predict motor performance and learning (e.g., Moritz, Feltz, Fahrbach, & Mack, 2000; Pascua, Wulf, & Lewthwaite, 2015; Stevens, Anderson, O'Dwyer, & Williams, 2012), and various manipulations have been found to increase self-efficacy (Chiviacowsky, Wulf, & Lewthwaite, 2012; Hutchinson, Sherman, Martinovic, & Tenenbaum, 2008; Pascua et al., 2015; Saemi et al., 2012; Wulf et al., 2012). According to response expectancy theory (Kirsch, 1985), people's expectations of a certain outcome can cause them to inadvertently act in a way that produces that outcome. Thus, the conviction that one is doing well, and will likely do so in the future, might partially operate by facilitating the utilization of more automatic control processes (Lewthwaite & Wulf, 2010) that are typically associated with a higher skill level. The result is more effective motor performance and learning.

The purpose of the present study was to determine whether learning could be facilitated by enhancing learners' expectancies – but without giving selective or false feedback/information (e.g., Ávila et al., 2012; Clark & Ste-Marie, 2007), or biasing perception of target size through visual illusions (e.g., Chauvel et al., 2015). We asked whether providing a criterion for good performance that could be reached relatively easily, compared with a criterion that was more difficult to reach, would lead to improved learning. In a recent study using a coincident-timing task (Chiviacowsky et al., 2012), learners who were informed that errors within a very small bandwidth (4 ms) constituted good performance, showed less effective learning than those given a comparatively large error bandwidth (30 ms), or those who had not been given a criterion (control group). Thus, having a difficult goal impeded learning. Yet, in all groups the learners themselves controlled the delivery of feedback. That is, it is likely that the autonomy support (self-controlled feedback) granted to all participants already optimized learning to some degree (see Lewthwaite & Wulf, 2012) – and this learning benefit was diminished by depriving the 4-ms group of the opportunity to experience success. Thus, it remains to be seen whether providing learners a criterion for "success" can benefit learning if that criterion is relatively easy to meet, compared with a criterion that is difficult to meet.

In the present study, we used a golf-putting task. Participants practiced the task with the target being surrounded by a large and a small circle. Different groups were informed that balls coming to rest in the large or small circle, respectively, would be considered good putts. Learning was then assessed by retention and transfer tests on the following day, with the circles removed. We hypothesized that the group with the large circle, or relatively easy goal (large-circle group), would outperform the group with the difficult goal (small-circle group) on both tests of learning.

1. Method

1.1. Participants

Thirty-four undergraduate kinesiology students (12 males, 22 females), with an average age of 24.6 years (*SD*: 5.20) and little or no experience playing golf, participated in the experiment. Participants were naïve as to the purpose of the study, and they gave their written informed consent before participation. The study was approved by the university's institutional review board.

1.2. Apparatus and task

Participants were asked to putt standard white golf balls to a horizontal target (2 × 2 cm square) on a level artificial-turf indoor green (400 × 55 cm). A large circle (14 cm in diameter) and a small circle (7 cm) surrounded the target. The circles were made of contact paper and affixed to the green's surface. Participants putted from a distance of 150 cm. They were instructed to try to make the ball stop as close to the target as possible. Putting accuracy was measured as the distance between the center of the target and the edge of the ball. If a ball contacted the rear border of the putting green, the maximum measurable deviation of 100 cm was recorded. (This was the case for 1.9% of practice trials and 2.4% of the retention or transfer trials.)

1.3. Procedure

Participants were randomly assigned to one of two groups: The large-circle group was informed that balls coming to rest within the large circle were considered good trials, while the small-circle group was told balls ending up in the small circle would be considered good trials. Each participant first completed a pre-test consisting of 5 trials without surrounding circles. Subsequently, both circles were placed around the target, and participants were given the information mentioned above, depending on group assignment. They then performed 5 blocks of 10 practice trials. In addition to their intrinsic visual feedback, they were given augmented feedback (deviation in cm) after each trial. One day later, participants performed the retention test from the same distance (150 cm) and subsequently a transfer test from a greater distance (180 cm) to examine learning and generalizability to novel situations as a function of practice conditions. Each test consisted of 12 trials without the circles.

1.4. Data analysis

To assess putting performance, deviations from the target were averaged across all 5 trials for the pre-test and across 10 trials for the practice phase. Retention and transfer test data were averaged across all 12 trials. A univariate analysis of variance (ANOVA) was used for the pre-test. A 2 (groups) x 5 (blocks of 10 trials) ANOVA with repeated measures on the last factor was used to analyze the practice data. The retention and transfer test data were each analyzed in analyses of covariance, with pre-test performance included as a covariate. An alpha level of $p < .05$ was adopted for all statistical analyses.

2. Results

2.1. Pre-test

The two groups' putting performance on the pre-test did not differ significantly, $F(1, 32) = .695$ (see Fig. 1).

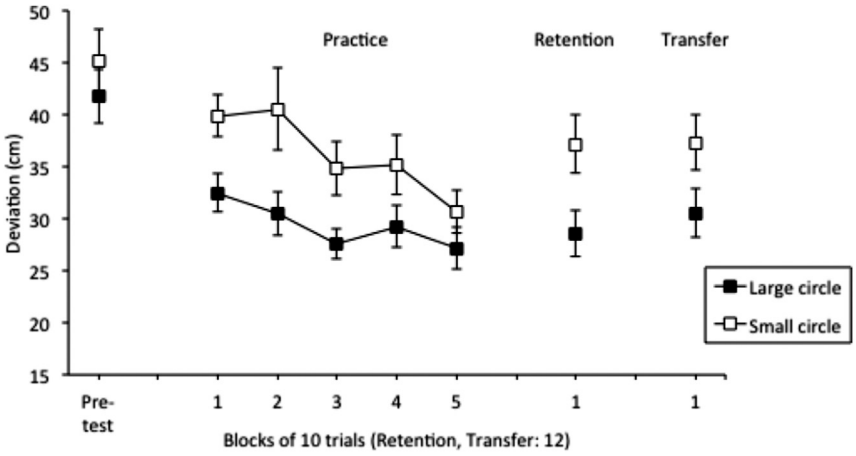

Fig. 1. Putting performance (i.e., deviation from the center of the target) of the large- and small-circle groups during practice on Day 1 (with surrounding circles), and retention and transfer tests on Day 2 (without circles). Error bars represent standard errors.

2.2. Practice

During the practice phase, both groups consistently reduced their deviations from the target. The main effect of block was significant, $F(4, 128) = 4.73$, $p = .001$, $\eta_p^2 = .13$. Block 1 differed from Block 5 ($p < .01$). Large-circle group participants experienced "good" performance (i.e., balls coming to rest in the large circle) on 22.0% of the practice trials, whereas participants in the small-circle group experienced "good" performance (i.e., balls coming to rest in the small circle) on 7.9% of the trials. The large-circle group outperformed the small-circle group throughout the practice phase. The main effect of group was also significant, $F(1, 32) = 8.92$, $p = .005$, $\eta_p^2 = .22$. The Group × Block interaction was not significant, $F(1, 32) = 1.84$, $p = .571$.

2.3. Retention

On the retention test without surrounding circles one day later, deviations from the hole were smaller for the large-circle group ($M = 28.6$ cm, $SD = 9.17$) than the small-circle group ($M = 37.2$ cm, $SD = 11.38$), $F(1, 31) = 5.07$, $p = .032$, $\eta_p^2 = .14$.

2.4. Transfer

On the transfer test, which involved a longer putting distance (180 cm), the large-circle group ($M = 30.4$ cm, $SD = 9.49$) again showed smaller errors than the small-circle group ($M = 37.9$ cm, $SD = 10.88$), $F(1, 31) = 4.46$, $p = .043$, $\eta_p^2 = .13$.

3. Discussion

The purpose of the present study was to examine whether enhancing learners' expectancies by providing them with an "easy" criterion for good performance, relative a more difficult one, would lead to more effective learning of a golf-putting task. This was indeed the case. Large-circle group participants who, according to the criterion provided to them, had more successful putts during the practice phase, generally outperformed participants of the small-circle group who had fewer successful putts during practice. Group differences emerged even early in practice. While the large- and small-circle groups had similar errors on the first practice trial (53.3 and 53.9 cm, respectively), the groups soon tended to diverge, and the large-circle group consistently outperformed the small-circle group during the practice phase. Importantly, enhanced performance of the large-circle group was still seen on both the delayed retention and transfer tests, during which the circles defining success were removed. Thus, giving learners a criterion for performance that was easier to reach resulted in more effective learning than having a criterion that was difficult to reach. The learning advantage was seen when participants putted from both the same distance as during practice (retention) or a novel distance (transfer).

The present results are in line with other recent findings showing that enhancing performers' expectancies during practice – be it through suggestions that they are performing or improving well (e.g., Chiviacowsky & Wulf, 2007; Clark & Ste-Marie, 2007; Saemi et al., 2012; Wulf et al., 2010), that their peers generally do well on a given task (Wulf et al., 2012; Experiment 2), that they are likely to perform well under pressure (McKay, Lewthwaite & Wulf, 2012), or visual illusions that make a task appear easier (Chauvel et al., 2015; Witt et al., 2012; Wood, Vine, & Wilson, 2013) – have the capacity to improve performance and learning. Using a visuomotor adaptation task and a similar paradigm, Trempe, Sabourin, and Proteau (2012) also found that setting a performance criterion that could be reached relatively easily facilitated learning. Greater "success" experienced during practice manifested itself in enhanced learning, as measured 24 h later – even though having an easy criterion did not actually lead to better performance during practice in their study. That finding suggests that learners' perceptions of success are more important for learning than actual success.

An interesting question is: Why do performance expectancies affect learning? We suggest that two factors contribute to the learning effects. First, the confidence produced by presumed good performance (large-circle group) might free learners from concerns about their performance, promoting greater movement automaticity (Lewthwaite & Wulf, 2010). Conversely, lack of perceived success, resulting from fewer than 8% of trials deemed successful, may have caused more conscious control attempts in small-circle group participants. Concerns about performance tend to increase conscious effort to control actions in attempts to improve performance; somewhat paradoxically, conscious control typically leads to performance decrements (e.g., Baumeister, 1984; Wulf et al., 2012). Situations that involve negative feedback (e.g., Hutchinson et al., 2008) or perceived lack of success (e.g., Chiviacowsky et al., 2012; Trempe et al., 2012) are likely to result in self-regulatory processes, which disrupt automaticity and result in inefficient muscular activation (termed "microchoking" episodes by Wulf &

Lewthwaite, 2010; see also McKay, Wulf, Lewthwaite, & Nordin, 2015).

Enhanced expectancies have also been found to be associated with positive affect (Pascua et al., 2015; Stoate, Wulf, & Lewthwaite, 2012). The importance of success experience, positive feedback, or reward for motor skill consolidation is becoming increasingly clear (Trempe & Proteau, 2012). Positive affect has been found to be associated with phasic increases in dopamine discharge that strengthens neural connection and might therefore help to cement learning (Ashby, Turner, & Horvitz, 2010).

A limitation of the present study is that we only used performance measures. In future studies, it would be useful to include measures of self-efficacy or perceived competence as well as positive affect to determine more directly their possible role in the learning advantages resulting from manipulations of success experience during practice (Chiviacowsky et al., 2012; Trempe et al., 2012; present study). Furthermore, we would expect measures of automaticity, such as dual-task performance, frequency of movement adjustments, movement fluency, or movement regularity (e.g., Kal, van der Kamp, & Houdijk, 2013; Wulf, McNevin, & Shea, 2001), to show greater automaticity in participants with enhanced expectancies. Finally, questionnaires to assess performers' attentional focus might reveal differences in self-related attention when they feel more or less successful (Wulf & Lewthwaite, 2015).

From an applied perspective, the present findings reinforce the need to enhance learner expectancies by creating appropriate practice, instructional, or feedback conditions to optimize learning. Importantly, the resulting performance improvements seem to be more than temporary and have the capacity to transfer to situations in which those conditions are no longer present (e.g., competitions). Thus, by creating conditions that increase the learner's feelings of competence – one of the basic psychological needs (Deci & Ryan, 2008) – instructors or coaches can enhance performance and speed the learning process.

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