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APPLIED RESEARCH

A Proposed Three-Stage Postperformance-Routine Framework

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Research has supported the use of preperformance routines to successfully manage the period preceding sport performance. In contrast, little research has been done on the period succeeding skill execution. This article introduces a three-stage model for postperformance routines (PoPR) for novice motor learning and performance including emotion regulation, performance analysis and correction, and continuation to the next performance trial. To test this model, 38 novice golfers completed a putting task after random assignment to either a PoPR or a control condition. Putting performance was measured after each putt, and self-efficacy, arousal, affect, and perceived task difficulty were recorded every 10 putts. Participants in the PoPR group improved their performance from baseline to postintervention ($d = -0.55$), while performance in the control group remained unchanged ($d = -0.01$). No significant differences were observed for performance consistency, emotions, self-efficacy, and perceived task difficulty. Thus, practitioners implementing a PoPR in novice athletes may consider the proposed three-stage framework for improvements in motor learning and performance.

Keywords: preperformance routine, performance enhancement, self-regulation, PPR

In sport, there are key moments that can determine games, seasons, and careers. The period leading to these moments is the focus of intense research on preperformance routine (PPR) in sport psychology. Consistent PPRs have been shown to increase performance across a number of sports and populations (Cotterill, 2010; Rupprecht et al., 2021). Demonstrated benefits of consistent PPRs include improved emotion regulation, attentional control, decreased warm-up period, automatic skill execution, reduced injury, and improved motor learning (Foster et al., 2006; McHugh & Cosgrave, 2010; Moradi, 2019). While PPRs have been well studied in sport psychology, postperformance routines (PoPRs) have received little attention in the literature.

The repetition of actions, with breaks in between, is a common characteristic of many sports such as golf, baseball, or American football. During the time between motor skills, dwelling on previous performance can impact the preparation and execution of the succeeding performance (Hatfield & Kerick, 2007). PoPRs are a series of behavioral and psychological strategies, which allow performers to cope with previous performances and improve their performance. Although the scientific evidence supporting the use of PPR on athletic performance and motor learning is strong, the support for PoPR is much more limited. This is surprising given the importance of motor learning and performance in applied sport psychology. One possible explanation is that even in studies that have tested routines immediately after task execution, PPR terminology is used in the literature (Rupprecht et al., 2021). Preliminary studies focusing specifically on PoPR have found potential benefits (Bloom et al., 1997; Mesagno, 2014), but a model organizing the different phases is still lacking. The goal of this article is to develop and test a three-stage model of PoPR.

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Preperformance Routine

PPRs are the "sequences of task-relevant thoughts and actions an athlete systematically engages in prior to performance of a sport skill" (Moran, 1996, p. 177). PPRs are capable of improving motor learning and performance in numerous ways. They may be used as a method of procedural consistency that acts to prevent nonrelevant stimuli from distracting the performer from their goal (Moore & Stevenson, 1994). Similarly, they help the performer focus on environmental cues that are relevant for successful performance (Harle & Vickers, 2001). Internally, they work to help the performer maintain task-relevant thoughts (Gould & Udry, 1994) while also facilitating the ideal physical and mental state from which to perform optimally (Marlow et al., 1998). Furthermore, PPR has been shown to improve motor learning and performance in novices performing golf putting, tennis serving, volleyball serving, and basketball free-throw shooting (Moradi, 2020; Perry et al., 2018). For novices, PPR is thought to establish a motor execution plan and improve self-regulation of emotion and attention (Cohn, 1990; Lidor & Mayan, 2005). Meta-analytic results supported the positive impact of PPR on performance across many tasks and sports (Cotterill, 2010; Mesagno et al., 2015; Rupprecht et al., 2021).

Postperformance Routine

Relative to the amount of research investigating PPRs, very little research has investigated PoPRs. Since PPRs are aimed at improving performance through mental rehearsal and establishing motor execution plans, among other mechanisms, it may be that similar mechanisms can help improve performance if used immediately after skill execution. This may be particularly relevant for motor learning when novice athletes are establishing their early motor execution plans. For the purposes of this study, PoPR is defined as "a series of behavioral or psychological strategies undertaken after performance execution, yet prior to the pre-performance routine of the next performance attempt" (Mesagno et al., 2015, p. 86). Hill et al. (2010) demonstrated that golfers who excelled under pressure had task-related behavioral responses in their PoPRs after each shot; in contrast, golfers who performed poorly under pressure did not report using a PoPR. This would seem to indicate that PoPRs are effective in enhancing performance under pressure. Based on this finding, Mesagno et al. (2015) developed a PoPR that focused on performance analysis and correction only and found that PPR and PPR combined with PoPR improved bowling performance, but that PoPR alone did not improve performance. The PoPR proposed in the present study builds on the empirically validated aspects from the PPR literature (i.e., emotional regulation and present moment focus) and Mesagno et al.'s (2015) research on PoPR (i.e., performance analysis and correction) to introduce a new three-stage model of PoPR. Therefore, the proposed framework consists of three stages: *emotional regulation, performance analysis and correction*, and *continuation to the next performance*.

Emotional Regulation

The most prevalent theories on emotion consider emotions to be a combination of valence and arousal (Raedeke & Stein, 1994; Russell et al., 1989). Understanding how emotion affects performance has primarily been examined using cognition-emotion theories that focus on the relationship between appraisal and arousal (e.g., Ortony et al., 1988). This approach has culminated in theories such as the Individual Zone of Optimal Functioning, which is the specific combination and intensity of pleasant and unpleasant emotions leading to an individual's optimal performance (Hanin, 1997; Kamata et al., 2002).

Given that cognitive appraisal is central to emotion, self-regulation allows performers to adjust, among other aspects, their emotional state and thereby improve performance (Hanin, 2000). Through self-regulation, implemented in the postperformance period, emotions can be managed in a way that is facilitative for the performer (Beck & Weishaar, 1995). For example, a pleasant emotion such as happiness may be used to reinforce the result of a good performance and facilitate future optimal performance. Conversely, an unpleasant emotion such as frustration can be reframed as the performer recognizing their high level of investment and can fuel their motivation for the next performance. This self-regulation of cognitive appraisals affects how the emotion is perceived and thus its potential impact on performance.

In addition to cognitive reframing, other emotional regulation techniques such as deep breathing, imagery, and progressive muscle relaxation have been shown to effectively manage emotions and facilitate superior performance (Hanin, 2000). Breathing techniques, in particular, have been shown to be a simple and effective means of managing emotional responses (Williams & Harris, 2006).

In addition to the performance-related importance of emotional regulation, emotions also have numerous other effects that may be optimized through the implementation of a PoPR. For example, emotions such as shame or frustration can lead to an increased drive to improve if the PoPR is implemented properly (Markus & Kitayama, 1991). Additionally, in team sports, positive emotions have been shown to facilitate team performance via team resilience (Meneghel et al., 2016). A structured but flexible PoPR would help novice performers regulate their emotions, hence leading to optimal conditions for successful learning and performance. Furthermore, once the emotions following a performance have been regulated, the analysis and correction of that performance are likely to be more accurate due to less emotional interference on cognition (Ortony et al., 1988).

Performance Analysis and Correction

Receiving accurate feedback is essential for improving performance. Knowledge of result and knowledge of performance are two aspects of feedback that are particularly important in sport, particularly for novices (Schmidt et al., 2018). Knowledge of result refers to information gained by looking at the result of the performance, such as a dart missing 2 inches to the right of target. On the other hand, knowledge of performance is the information gained through the nature of the movement, such as a golf ball slicing away after contact. These two forms of extrinsic feedback, combined with intrinsic feedback, allow the performer to analyze their action in order to improve the next performance (Schmidt & Walters, 1984). The second stage of the PoPR allows for these forms of feedback to be intentionally gathered and processed before a decision is made about how to improve the next performance. For those learning a motor movement, reflecting on the performance outcome and the motor process that led to it are essential for learners to make necessary adjustments (Singer, 1988).

With a systematic analysis of the performance, any subsequent decisions made to improve performance should be more accurate compared with the absence of such analysis. Furthermore, the accuracy of feedback analysis is facilitated through the preceding emotional regulation stage. One example of a performance analysis was explored with bowlers who reflected on questions regarding both knowledge of results and performance. This reflection routine led to increased accuracy and overall performance (Mesagno, 2014; Post et al., 2022). Similarly, in an examination of novice swimmers, event-level postperformance evaluation and reflection were positively correlated with youth swimmers' performance (Post et al., 2022). Following the analysis of information gathered from the performance, the decisions to make small technical, tactical, mental, and/or physical adjustments can then be made for the upcoming performance, especially in the case of novices learning a new skill. This in turn would also lead to a heightened belief that one could be successful with the task at hand (i.e., self-efficacy; Bandura, 1997), which has been linked to superior sport performance (Moritz et al., 2000).

Continuation to the Next Performance

Once the performance has been emotionally regulated, analyzed, and corrected, the performer can shift their attention toward the next performance. The benefits of including a continuation to the next performance phase are twofold. First, it facilitates a present-moment focus on the upcoming performance. Second, if the performer has been trained to use PPRs, it promotes the use of that routine.

By including a continuation phase in the PoPR, performers are reminded to turn their attention onto the next performance. This is similar to many mindfulness-based programs which enhance performance by promoting awareness of an objective present-moment focus (Gardner & Moore, 2004). This phase combines the previous steps, which focus on cognitive control over emotions and corrections, with a more natural and flow-like state. This state allows performers to focus their attention on their intended performance (Kaufman et al., 2009). Shifting focus from the previous performance to the next is an important intersection during the learning of a motor skill, and performers should be prepared for this transition.

In this study, the verbal cue "next putt" was used to signal the end of the PoPR and redirect participants' attention to the ensuing performance. Although the present study focused on PoPR, a cue for continuation to the next performance was included as a delineation point for cessation of attention on the previous performance, thus terminating the PoPR. Based on research supporting the use of PPRs, combining a PoPR with a PPR is likely to facilitate successful performance through PPR mechanisms as well, although this combination was not tested in the present study (e.g., Cohn et al., 1990; Gould et al., 1981; Moore, 1986).

The Present Study

This study aims at addressing a gap in the PoPR literature by providing a framework for researchers and practitioners. The goal of this paper is to experimentally test the proposed three-stage PoPR in novices completing a golf putting task. Golf putting is an ideal task to utilize PoPRs as it is self-paced and requires the repetition of several performances across a long period of time. We hypothesize that emotional responses will be more pleasant and less variable following the implementation of the three-stage PoPR. Putting performance should similarly improve in accuracy and become more consistent. We also hypothesize that a PoPR would improve self-control, self-efficacy, and perceived task difficulty.

Method

Participants

Participants were recruited via a College of Education research participant pool, at a University in the Southeast of the United States. Participants had no formal golf training but had experience playing golf recreationally. An a priori power analysis was conducted for repeated-measures multivariate analyses of variance (MANOVAs) using G*Power (version 3; Faul et al., 2007). Alpha level was set at .05 and power $(1 - \beta)$ at .80. The power analysis indicated that a two-group, two-measurement $(r = .5)$ repeated-measures MANOVA, with an estimated effect size of Cohen's $f = 0.25$ based on previous research in PoPR (Mesagno et al., 2015), required a total sample size of 34 participants. To account for potential attrition, an additional seven participants (20%) were recruited; three participants' data were removed as described in the "Data Analysis" section, resulting in a sample of 38 participants. Participants were predominately college-aged ($M = 23.00$ years, $SD = 4.84$), male ($n = 28$), novice golfers with no participants reporting holding a golf handicap and 18 reporting no years of competitive golf experience ($M = 1.08$, $SD = 1.46$).

Measures

Commitment

Two items assessed participant's commitment level to the putting task and the PoPR. The first item was "How much effort did you invest in the putting task?" The second item, only presented to the PoPR group, was "How much effort did you invest in the PoPR?" Participants ranked their response on a Likert-style response ranging from 1 (*none*) to 5 (*very much*). Various versions of these commitment scales have been used in a wide range of psychological skills manipulation checks (e.g., Braun-Trocchio et al., 2022; Richard et al., 2018; Tenenbaum & Connolly, 2008).

Emotion

The Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985) and Feeling Scale (FS; Hardy & Rejeski, 1989) were used to measure overall pleasantness and arousal throughout the task. The FAS is anchored from 1 (*Low arousal*) to 6 (*High arousal*), while the FS was measured on a scale from −5 (*Very bad*) to +5 (*Very good*). The FS and the FAS represent the two components of the circumplex model, which is an integrative approach to the study of emotions (Posner et al., 2005). The FS and FAS have been used in numerous studies on emotional response in sport and exercise setting (e.g., Beltrão et al., 2020; Follador et al., 2019; Vandoni et al., 2016). Test–retest reliability for this sample was supported through high correlation coefficients for both the FSA $(r = .84)$ and the FS $(r = .83)$.

Performance

Putting performance was measured via an eight-camera motion analysis system (Vicon Bonita 10, Vicon Motion Systems). These cameras have a one-megapixel resolution and sample at 250 Hz. Reflective tape was placed on the target and the ball in a way that did not disrupt performance. The cameras were arranged to surround the putting target and mounted to the walls 2 m above the floor. Cameras ranged from 3 to 6 m away from the target and were calibrated and analyzed using Vicon's Tracker software (version 3, Vicon Motion Systems). Previous research has supported a precision of 0.5 mm using this system (Thewlis et al., 2013).

Self-Control

The brief Self-Control Scale is a 13-item measure of self-control with anchors from 1 (*Not at all like me*) to 5 (*Very much like me*). Items include questions such as: "I am good at resisting temptations" and "I have trouble concentrating." Scores are averaged with the lowest possible score of 1 indicating low self-control and the highest possible score of 5 indicating high self-control (Tangney et al., 2004). Considerable examination of the brief Self-Control Scale factorial composition has been completed in recent years (e.g., de Ridder et al., 2011; Fung et al., 2020; Maloney et al., 2012). Following De Ridder et al.'s (2011) recommendation, a 10-item version of the scale was used with three commonly redundant and generic items removed. Cronbach's α for the present study was determined to be quite low at .50.

Self-Efficacy and Perceived Task Difficulty

To assess self-efficacy, participants were asked: "To what extent do you think you can have the ball land in the white circle for at least one putt out of the next 10?" This item was rated on a scale from 0 (*Cannot do at all*) to 100 (*Highly certain can do*). Similarly, a one-item scale assessed difficulty by asking: "How difficult is it to have at least one putt out of the next ten land in the white circle?" Participants recorded their response on a scale from 0 (*Not difficult at all*) to 100 (*Extremely difficult*; Bandura, 1997). Numerous studies have argued on behalf of the validity of single-item scales (e.g., Allen et al., 2022; Kamakura, 2015) and single-item measures of self-efficacy (e.g., Hoeppner et al., 2011; Williams & Smith, 2016), and this version of a single-item Self-Efficacy (SE) Scale has been used frequently in sport and exercise psychology research (e.g., Braun-Trocchio et al., 2022; Richard et al., 2018). Test–retest reliability for this sample was high for both self-efficacy $(r = .69)$ and perceived task difficulty $(r = .78)$.

Task and Procedure

Preintervention

Upon arrival at the lab, participants completed an informed consent form, demographic questionnaire, and were familiarized with the FAS, the FS, and the Self-Control Scale. A research assistant then informed participants that they will be performing a putting task while being recorded via video camera and that the highest two performers will receive a $20 gift card while the bottom 25% of performers will complete additional surveys about their experience. The putting task was to lag (or stop) the putt of a regulation golf ball (4.3 cm in diameter) as close to a painted white target circle (10.8 cm in diameter, a regulation-size golf hole) as possible. The ball was placed 4.88 m away from the target on a flat artificial putting surface. Participants were provided with a right- or left-handed putter and completed five practice putts, waiting at least 10 s before each putt. Following the practice putts, participants completed the SE Scale, Perceived Task Difficulty Scale, FAS, and FS. Participants then began the pretest portion of the experiment and completed 30 putts, waiting at least 10 s between putts. After every 10 putts, participants filled out the SE Scale, FAS, FS, and Perceived Task Difficulty Scale. After this pretest, participants completed the first item of the commitment check and the SE Scale, FAS, FS, and Perceived Task Difficulty Scale again.

Intervention

Following this pretest, researchers randomly assigned participants to either a PoPR or a control group (CG) via a spreadsheet. Participants in the CG watched a video on the benefits of exercise for 10 min. Participants in the PoPR condition were taught a PoPR based on the three phases (i.e., emotional regulation, performance analysis and correction, continuation to the next shot). To address emotional regulation, a research assistant taught participants to take a diaphragmatic breath following each of their putts. Researchers taught participants to assess and correct their performance by stating the result of their putt and the corresponding correction out loud. Researchers did not provide any feedback or details to participants about putting or their putting performance, thus participants relied on visual and kinesthetic feedback to analyze and correct their performance. For example, a putt that came to rest short and right of the target might result in the following statement "I left the ball short and right of the target therefore I'm going to make sure keep the front [toe] of the club facing the target during my swing and I'm going to follow through a little more." Finally, a research assistant taught participants to shift their attention from the previous putt to the succeeding putt by saying the cue word "Next Putt." Neither condition was using a PPR. The self-talk cue of "Next Putt" was used as a tool to redirect attention. Given that participants in the present study were novice golfers, it is unlikely that they had preexisting training in putting PPRs. Training for the PoPR condition took approximately 10 min. Both groups then took five practice putts, the CG waiting at least 10 s between putts and the PoPR group going through their PoPR. To ensure that participants were following their PoPR, participants explained their routine aloud during the 10-s break between putts. Additionally, the steps of the PoPR were visible on a whiteboard next to the participant. If the participant did not complete the PoPR aloud, the researcher prompted them to do so. To control for this speak-aloud protocol, participants in the control condition were asked (and reminded) to vocalize their internal dialog.

Postintervention

Following the training and practice, participants were reminded of the consequences of their performance and completed the SE Scale, FAS, FS, and Perceived Task Difficulty Scale again. Participants then completed 30 putts with either a 10-s pause and think aloud or the vocalized PoPR as appropriate. Every 10 putts, participants completed the SE Scale, FAS, FS, and Perceived Task Difficulty Scale again. Following the 30 putts, participants completed a final iteration of the SE Scale, FAS, FS, and Perceived Task Difficulty Scale and the commitment check measure. Participants were then debriefed and told that even if they performed poorly, they will not have to fill out additional surveys. Additionally, they were informed that the cameras were not recording them but only the path of the ball in relation to the target. All procedures were followed as approved by Florida State University's human subjects institutional review board, 2017.20,825.

Data Analysis

To analyze the data, a series of t tests and repeated-measures MANOVAs were used. Outlier analysis detected three participants (two from PoPR group, one from CG) who had outliers on multiple dependent variables. Upon examination of the putting accuracy of the three participants, it was apparent that they had difficulty with the putting task with multiple misses greater than the available putting surface (i.e., more than 2 m). Upon removing those three participants, assumptions of normality were met for all univariate and multivariate tests using the remaining 38 participants. There were no multicollinear relationships greater than 0.9 in any of the MANOVAs. Lastly, there were no violations of homogeneity of variance–covariance matrices, as indicated by Box's M test or homogeneity of variance, as tested through Levene's test. Cohen's d and η_p^2 were used to estimate effect sizes (Cohen, 1988). For assessments taken multiple times during pre- or postintervention, averages and *SD*s were compared across groups and time points as appropriate. For example, average distance to the target represents the accuracy of putting (i.e., a 20-cm average distance is closer to the target than a 40-cm average distance to target), while the *SD* of distance to target measures precision and consistency of putting (i.e., a 10-cm *SD* of distance to target represents a more consistent putting performance than a 20-cm *SD* of distance to target; see Figure 1). Analyses were run with SPSS (version 26) and alpha level was set at .05.

Results

T tests of commitment levels to the putting task after baseline resulted in no significant difference between the CG ($M = 3.63$,

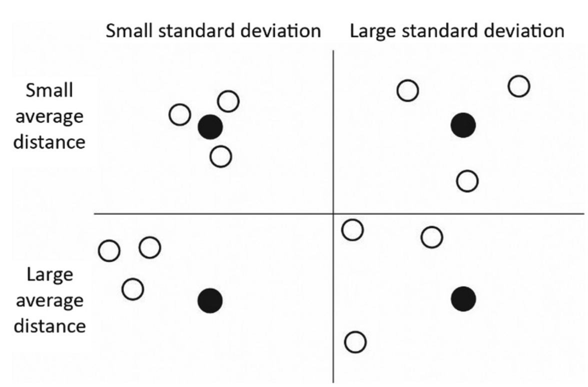

Figure 1 — Putting performance, average distance, and *SD*. *Note*. Black circles indicate the target, and white circles indicate final ball location.

SD = 0.90) and PoPR group (*M* = 3.89, *SD* = 0.88), *t*(36) = .92, *p* = .366, *d* = 0.30. Postintervention, *t* tests of commitment levels to the putting task approached significance with the CG (*M* = 3.84, *SD* = 1.07) reporting slightly lower levels of commitment than the PoPR group (*M* = 4.32, *SD* = 0.48), *t*(36) = 1.77, *p* = .086, *d* = 0.57. Participants in the PoPR group reported moderately high levels of commitment to the PoPR (*M* = 3.58, *SD* = 0.84). No participant reported a one (no commitment) at any point during the experiment.

Self-Control

T tests yielded no significant difference in self-control qualities between the CG (*M* = 3.75, *SD* = 0.59) and the PoPR group (*M* = 3.64, *SD* = 0.77), *t*(36) = .50, *p* = .622, *d* = 0.16.

Self-Efficacy and Perceived Task Difficulty

Repeated-measures MANOVA including self-efficacy and perceived task difficulty (average and *SD* of responses) resulted in no significant interaction of group and time point, Wilks' λ = .93, *F*(4, 33) = 0.61, *p* = .660, η_p^2 = .07 (see Table 1). There was a significant multivariate effect of time point, Wilks' λ = .46, *F*(4, 33) = 9.84, *p* = .001, η_p^2 = .544. Specifically, average self-efficacy significantly increased, *F*(1, 36) = 4.76, *p* = .036, η_p^2 = .117, and became more consistent, *F*(1, 36) = 13.83, *p* < .001, η_p^2 = .278, over time. Perceived task difficulty did not significantly change over time, *F*(1, 36) = 1.10, *p* = .302, η_p^2 = .030, but responses did become more consistent, *F*(1, 36) = 6.12, *p* = .018, η_p^2 = .145.

There was no significant multivariate effect of group, Wilks' λ = .89, *F*(4, 33) = 1.03, *p* = .406, η_p^2 = .111.

Emotion

Analyses of FAS and FS (average and *SD* of responses) resulted in no significant interaction of group and time point, Wilks' λ = .84, *F*(4, 33) = 1.54, *p* = .214, η_p^2 = .16 (see Table 2). Multivariate main effects were not significant for time point, Wilks' λ = .92, *F*(4, 33) = 0.75, *p* = .57, η_p^2 = .083, or group, Wilks' λ = .93, *F*(4, 33) = 0.60, *p* = .66, η_p^2 = .068.

Table 1 Self-Efficacy and Perceived Task Difficulty Averages and *SD*s by Group and Time Point, *M* (*SD*)

Group	Time point	Average of responses	*SD* of responses
Self-efficacy			
CG	Baseline	35.09 (21.33)	11.64 (10.69)
	Postintervention	27.89 (19.79)	2.73 (2.96)
PoPR	Baseline	45.61 (20.88)	9.49 (8.57)
	Postintervention	51.58 (25.66)	4.93 (6.41)
Perceived task difficulty			
CG	Baseline	79.12 (14.31)	6.19 (5.12)
	Postintervention	80.70 (13.22)	2.05 (3.22)
PoPR	Baseline	76.32 (16.02)	5.15 (5.92)
	Postintervention	77.54 (17.60)	3.48 (4.92)

Note. CG = control group; PoPR = postperformance-routine group.

Performance

Analyses on average distance to the target and *SD* of distance to target resulted in a significant interaction of group and time point, Wilks' λ = .81, *F*(2, 35) = 4.05, *p* = .026, η_p^2 = .19. Univariate analysis indicated that there was a significant interaction of group and time point on average displacement from target such that the PoPR groups average displacement decreased from baseline to postintervention (*d* = −0.55) relative to the CG change in average displacement (*d* = −0.01), *F*(1, 36) = 6.86, *p* = .013, η_p^2 = .16 (see Figure 2). There was no significant interaction for *SD* of displacement, *F*(1, 36) = 1.94, *p* = .172, η_p^2 = .05 (see Table 3).

There was a significant multivariate main effect of time, Wilks' λ = .81, *F*(2, 35) = 4.08, *p* = .026, η_p^2 = .19. Univariate results indicated that average displacement improved significantly (i.e., became more accurate), *F*(1, 36) = 7.81, *p* = .008, η_p^2 = .178, but did not become more consistent, *F*(1, 36) = 0.92, *p* = .344, η_p^2 = .025, over time. Overall, there was a significant multivariate main effect of group, Wilks' λ = .84, *F*(2, 35) = 3.38, *p* = .045, η_p^2 = .16. Univariate results indicated that average displacement was more accurate, *F*(1, 36) = 6.96, *p* = .012, η_p^2 = .162, and more consistent, *F*(1, 36) = 4.83, *p* = .035, η_p^2 = .118, for the PoPR group than the CG.

Discussion

The goal of this study was to propose a model for PoPR and test its efficacy for novices learning a golf-putting task. Our proposed three-stage PoPR resulted in improved putting performance in novice golfers. This supports the benefits of using a PoPR for performance accuracy and motor learning, and is consistent with previous research on PoPR in bowling (Mesagno et al., 2015). The three-stage model of emotional regulation, performance analysis and correction, and continuation to the next performance appears to be a successful tool for improving putting performance and motor learning in novices.

A potential mechanism explaining the positive effects of PoPR on performance accuracy is a positive and less variable emotional valence. However, our hypothesis was not supported. Substantial research indicates that PPRs, which promote self-regulation of attention and behavior, are successful in changing performers' emotional responses and facilitating performance (e.g., Mesagno et al., 2015). The tested three-stage PoPR was informed by that

Table 2 Arousal and Feeling Scale Averages and *SD*s by Group and Time Point, *M* (*SD*)

Group	Time point	Average of responses	*SD* of responses
Arousal			
CG	Baseline	2.74 (1.10)	0.44 (0.33)
	Postintervention	2.77 (1.25)	0.27 (0.30)
PoPR	Baseline	3.19 (0.94)	0.27 (0.33)
	Postintervention	3.26 (1.09)	0.41 (0.35)
Feeling Scale			
CG	Baseline	2.32 (1.27)	0.30 (0.33)
	Postintervention	2.30 (1.29)	0.30 (0.39)
PoPR	Baseline	2.33 (1.12)	0.32 (0.44)
	Postintervention	2.16 (1.14)	0.51 (0.41)

Note. CG = control group; PoPR = postperformance-routine group.

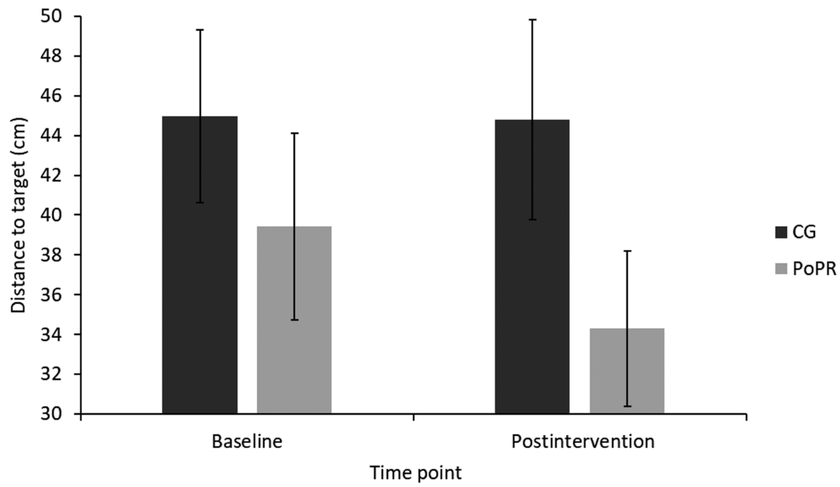

Figure 2 — Average distance to target by group and time point with 95% confidence interval. CG = control group; PoPR = postperformance-routine group.

Table 3 Average Distance and *SD*s to Target by Group and Time Point, *M* (*SD*)

Group	Time point	Average distance to target	*SD* of distance to target
CG	Baseline	44.98 (9.48)	12.31 (2.97)
	Postintervention	44.81 (10.97)	12.58 (4.07)
PoPR	Baseline	39.43 (10.24)	11.12 (2.83)
	Postintervention	34.29 (8.48)	9.70 (3.60)

Note. CG = control group; PoPR = postperformance-routine group.

research and integrated a single diaphragmatic breath. Results indicated that such brief training on an isolated skill did not have a significant impact on emotional response. However, our results revealed a trend toward more consistent arousal levels following the PoPR intervention. Future research should continue to examine the effects of more substantiative emotional regulation strategies integrated into three-stage PoPR.

Another potential explanation of performance improvements following the use of a PoPR is an increase in self-efficacy, critical for novice performers. However, in the present study, participants' self-efficacy was largely unaffected. Participants in both groups reported improvements in self-efficacy between pre- and postintervention, with self-efficacy responses becoming more consistent over time as well, indicating that novice golfers' self-efficacy improved with experience. Furthermore, participants' perceptions of task difficulty did not change but did become more consistent between pre- and postintervention. Thus, it appears that the three-stage PoPR did not change self-efficacy or perceived task difficulty, but that continued practice improved both groups' self-efficacy. It is important to note that this absence of change on those variables is consistent with studies on PPRs (e.g., Richard et al., 2021; Wergin et al., 2020), and this study is one of the first attempts at assessing self-efficacy and perceived task difficulty following a PoPR specifically and not in relation to PPR in novice performers. In the absence of significant effects on emotion and self-efficacy, mechanistic explanations for the improved putting performance via PoPR are uncertain.

The first possible explanation is the use of instructional self-talk by the novice participants. Because participants were asked to state their performance out loud and provide a correction, this might have directed them to deriving self-instructions for the next putt. This explanation is supported by Hatzigeorgiadis et al. (2011) who found that instructional self-talk was especially effective for supporting sport performance, with the strongest effects being found for novel tasks, fine motor skills, and groups of students/beginner athletes, all of which apply to the present sample characteristics and the study task.

Another potential explanation for our results is the use of a single-item measure of self-efficacy rather than a multiple-item measure. The use of a multiple-item scale may have resulted in more reliable assessment of self-efficacy (Bandura, 1997). However, given the frequent administrations of the self-efficacy questionnaire and arguments on behalf of the validity and reliability of single-item scales, the single-item measure was used (Allen et al., 2022; Braun-Trocchio et al., 2022; Richard et al., 2018).

A third potential explanation may be related to participants' commitment levels. Our PoPR intervention resulted in a trend toward higher commitment to the putting task for the PoPR group compared with the CG. This aligns with Post et al.'s (2022) finding that higher performing swimmers engaged more with post reflection and evaluation processes. As such, it is possible that participating in the three-stage PoPR increased commitment levels and may have resulted in more intentional and deliberate skill execution and reflection. The improvement in performance was not contingent on receiving expert feedback or instruction; novice golfers were able to adapt their performance through self-guided deliberate action and reflection. This potential mechanism is extremely valuable for practitioners who are working with novice performers who are attempting to improve motor execution and reinforces the importance of committed and deliberate self-evaluation during motor learning.

Although the performance of novice participants in the PoPR group improved overall, practitioners should consider individual differences when implementing PoPR. In particular, the performance analysis and correction stage may induce maladaptive emotional responses in those predisposed to perfectionist concerns (Stoeber et al., 2020). In such instances, the PoPR may need to emphasize the importance of emotional regulation and refocusing, thus providing facilitative boundaries for performance analysis and correction to occur within. Additionally, it is important to note that performance analysis and corrections are helpful in the learning phase during the acquisition of a motor skill (i.e., in the cognitive stage and the early associative stage of motor learning according to Fitts and Posner [1967]), because they facilitate instructional self-talk in novel tasks (Hatzigeorgiadis et al., 2011).

Such adaptations to individual differences can be accommodated using the proposed three-stage PoPR. The present routine was successful in improving novices' putting performance, but the mechanism remains unclear. Future investigations should consider different performance skills (i.e., consider other open and closed skills) and participant skill levels. Furthermore, attempts to improve the efficacy of emotional regulation through PoPRs and other strategies are warranted. For example, positive self-talk and avoiding excess rumination were not examined in the present study but represent important correlates of successful performance.

Limitations and Implications

While this study advances the field of PoPR, several design characteristics limit the external validity of its findings. In particular, this putting task was a lag putt. While lag putting occurs frequently in golf settings, our putting area did not include a hole, allowing more precise accuracy readings, but being less ecologically valid. Additionally, the present study used volunteer novice golfers whose performance improved with the implementation of PoPR. Perhaps more experienced golfers who are used to performance analysis and correction may experience different effects. Furthermore, golfers with more experience may have different emotional regulation strategies and may have differential responses to a regimented PoPR. Finally, three manipulations (i.e., surveys for poor performers, gift cards for top performers, and video cameras) were put in place to increase performance pressure; unfortunately, those manipulations were not tested other than via change in emotional response as measured using the affect grid. As such, it is unclear how much performance pressure participants experienced.

Similarly, the reliance of the present study on single-item questionnaires to measure affective response and self-efficacy may have reduced the power of the present study to detect significant changes. The FS and FAS are based on the circumplex model, which considers valence and arousal as core dimensions of emotion (Russell et al., 1989). While anxiety is a particular aversive and high arousal emotional state, levels of anxiety were not directly measured in the present study. Given the importance of anxiety in high pressure performance, a discrete measure of state anxiety may have yielded different results. Likewise, the simplification of self-efficacy to a single item may have resulted in reduced reliability, possibly explaining lack of significant effect of PoPR in the present study.

Applied practitioners can use the results of this study to inform their practice of designing and implementing a PoPR for novices learning a motor task. The results of this study support the use of PoPRs for motor learning in a self-paced task. In particular, the three-stage PoPR of (a) emotion regulation, (b) performance analysis and correction, and (c) continuation to the next performance was effective in improving novices' learning and putting performance with very minimal training. This PoPR offers a convenient model to work with novice athletes and performers as it allows some flexibility to individualize the content to the individual while providing a structure to guide the learning process. It is our hope that this study will spark further research in the domain, to aid consultants in their effort to increase the learning and well-being of their clients.

References

Allen, M.S., Iliescu, D., & Greiff, S. (2022). Single item measures in psychological science: A call to action. *European Journal of Psychological Assessment, 38*(1), 1–5. https://doi.org/10.1027/1015-5759/a000699

Bandura, A. (1997). *Self-efficacy: The exercise of control*. W.H. Freeman and Company.

Beck, A.T., & Weishaar, M. (1995). Cognitive therapy. In R.J. Corsini& D. Wedding (Eds.), *Current psychotherapies* (pp. 238–268). Peacock Publishers.

Beltrão, N.B., Ximenes Santos, C., de Oliveira, V.M.A., Pirauá, A.L.T., Behm, D., Pitangui, A.C.R., & de Araújo, R.C. (2020). Effects of a 12-week chronic stretch training program at different intensities on joint and muscle mechanical responses: A randomized clinical trial. *Journal of Sport Rehabilitation, 29*(7), 904–912. https://doi.org/10.1123/jsr.2018-0443

Bloom, G.A., Durand-Bush, N., & Salmela, J.H. (1997). Pre- and post-competition routines of expert coaches of team sports. *The Sport Psychologist, 11*(2), 127–141. https://doi.org/10.1123/tsp.11.2.127

Braun-Trocchio, R., Renteria, J., Warfield, E., Harrison, K., & Williams, A. (2022). The effects of face coverings on perceived exertion and attention allocation during a stepping task. *International Journal of Environmental Research and Public Health, 19*(11), Article 6892. https://doi.org/10.3390/ijerph19116892

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Lawrence Erlbaum.

Cohn, P.J. (1990). Preperformance routines in sport: Theoretical support and practical applications. *The Sport Psychologist, 4*(3), 301–312. https://doi.org/10.1123/tsp.4.3.301

Cohn, P.J., Rotella, R.J., & Lloyd, J.W. (1990). Effects of a cognitive-behavioral intervention on the preshot routine and performance in golf. *The Sport Psychologist, 4*(1), 33–47. https://doi.org/10.1123/tsp.4.1.33

Cotterill, S. (2010). Pre-performance routines in sport: Current understanding and future directions. *International Review of Sport and Exercise Psychology, 3*(2), 132–153. https://doi.org/10.1080/1750984X.2010.488269

de Ridder, D.T.D., de Boer, B.J., Lugtig, P., Bakker, A.B., & van Hooft, E.A.J. (2011). Not doing bad things is not equivalent to doing the right thing: Distinguishing between inhibitory and initiatory self-control. *Personality and Individual Differences, 50*(7), 1006–1011. https://doi.org/10.1016/j.paid.2011.01.015

Faul, F., Erdfelder, E., Lang, A.G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191. https://doi.org/10.3758/BF03193146

Fitts, P.M., & Posner, M.I. (1967). *Human performance*. Brooks/Cole.

Follador, L., Alves, R.C., Ferreira, S.D.S., Silva, A.C., & Silva, S.G.D. (2019). Perceived exertion and affect from tai chi, yoga, and stretching classes for Elderly women. *Perceptual and Motor Skills, 126*(2), 223–240. https://doi.org/10.1177/0031512518823661

Foster, D.J., Weigand, D.A., & Baines, D. (2006). The effect of removing superstitious behavior and introducing a pre-performance routine on basketball free-throw performance. *Journal of Applied Sport Psychology, 18*(2), 167–171. https://doi.org/10.1080/10413200500471343

Fung, S.F., Kong, C., & Huang, Q. (2020). Evaluating the dimensionality and psychometric properties of the brief self-control scale amongst

Chinese University students. *Frontiers in Psychology, 10,* Article 2903. https://doi.org/10.3389/fpsyg.2019.02903
Gardner, F.L., & Moore, Z.E. (2004). A mindfulness-acceptance-commitment-based approach to athletic performance enhancement: Theoretical considerations. *Behavior Therapy, 35*(4), 707–723. https://doi.org/10.1016/S0005-7894(04)80016-9
Gould, D., & Udry, E. (1994). Psychological skills for enhancing performance: Arousal regulation strategies. *Medicine & Science in Sports & Exercise, 26*(4), 478–485. https://doi.org/10.1249/00005768-199404000-00013
Gould, D., Weiss, M., & Weinberg, R.S. (1981). Psychological characteristics of successful and nonsuccessful Big Ten wrestlers. *Journal of Sport Psychology, 3*(1), 69–81. https://doi.org/10.1123/jsp.3.1.69
Hanin, Y.L. (1997). Emotions and athletic performance: Individual zones of optimal functioning model. In D. Smith& M. Bar-Eli (Eds.), *European yearbook of sport psychology* (pp. 55–73). Human Kinetics.
Hanin, Y.L. (2000). An individualized approach to emotion in sport. In Y.L. Hannin (Ed.), *Emotions in sport* (pp. ix–xii) Human Kinetics.
Hardy, C.J., & Rejeski, W.J. (1989). Not what, but how one feels: The measurement of affect during exercise. *Journal of Sport and Exercise Psychology, 11*(3), 304–317. https://doi.org/10.1123/jsep.11.3.304
Harle, S.K., & Vickers, J.N. (2001). Training quiet eye improves accuracy in basketball free throw. *The Sport Psychologist, 15*(3), 289–305. https://doi.org/10.1123/tsp.15.3.289
Hatfield, B.D., & Kerick, S.E. (2007). The psychology of superior sport performance: A cognitive and affective neuroscience perspective. In G. Tenenbaum& R.C. Eklund (Eds.), *Handbook of sport psychology* (pp. 84–109). John Wiley & Sons.
Hatzigeorgiadis, A., Zourbanos, N., Galanis, E., & Theodorakis, Y. (2011). Self-talk and sports performance: A meta-analysis. *Perspectives on Psychological Science, 6*(4), 348–356. https://doi.org/10.1177/1745691611413136
Hill, D.M., Hanton, S., Matthews, N., & Fleming, S. (2010). A qualitative exploration of choking in elite golf. *Journal of Clinical Sport Psychology, 4*(3), 221–240. https://doi.org/10.1123/jcsp.4.3.221
Hoeppner, B.B., Kelly, J.F., Urbanoski, K.A., & Slaymaker, V. (2011). Comparative utility of a single-item versus multiple-item measure of self-efficacy in predicting relapse among young adults. *Journal of substance abuse treatment, 41*(3), 305–312. https://doi.org/10.1016/j.jsat.2011.04.005
Kamakura, W.A. (2015). Measure twice and cut once: The carpenter's rule still applies. *Marketing Letters: A Journal of Research in Marketing, 26*(3), 237–243. https://doi.org/10.1007/s11002-014-9298-x
Kamata, A., Tenenbaum, G., & Hanin, Y. (2002). Individual zone of optimal functioning (IZOF): A probabilistic conceptualization. *Journal of Sport & Exercise Psychology, 24*(2), 189–208. https://doi.org/10.1123/jsep.24.2.189
Kaufman, K.A., Glass, C.R., & Arnkoff, D.B. (2009) Evaluation of mindful sport performance enhancement (MSPE): A new approach to promote flow in athletes. *Journal of Clinical Psychology, 4,* 334–356. https://doi.org/10.1123/jcsp.3.4.334
Lidor, R., & Mayan, Z. (2005). Can beginning learners benefit from preperformance routines when serving in volleyball? *The Sport Psychologist, 19*(4), 343–363. https://doi.org/10.1123/tsp.19.4.343
Maloney, P.W., Grawitch, M.J., & Barber, L.K. (2012). The multi-factor structure of the brief self-control scale: Discriminant validity of restraint and impulsivity. *Journal of Research in Personality, 46*(1), 111–115. https://doi.org/10.1016/j.jrp.2011.10.001
Markus, H.R., & Kitayama, S. (1991). Culture and the self: Implications for cognition, emotion, and motivation. *Psychological Review, 98*(2), 224–253. https://doi.org/10.1037/0033-295X.98.2.224
Marlow, C., Bull, S., Heath, B., & Shambrook, C. (1998). The use of a single case design to investigate the effect of a pre-performance routine on the water polo penalty shot. *Journal of Performance and Medicine in Sport, 1,* 143–155. https://doi.org/10.1016/S1440-2440(98)80010-8
McHugh, M.P., & Cosgrave, C.H. (2010). To stretch or not to stretch: The role of stretching in injury prevention and performance. *Scandinavian Journal of Medicine & Science in Sports, 20,* 169–181. https://doi.org/10.1111/j.1600-0838.2009.01058.x
Meneghel, I., Salanova, M., & Martínez, I.M. (2016). Feeling good makes us stronger: How team resilience mediates the effect of positive emotions on team performance. *Journal of Happiness Studies, 17*(1), 239–255. https://doi.org/10.1007/s10902-014-9592-6
Mesagno, C. (2014, April 28). Testing pre-shot and post-shot routine effectiveness—part 1. *Bowling This Month*.
Mesagno, C., Hill, D.M., & Larkin, P. (2015). Examining the accuracy and in-game performance effects between pre- and post-performance routines: A mixed methods study. *Psychology of Sport and Exercise, 19,* 85–94. https://doi.org/10.1016/j.psychsport.2015.03.005
Moore, W.E. (1986). *Covert-overt service routines: The effects of a service routine training program on elite tennis players* (Unpublished Doctoral Dissertation). University of Virginia.
Moore, W.E., & Stevenson, J.R. (1994). Training a pre-shot routine for golf. *Applied Research in Coaching and Athletics Annual,* 161–167.
Moradi, J. (2020). Benefits of a guided motor-mental preperformance routine on learning the basketball free throw. *Perceptual and Motor Skills, 127*(1), 248–262. https://doi.org/10.1177/0031512519870648
Moran, A.P. (1996). *The psychology of concentration in sport performers: A cognitive analysis*. Taylor & Francis.
Moritz, S.E., Feltz, D.L., Fahrbach, K.R., & Mack, D.E. (2000). The relation of self-efficacy measures to sport performance: A meta-analytic review. *Research Quarterly for Exercise and Sport, 71*(3), 280–294. https://doi.org/10.1080/02701367.2000.10608908
Ortony, A., Clore, G., & Collins, A. (1988). *The cognitive structure of emotions*. Cambridge University Press.
Perry, I., Chow, G., Tenenbaum, G., & Katz, Y. (2018). The effect of motor-mental preperformance routines on motor performance in novice learners. *Journal of Applied Sport Psychology, 30*(4), 402–420. https://doi.org/10.1080/10413200.2017.1411404
Posner, J., Russell, J.A., & Peterson, B.S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology, 17*(3), 715–734. https://doi.org/10.1017/S0954579405050340
Post, A.K., Koning, R.H., Visscher, C., & Elferink-Gemser, M.T. (2022). The importance of reflection and evaluation processes in daily training sessions for progression toward elite level swimming performance. *Psychology of Sport and Exercise, 61,* Article 102219. https://doi.org/10.1016/j.psychsport.2022.102219
Raedeke, T.D., & Stein G.L. (1994). Felt arousal, thoughts/feelings, and ski performance. *The Sport Psychologist, 8*(4), 360–375. https://doi.org/10.1123/tsp.8.4.360
Richard, V., Lebeau, J.C., Becker, F., Inglis, E.R., & Tenenbaum, G. (2018). Do more creative people adapt better? An investigation into the association between creativity and adaptation. *Psychology of Sport and Exercise, 38,* 80–89. https://doi.org/10.1016/j.psychsport.2018.06.001
Richard, V., Mason, J., Alvarez-Alvarado, S., Perry, I., Lussier, B., & Tenenbaum, G. (2021). Effect of preperformance routine on advanced swimmers' performance and motor efficiency, self-efficacy, and idiosyncratic emotions. *The Sport Psychologist, 35*(2), 97–107. https://doi.org/10.1123/tsp.2020-0023

Rupprecht, A.G., Tran, U.S., & Gröpel, P. (2021). The effectiveness of pre-performance routines in sports: A meta-analysis. *International Review of Sport and Exercise Psychology*. Advance online publication. https://doi.org/10.1080/1750984X.2021.1944271

Russell, J.A., Weiss, A., & Mendelsohn, G.A. (1989). Affect grid: A single-item scale of pleasure and arousal. *Journal of Personality and Social Psychology, 57*(3), 493–502. https://doi.org/10.1037/0022-3514.57.3.493

Schmidt, R.A., Lee, T.D., Winstein, C., Wulf, G., & Zelaznik, H.N. (2018). *Motor control and learning: A behavioral emphasis*. Human Kinetics.

Schmidt, R.A., & Walter, C.B. (1984). Knowledge of results and motor learning: A review and critical reappraisal. *Psychological Bulletin, 95*(3), 355–386. https://doi.org/10.1037/0033-2909.95.3.355

Singer, R.N. (1988). Strategies and metastrategies in learning and performing self-paced athletic skills. *The Sport Psychologist, 2*(1), 49–68. https://doi.org/10.1123/tsp.2.1.49

Stoeber, J., Madigan, D.J., & Gonidis, L. (2020). Perfectionism is adaptive and maladaptive, but what's the combined effect? *Personality and Individual Differences, 161,* Article 109846. https://doi.org/10.1016/j.paid.2020.109846

Svebak, S., & Murgatroyd, S. (1985). Metamotivational dominance: A multimethod validation of reversal theory constructs. *Journal of Personality and Social Psychology, 48*(1), Article 107. https://doi.org/10.1037/0022-3514.48.1.107

Tangney, J.P., Baumeister, R.F., & Boone, A.L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality,* 271–324. https://doi.org/10.1111/j.0022-3506.2004.00263.x

Tenenbaum, G., & Connolly, C.T. (2008). Attention allocation under varied workload and effort perception in rowers. *Psychology of Sport and Exercise, 9*(5), 704–717. https://doi.org/10.1016/j.psychsport.2007.09.002

Thewlis, D., Bishop, C., Daniell, N., & Paul, G. (2013). Next generation low-cost motion capture systems can provide comparable spatial accuracy to high-end systems. *Journal of Applied Biomechanics, 29*(1), 112–117. https://doi.org/10.1123/jab.29.1.112

Vandoni, M., Codrons, E., Marin, L., Correale, L., Bigliassi, M., & Buzzachera, C.F. (2016). Psychophysiological responses to group exercise training sessions: Does exercise intensity matter? *PLoS One, 11*(8), Article e0149997. https://doi.org/10.1371/journal.pone.0149997

Wergin, V.V., Beckmann, J., Gröpel, P., & Mesagno, C. (2020). Investigating cumulative effects of pre-performance routine interventions in beach volleyball serving. *PLoS One, 15*(1), Article e0228012. https://doi.org/10.1371/journal.pone.0228012

Williams, G., & Smith, A. (2016) Using single-item measures to examine the relationships between work, personality, and well-being in the workplace. *Psychology, 7*(6), 753–767. https://doi.org/10.4236/psych.2016.76078

Williams, J.M., & Harris, D.V. (2006). Relaxation and energizing techniques for regulation of arousal. In J. Williams (Ed.), *Applied sport psychology: Personal growth to peak performance* (5th ed., pp. 285–305). Mayfield Publishing.