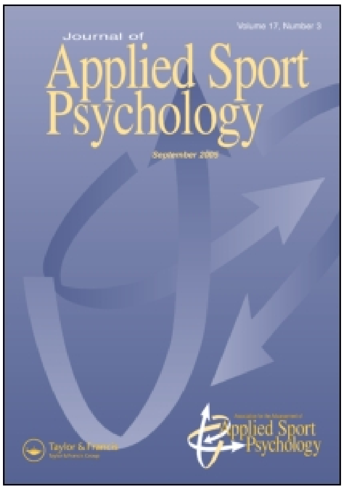

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A Comparison of Different Pre-Performance Routines as Possible Choking Interventions

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The purpose of the current study was to ascertain which aspect of a pre-performance routine (PPR) is most beneficial to alleviate choking. Participants included 60 experienced Australian football players in Australia, who attempted 20 kicks at a scoring zone in low- and high-pressure phases. Participants were assigned to one of five groups, with four groups undertaking intervention training and the pressure control group receiving no training, prior to the high-pressure phase. Results indicated that state anxiety increased during the high-pressure phase. Intervention groups responded to the increased anxiety with improved performance, while the pressure control group decreased performance. Thus, results add support to existing literature that a non-automated PPR, with psychological and behavioral components, decreases the likelihood of choking. Applied implications for consulting with potential choking-susceptible athletes are discussed.

The ability to perform successfully under pressure is a crucial aspect of sport performance. In Australia, professional athletes who excel during the pressure of competition are considered celebrities and receive sponsorships and endorsements, whereas athletes who experience a collapse in performance under pressure are often defamed, embarrassed, and said to have experienced the humiliating phenomenon of *choking under pressure* (referred to hereafter simply as choking). Although there has been recent progress toward better choking definitions (e.g., Gucciardi, Longbottom, Jackson, & Dimmock, 2010; Hill, Hanton, Fleming, & Matthews, 2009), there are no universally accepted definitions of choking. Nevertheless, we define choking as a critical deterioration in skill execution leading to substandard performance that is caused by an elevation in anxiety levels under perceived pressure at a time when successful outcome is normally attainable by the athlete. This definition was based on, and formulated from, other choking research and definitions (e.g., Hall, 2004; Mesagno, Marchant, & Morris, 2008; Wang, 2002) and, if accepted as a universal research definition, could help curtail the debate about the meaning of choking and enhance interpretability and application of future choking research.

Over the past 30 years, choking has become an increasingly popular topic for many sport psychology researchers; however, only minimal attempts have been made to investigate theory-matched choking interventions. Before developing possible interventions, researchers attempted to investigate, and eventually identified two explanatory models of choking:

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self-focus and distraction. Advocates of the self-focus model (e.g., Baumeister, 1984; Beilock & Carr, 2001; Gucciardi & Dimmock, 2008; Jackson, Ashford, & Norsworthy, 2006; Lewis & Linder, 1997; Masters, 1992; Mesagno, Marchant, & Morris, 2009) suggest that choking occurs because a skilled athlete consciously processes task execution when an increase in anxiety and self-awareness (i.e., the state form of self-consciousness) occurs. Baumeister (1984) originally proposed the self-focus model, but Masters (1992) expanded this model by explaining that competitive anxiety causes attention to shift toward monitoring explicit rules learned through stages of motor learning. Furthermore, Beilock and Carr stated that highly skilled performers may be negatively affected by monitoring the step-by-step procedures in high-pressure situations. Jackson et al. (2006) extended Beilock and Carr's explicit monitoring hypothesis by explaining that explicit monitoring may have a detrimental effect on performance when performers attempt to both consciously monitor *and* control movements.

Alternatively, supporters of the distraction model (e.g., Hardy, Mullen, & Martin, 2001; Mullen, Hardy, & Tattersall, 2005; Nideffer, 1992) propose that choking occurs because attention shifts from task-relevant to irrelevant cues. Nideffer (1992) explained that, as arousal increases, athletes become internally focused on task-irrelevant thoughts (e.g., worry about the score in a close game or awareness of spectators), resulting in the failure to attend to relevant cues. Arousal influences performance because it creates a distraction in one's psychological and physical environment, which compromises the individual's working memory capacity. In a high-pressure situation, working memory and task-focused attention become disrupted, leading to a decrement in performance (Kane & Engle, 2000). Recently, Hardy, Mullen, and colleagues (e.g., Hardy et al, 2001; Mullen et al., 2005) extended the distraction model by arguing that negative cognitions (e.g., worry) and explicit instructions do not individually diminish performance, but may exceed a threshold of attentional capacity when they simultaneously deplete the attentional resources available to maintain performance. To date, the self-focus model is the most widely supported of the two choking models; however, Beilock, Kulp, Holt, and Carr (2004) suggested that both explanations might still be applicable. Similarly, Mesagno et al. (2008) provided qualitative support for the notion that the distraction and self-focus models may coexist.

With both models apparently still relevant, applied sport psychology researchers have recently directed their attention toward investigating theory-matched techniques designed to reduce the likelihood of choking. To date, only two studies (Mesagno et al., 2008; Mesagno et al., 2009) have explored whether theory-matched interventions can minimize choking. Fundamental to the distraction model (Nideffer, 1992), athletes experience choking because concentration is shifted to irrelevant cues. In a theory-matched choking intervention study designed for the distraction model, Mesagno et al. (2008) explained that a pre-performance routine (PPR), which Moran (1996) defined as a sequence of task-relevant thoughts and actions an athlete systematically engages in prior to performance of a self-paced sport skill (like golf or a tennis serve), would be an ideal intervention for *choking-susceptible* athletes (athletes more prone to distractions and choking) because it helps them maintain appropriate attentional control under pressure. The single-case design study by Mesagno et al. (2008) was based on Cohn's (1990) supposition that a PPR minimizes attention to irrelevant information and directs attention to task-relevant cues. After personalized and tailor-made PPR training, Mesagno et al. (2008) found that the PPR improved performance an average of 29% for the three participants in a high-pressure situation compared to the initial, high-pressure phase where no PPR was developed. The PPR training included a number of components including a deep breath for relaxation and a cue word to improve concentration. The mixed methods design also included a qualitative interview that indicated the adapted PPRs produced positive psychological outcomes including decreased conscious processing and adaptive and relevant, task-focused attention.

Researchers in applied psychology and sport psychology often use single-case designs, especially in the early stages of testing the efficacy of treatments and interventions (e.g., Pates, Cummings, & Maynard, 2002). The research by Mesagno et al. (2008) was an original choking intervention study that provided robust evidence of the positive effects of using a PPR to alleviate choking. One limitation of the Mesagno et al. study (and single-case design research generally), however, was that it did not ascertain a causal relationship between the intervention and improved performance. That is, it could not be determined which component of the PPR intervention improved performance. Furthermore, the PPR components that may have positively influenced performance under pressure were deep breathing, cue word utilization, time duration, time consistency, or some combination of them.

The use of relaxation techniques (see Williams & Harris, 2006, for an overview), and cue words or swing thoughts (see Gucciardi & Dimmock, 2008, and Jackson & Willson, 1999, for more information) have been suggested as sport psychology interventions with positive effects on performance, yet, research support for positive performance effects on PPR temporal duration (i.e., the length of time to perform a PPR) or PPR temporal consistency (i.e., PPR time variability) is still unclear. Recently, Jordet and Hartman (2008) analyzed the preparation time for 359 soccer penalty kicks from 291 players and found that players that missed goals in the high-pressure penalty kicks had significantly faster preparation times (argued as wanting to get the shot "over with") than those that scored a goal. Jordet and Hartman (2008) suggested that the quicker preparation times may be a product of escapist behavior. That is, inappropriate self-regulation techniques may lead the person to immediate, behavioral withdrawal from the situation (observed in quicker preparation times). Jordet and Hartman explained that although escape from the penalty shootout may provide a break from unpleasant emotions, it may harm performance, thus ultimately becoming self-defeating. Jordet (2009) also provided support for this supposition when internationally esteemed players performed worse and engaged in more escapist self-regulatory behaviors with shorter response time than players with lower public status.

Temporal duration may not be the only time-related factor that positively affects sport performance. For example, Boutcher and Crews (1987) investigated the PPR consistency of golfers and found a positive relationship between PPR consistency and performance, indicating that as time consistency improved, so did performance. Anecdotally, Wrisberg and Pein (1992) assessed the relationship between PPR consistency and performance in collegiate basketball players during free-throw shots. The standard deviation (thus the variability) of each player's pre-shot interval over the course of a season was calculated. A significant negative correlation was found between variation and percentage success, indicating that the more successful players demonstrated a more time consistent routine. Thus, considering researchers (e.g. Jordet, 2009; Jordet & Hartmann, 2008) established that quicker preparation time leads to decreased performance, and Boutcher and Crews (1987; Wrisberg & Pein, 1992) indicated PPR time variability is an important factor for successful performance, maintaining an extended and consistent PPR could be a potential intervention to minimize choking.

Thus, the aim of the current study was to expand research on theory-matched choking interventions by determining which component of a PPR is most beneficial to performance under pressure. A secondary purpose was to investigate whether increasing time duration and consistency plays a significant role in improving performance under pressure. It was hypothesized that groups undergoing aspects of a PPR development would perform more accurately under pressure.

METHOD

Participants

Sixty male, experienced (with at least 5 years playing experience at a competitive level) Australian football (AF) players, between the ages of 18 and 38 ($M = 22.85$, $SD = 3.44$), were recruited from leagues in Australia. Participants were randomly assigned into one of five (i.e., extensive PPR, deep breath, cue word, temporal consistency, or pressure control) equally numbered groups. The groups will be explained in more detail below.

Equipment and Specifications

Footballs and Shot Distance

Participants used a standard full-sized football for the kicking task, which was conducted on a grass-covered field with orange safety cones placed 30 m from the scoring zone at four different angles (i.e., designated as the kicking areas). The 30-m distance was decided after consulting with two AF coaches and conducting pilot data from different distances and angles to determine a moderately challenging, but not overly simplistic, task for experienced players.

Measures

Revised Competitive State Anxiety Inventory-2 (CSAI-2R)

State anxiety was measured using the CSAI-2R, (Cox, Martens, & Russell, 2003; Martens, Burton, Vealey, Bump, & Smith, 1990) which assesses how anxious an individual feels “at the present moment.” The CSAI-2R is a result of a systematic item deletion procedure, in which the weakest parameters were removed, resulting in a total of 17 self-report statements that measure the intensity components of somatic anxiety (seven items), cognitive anxiety (five items), and self-confidence (five items; Cox et al., 2003). For each subscale, intensity level responses were scored on a 4-point Likert scale, ranging from 1 (*not at all*) to 4 (*very much so*). Total scores on each subscale could range from 10 to 40, with higher scores indicating higher anxiety levels. Cox et al. reported Cronbach alpha reliability coefficients for both cognitive and somatic anxiety to be acceptable ($\alpha > .80$). Only the cognitive and somatic anxiety subscales were used in compliance with the purpose of the study.

Performance

Score was determined by the accuracy of the set shot to the center of the scoring zone (for the benefit of readers unfamiliar with AF, the set shot is similar to punting in American football; it is a closed skill that involves the player kicking for goal with no need to quickly react to play because he is allowed to “set” himself for each shot attempt and kick without pressure from players). The scoring zone (see Figure 1) consisted of 10 posts divided into nine scoring gaps (with a distance of 2.13 m for each gap), which is a slightly modified version to normal AF games. When participants kicked the football through the center gap, 10 points were awarded. When either of the center posts (that made up the center gap) was hit during the attempt, nine points were awarded. Kicking the football through either adjacent gap meant that eight points were awarded. The points continued in descending order from the middle gap (10 points) to the outer posts, whereby one point was earned for hitting either of the outer poles of the scoring zone. If the scoring zone was missed completely, a score of zero was given.

Pre-Performance Routine Completion Time

The PPR completion time and variability was measured using a stopwatch from the moment the participant picked up the football to when he started his run-up (i.e., momentum generating

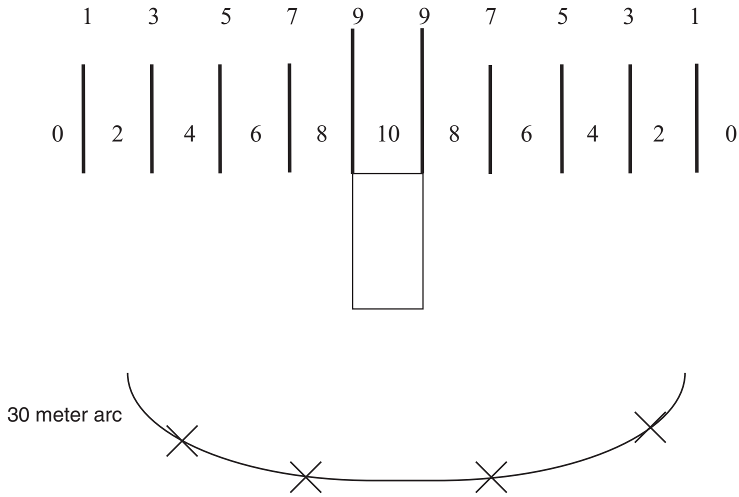

Figure 1. Set-up for the football kicking task.

forward running to set up a purposeful football kick) for the attempted kick. A comparison was made of each participant's PPR duration (in seconds) and consistency (i.e., variability).

Procedure

Prior to the commencement of the study, participants were recruited from an AF team and were asked to complete a demographic questionnaire and an informed consent form. A plain language statement was also issued, which explained that the University Ethics Committee approved the project. The procedures for the low- and high-pressure phases in this study were similar to those used by Mesagno et al. (2008) with the exception that the number and type of attempts were different and a video camera was not used in the high-pressure phase.

Low-Pressure

During the low-pressure phase, each participant was tested independently with only the second author (hereafter called researcher) present. Prior to the low-pressure phase, general information about the experiment was narrated directly from prepared instructions. Testing began by administering the CSAI-2R and kicking attempts commenced immediately after the participant acknowledged he understood the instructions. It was important to obtain a baseline performance score; thus, after completing the CSAI-2R, the participant completed five practice attempts (which were not included in the analysis) and 20 kicks at the scoring zone in a low-pressure situation. The kicking attempts were taken from four different angles to simulate real competition and the angles were randomized for all participants to decrease the likelihood of order effects.

Possible performance scores in each phase ranged from 0 to 200, yet, it was essential to set a criterion for continued participation for the experienced competitors. This was similar to the performance criterion set by Mesagno et al. (2008, 2009) with the exception that we modified it for the AF task. Thus, unknown to participants, a performance range from 120 to 170 points for the low-pressure phase performance was set for continued participation in the study. This range offered a task that was difficult, but not too simplistic, for participants to succeed. That is, if the task was too difficult, performance improvements would have been complicated even with a PPR intervention, whereas if the task was simple, performance improvements may not occur because of ceiling effects. Mean performance scores for the five groups ranged from 140.67 to 146.83 during the low-pressure phase, which ensured equal ability levels at baseline testing and that task complexity was at a moderate level.

Intervention Training and Experimental Groups

Prior to commencement of the high-pressure phase, participants in the four intervention groups (i.e., deep breath, cue word, temporal consistency, and extensive PPR) undertook a group-specific PPR education/development session. During the education period, the researcher defined, explained the benefits of (with reference to research evidence), and demonstrated the intervention to each participant. In the development period, the researcher helped the participant establish the intervention until the participant and the researcher were satisfied that the PPR could be repeated. To acknowledge that the PPR was understood, and before the high-pressure phase commenced, the participant was asked to perform five practice attempts while using the PPR.

As previously stated, participants were randomly allocated into four intervention groups. Participants in the deep breath group were educated about the benefits and applicability of deep, diaphragmatic breathing and were asked to take three diaphragmatic deep breaths before kicking at the scoring zone on each attempt. It took an average of 9 min to demonstrate to participants this proper breathing technique. Participants in the cue word group were educated about the benefits of using cue words for concentration. With the researcher's assistance, participants developed a cue word that was specific to their own perception of successful performance. To improve concentration, participants were asked to say the cue word, or phrase, aloud before each attempt. The cue word group took an average of 12 min to develop a cue word with the researcher's help. Members of the temporal consistency group were asked to provide a 5 s "countdown" aloud before each attempt to maintain time consistency. The temporal consistency group took an average of 5 min to understand and demonstrate this intervention to the researcher. Participants in the extensive PPR group were trained in adopting an extensive PPR (similar to participants in the Mesagno et al., 2008 study) that included using PPR behaviors such as modification of optimal arousal levels, behavioral steps, appropriate attention control (e.g., external focus on the scoring zone), and cue words. Participants in the extensive PPR group took an average of 22 min to understand and demonstrate this intervention. For the intervention groups, minor adjustments to the routines were applied to promote individuality, with the exception that the temporal consistency group was asked to provide a countdown speed similar to 5 s in real time. Participants in the pressure control group were not educated about a PPR, but performed in the high-pressure phase as a comparison of ability levels under pressure.

The time allocated to develop participants' routines in any intervention group was approximately 15 min, with participants' intervention explanation and development taking between 3 and 28 min. The training (or no training) of some intervention groups were not likely to take the allotted 15 min, thus, participants received a history of AF document to read if their intervention took less time. This was employed so that no participants had extra time to mentally prepare for the high-pressure phase (even though they were not told about the high-pressure until after intervention development).

High-Pressure

Once the education/development session was administered, individual routine developed, and pressure instructions read, participants again completed the CSAI-2R immediately after being informed about the high-pressure phase to determine if differences in state anxiety existed. The high-pressure phase was identical to the low-pressure phase with the exception that participants were asked to use their learned routine (if applicable) throughout the high-pressure phase. To induce high-pressure, a small audience consisting of teammates and a monetary incentive, which acted to increase competitiveness, were used. Participants were informed six teammates would watch them complete the next 20 attempts, but teammates were not to interact, encourage, or discourage them. The audience members were positioned to both sides in peripheral view (approximately 10 m away) of the participant. The monetary incentive involved a competition to win a $50 cash prize, which would only be awarded to the participant with the highest total score during the high-pressure phase. These pressure manipulations have been used previously and successfully (e.g., Baumeister, 1984; Lewis & Linder, 1997; Masters, 1992). To maintain control over external environmental factors, such as weather and ground conditions, and to decrease fatigue effects, participants were tested on the same field with similar weather conditions over two separate days.

Pre-Performance Routine Time Duration and Adherence

During the low- and high-pressure phase, the researcher independently recorded the PPR completion time. Another observer or a video camera could potentially be confounding variables; therefore, they were not used to record the competition times in the low-pressure phase. To improve reliability, in the high-pressure phase, an audience member was asked to observe PPR completion times for each attempt, and then write down, to the nearest 10 s, the time taken. No explanation was given to the audience member about why this measure was (or was not) important. Analysis of this data indicated that no major discrepancies existed between the researcher and audience members' time duration, with an inter-observer reliability indicating adequate correlation between the two observers (Pearson's $r = .99$, $p < .001$). Thus, the researcher's data set was used for this analysis.

To ensure that PPR routines were adhered to, the researcher made a checklist of each participant's routine before he undertook the high-pressure phase. The researcher then observed each participant's attempts, and if the routine was not followed, or modified even slightly, the trial was discontinued during the "run up" (and before an attempt was recorded). This was an effective method for PPR adherence with AF players for two reasons. First, the routines had behavioral components that the researcher could observe, or listen for (in the case of the cue word and temporal consistency groups), to determine adherence. Second, the run up is undertaken prior to each attempt and can be stopped without any potential injury or repercussions. If there was an aborted attempt, the participant was asked to commence the new attempt by picking up a different football and adhering to the predetermined routine. Overall, there were only seven aborted attempts (and subsequent repeat shots) with two, one, one, and three aborted attempts for the cue word, deep breath, temporal consistency, and extensive PPR groups, respectively, indicating intervention adherence.

Performance

The dependent variable for performance was the total points for each participant following the 20 kicks. Combined mean total points for each group in each phase were tallied and measured against other groups and phases.

RESULTS

Results were analyzed to determine differences in cognitive and, somatic anxiety intensity, total performance accuracy, time duration and time consistency. For all dependent measures, separate 5 (Group) × 2 (Phase) mixed design Analysis of Variance (ANOVA) tests with repeated measures on the phase (low- vs. high-pressure) factor were used for the analyses. Exploration of the data indicated normal distributions and no violations of assumptions for the ANOVA test. Tukey's Honestly Significant Differences (HSD) post-hoc analysis test was used to identify any main effects. Significant interactions were further analyzed using pairwise comparisons.

Pressure Manipulation

Anxiety

Inclusion of a pressure manipulation in the high-pressure phase was critically important; thus, cognitive and somatic anxiety scores on the CSAI-2R were independently averaged across each group and results analyzed for both phases. Results of the cognitive anxiety scores indicated no main effect for group, $F\ (4, 55) = .42$, $p > .05$, partial $\eta^2 = .03$, and no interaction effect, $F\ (4, 55) = .71$, $p > .05$, partial $\eta^2 = .05$. A significant phase main effect occurred, $F\ (1, 55) = 15.71$, $p < .001$, partial $\eta^2 = .22$, indicating that all groups increased cognitive anxiety prior to the high-pressure, in comparison to the low-pressure, phase.

Somatic anxiety results indicated no significant group differences, $F\ (4, 55) = .76, p > .05$, partial $\eta^2 = .03$. A significant main effect for phase was apparent, $F\ (1, 55) = 19.90, p < .001$, partial $\eta^2 = .27$, with the high-pressure phase creating increased levels of somatic anxiety than the low-pressure phase. A significant interaction was also evident, $F\ (4, 55) = 2.80, p = .034$, partial $\eta^2 = .17$. Pairwise comparisons to evaluate the interaction indicated an increase in somatic anxiety for the pressure control, temporal consistency, deep breath, and extensive PPR groups, with a decrease in somatic anxiety for the cue word group, prior to the high-pressure phase. Cognitive and somatic anxiety results (see Table 1) indicate that the pressure manipulation was successful at increasing levels of state anxiety prior to the high-pressure phase, which is important to successful outcomes of choking research.

Table 1
Group means and standard deviations (SD) for cognitive and somatic anxiety scores in the low- and high-pressure phases.

Group	Low-pressure	SD	High-pressure	SD
Cognitive Anxiety				
Pressure control	16.20	4.94	20.00	6.04
Temporal Consistency	17.60	5.48	21.40	4.43
Deep breath	15.60	3.75	21.40	4.90
Cue word	19.20	5.27	20.00	5.74
Extensive PPR	17.40	4.68	20.80	7.44
Somatic Anxiety				
Pressure control	13.57	3.18	16.86	2.84
Temporal Consistency	12.71	3.26	17.71	4.11
Deep breath	13.00	1.84	15.00	3.25
Cue word	14.71	5.56	13.43	2.45
Extensive PPR	14.00	3.49	15.71	4.57

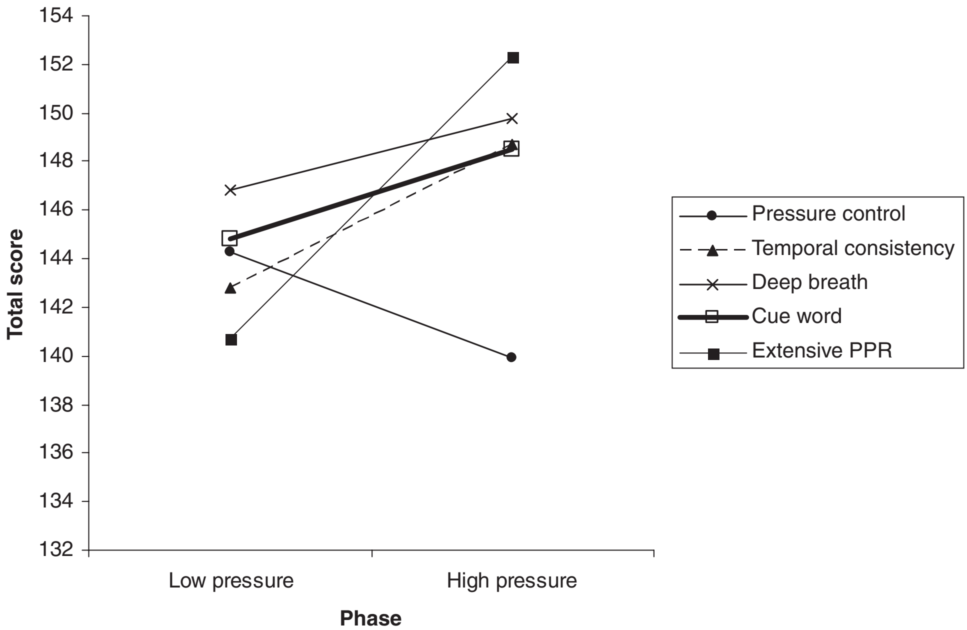

Figure 2. Total performance score across the low- and high-pressure phases for each group.

Performance

Prior to the performance analysis, it was important to ascertain that groups were similar in ability, otherwise group data results could be explained through unequal skill levels. Thus, a one-way ANOVA was conducted on the total performance score for each group in the low-pressure phase. Results indicated no significant group main effects, $F(4, 59) = .63$, $p > .05$, thus providing evidence that the five groups were equal in skill level at baseline testing.

Total performance accuracy (measured in total score) was assessed during both low- and high-pressure phases. Performance results analyzed using a mixed design ANOVA indicated no significant group main effect, $F(4, 55) = .82$, $p > .05$, partial $\eta^2 = .06$. There was, however, a significant phase main effect, $F(1, 55) = 15.42$, $p < .001$, partial $\eta^2 = .22$, with performance accuracy increasing in the high-pressure, compared to the low-pressure, phase. A Group $\times$ Phase interaction, $F(4, 55) = 6.53$, $p < .001$, partial $\eta^2 = .32$, was also evident. Figure 2 illustrates that total performance scores increased during the high-pressure, compared to the low-pressure, phase for all groups except the pressure control group. The performance decrease for the pressure control group also adds support that the pressure manipulation was successful at inducing a choking effect (i.e., increasing anxiety and decreasing performance).

PPR Duration and Consistency

The analysis conducted on mean time duration (in seconds) for PPR behavior during the low- and high-pressure phases revealed a significant group main effect, $F(4, 55) = 9.09$, $p < .001$, partial $\eta^2 = .40$. Group post-hoc analyses indicated that the extensive PPR group was significantly slower (i.e., spent more time) with their PPR than the pressure control, deep breath, and cue word groups. Likewise, the temporal consistency group was significantly

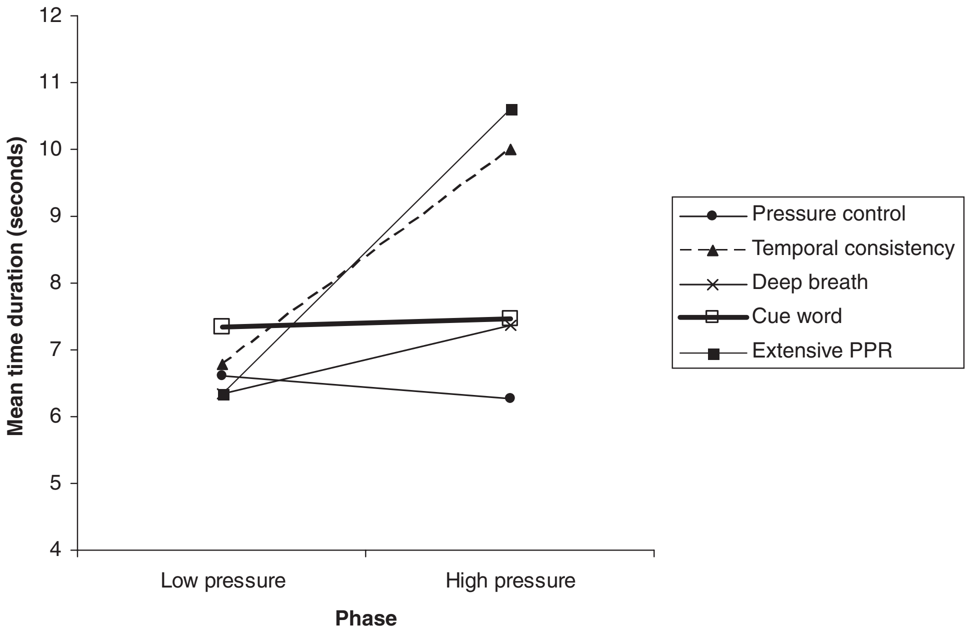

Figure 3. Mean time duration (in seconds) of PPR in the low- and high-pressure phases for each group.

slower in performing the routine than the pressure control, deep breath, and cue word groups. A phase main effect also occurred, $F(1, 55) = 38.23, p < .001$, partial $\eta^2 = .41$, with the routine duration being slower in the high-pressure, than the low-pressure, phase. Finally, a significant Group $\times$ Phase interaction was evident, $F(4, 55) = 11.08, p < .001$, partial $\eta^2 = .45$. Pairwise comparisons indicated that the four intervention groups increased (i.e., took more time) the PPR time duration, whereas the pressure control group slightly decreased time to perform the PPR, in the high-pressure, than the low-pressure, phase (Figure 3).

Homogeneity of variance of PPR temporal consistency among groups was first analyzed using Levene's statistic, which indicated no significance in variability in either the low-pressure ($p = .18$) or high-pressure ($p = .11$) phases. Thus, the means of the *SD* for each group were analyzed using a 5 (Group) $\times$ 2 (Phase) mixed design ANOVA with repeated measures on the phase factor. The analysis revealed a significant group main effect, $F(4, 55) = 4.20, p = .005$, partial $\eta^2 = .23$, with post-hoc analyses indicating that the *SD* for the temporal consistency group was significantly lower (i.e., more consistent) than the pressure control, deep breath, and the cue word groups. A phase main effect, $F(1, 55) = 10.24$, $p = .002$, partial $\eta^2 = .16$, was also evident with the *SD* for the high-pressure phase significantly lower than the *SD* for the low-pressure phase. Finally, a significant Group $\times$ Phase interaction, $F(4, 55) = 3.41$, $p = .015$, partial $\eta^2 = .20$, was also evident (see Figure 4), indicating that the four intervention groups had more consistent PPRs in the high-pressure, than the low-pressure phase, whereas the pressure control group was less consistent in the high-pressure phase.

DISCUSSION

The purpose of this study was to investigate which independent aspect of a PPR would be most beneficial for performance under pressure. The interventions included different

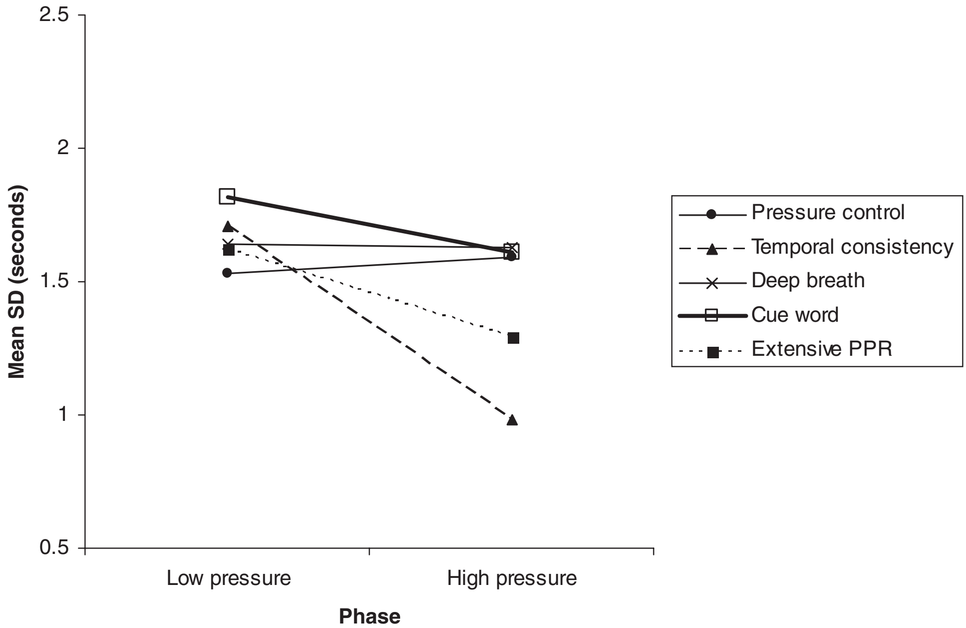

Figure 4. Mean SD of time consistency during the low- and high-pressure phase for each group.

components of a PPR that ultimately improved performance under pressure. The extensive PPR, which included psychological and behavioral components, and naturally incorporated a longer temporal duration and more consistency, resulted in the most improvement to performance under pressure.

State Anxiety

It was important to create a high-pressure phase to examine the effectiveness of a PPR under pressure. State anxiety was expected to increase from the low- to high-pressure phases as a result of the pressure manipulation. This result was supported. Researchers (e.g., Beilock & Carr, 2001; Masters, 1992; Mesagno et al., 2008, 2009; Wang, Marchant, & Morris, 2004) that investigate choking have used a combination of video camera, monetary incentive as motivation, and small audience to create a feeling of self-consciousness. Using this combined pressure, researchers have increased anxiety levels significantly (e.g., Beilock & Carr, 2001; Lewis & Linder, 1997; Masters, 1992). In our study, only two of the three pressure manipulations (excluding the video camera) were employed, and resulted in significantly higher anxiety in the high-pressure phase compared to the low-pressure phase. This result may have implications for future research because a video camera alone may not induce large pressure increases. The minimal (in some cases only an average of three CSAI-2R points) mean anxiety increase in our study has been replicated in other studies (e.g., Beilock & Carr) with similar statistically significant results. Consequently, group performance differences are likely due to the intervention rather than extraneous variables.

Group Performance Differences

After confirming the pressure manipulation was effective, group differences could now be attributed to pressure reactivity with or without (i.e., pressure control group) the PPR intervention. It was expected that the intervention groups would increase performance while the pressure control group would decrease performance under pressure, which was confirmed. Similar to Mesagno et al.'s (2008) results, using an inconsistent, or no, routine resulted in a performance decrease and the lowest performance levels under pressure. The inclusion of the pressure control group provided support that a decrease in performance, but not necessarily choking, was evident. That is, Hill et al. (2009) rightly questioned conclusions of some choking research stating, ". . .it should also be recognized that an 'inferior' performance, as suggested by Baumeister and Showers (1986), may not accurately represent the acute and dramatic deterioration in performance associated with choking in sport" (p. 203). In line with Hill et al.'s critical view of empirical choking studies, and based on our proposed definition of choking, we believe that choking occurred for the pressure control group because the three main elements of our choking definition were evident. That is, during the high-pressure phase, an elevation in anxiety and a decrease in performance were exhibited, with performance being below what is normally attainable. Clearly, anxiety increased (for all groups) and performance decreased for the pressure control group; however, the relative size of the decrease is questionable. We discuss at least three explanations to indicate the performance decrease was dramatic enough to infer that choking occurred. First, mean performance for the pressure control group decreased in the high-pressure phase, whereas the intervention groups increased performance. Second, performance for the pressure control group in the high-pressure phase was substandard in comparison to other groups in either phase of our study. That is, with groups being equivalent in ability and, from our choking definition, normally attainable interpreted as any mean group score from the low-pressure results, the pressure control group was below normal in the high-pressure phase. Finally, the pressure control group performance was considerably lower than the intervention groups' scores during the high-pressure phase. Thus, based on our empirically based choking definition, we would argue that choking was experienced for the pressure control group.

Mean performance increased differently for the four intervention groups with the extensive PPR group (educated about combining psychological and behavioral components) improving the most. Caution should be used when interpreting the results, however, because the extensive PPR group demonstrated the lowest mean score during the low-pressure phase, indicating the most improvement potential. Nevertheless, the extensive PPR group performance is consistent with Mesagno et al.'s (2008) study, who found that a personalized PPR improved performance under pressure. The Mesagno et al. study provided a unique perspective and an extension to the PPR and choking literature by presenting evidence that an extensive PPR minimizes choking in purposely selected choking-susceptible athletes. Similarly, Marlow, Bull, Heath, and Shambrook (1998) also provided support that a PPR improves performance of a closed skill, even though not specifically investigating performance under pressure. In Marlow et al.'s single-case design study, participants improved performance by 21%, 25%, and 28% after developing an extensive individualized PPR. From our results, performance improvements under pressure occur when behavioral and psychological routines are incorporated into the PPR development of experienced athletes.

The question still remains, which PPR is most beneficial to performance under pressure? In the context of the current design, and irrespective of applied sport psychology consulting prior to intervention development, clearly the most beneficial intervention was the extensive PPR. To help explain why a PPR is the most beneficial, we refer to recent research by Cotterill, Sanders, and Collins (2010) who interviewed six male international golfers about the use of their PPR. Cotterill et al. found that numerous functions of the PPR were suggested; however, the dominant function was the control and manipulation of attentional resources and focus. This supports Cohn's (1990) explanation that cognitive and behavioral components of the PPR assist in producing correct mental and physical organization prior to performance execution. One of the reasons that the PPR is effective is that it triggers the appropriate motor program (i.e., schema), thereby enabling more accurate skill execution (Cohn, 1990). In the context of our study, the PPR occupied attentional space, minimizing distractions from the high-pressure phase, triggering and preparing the motor program into action.

The extensive PPR was the most successful; however, we also believe that providing an athlete, especially one that is choking-susceptible, with *any* of these interventions could improve performance under pressure primarily because the intervention will act as a coping strategy to the athlete's arguably non-existent coping repertoire. For example, if our results were expanded to assist a choking-susceptible athlete and temporal consistency was adopted, the time consistency would provide a coping strategy (i.e., being more time consistent), not otherwise available, to deal with the situation demands. This view was adopted in light of a qualitative investigation by Hill et al. (2009), who interviewed applied sport psychology experts that had published in the stress and anxiety literature and had worked with elite athletes. Hill et al. found that the sport psychology experts believe that athletes who experience choking are unable to cope with the demands of the high-pressure situation, responding with negative emotional reactions. That is, choking is a product of situational appraisal as beyond the athlete's capability in which he/she reacts negatively to pressure. Relating Hill et al.'s findings to our study, in the absence of coping strategies (as indirectly observed from the performance of the pressure control group), even the basic interventions, such as temporal consistency, may improve performance.

To date, no known studies have directly compared performance of different PPRs (in general or under pressure). In the current study, the deep breath group improved mean performance, albeit minimally, from the low- to the high-pressure phase, by using deep diaphragmatic breathing, which may help psychologically and physiologically (Williams & Harris, 2006). The cue word group, essentially and theoretically, minimized distraction and improved performance by focusing attention toward a concentration phrase, or word, prior to each attempt. This finding supports previous research indicating that athletes who use attentional cues or "swing thoughts" (Jackson & Willson, 1999) maintain stronger attentional focus, allowing them to perform more accurately (Wilson, Peper, & Schmid, 2006). Similarly, in a choking-specific study, Gucciardi and Dimmock (2008) found that using a single swing thought, rather than explicit or task-irrelevant thoughts, decreases the likelihood of choking, which added support for self-focus models of choking.

Time Duration and Consistency

The results of our study indicated that the temporal consistency and the extensive PPR groups took more time with their PPR in the high-pressure phase than the other groups. These results combined with the performance effects may indicate that PPR duration may be important to minimizing choking effects. Similar to the results of Jordet (2009; Jordet & Hartman, 2008), participants in the pressure control group decreased preparation time (discussed as temporal duration in the current study) and also performance during the high-pressure phase. Jordet explained the decrease in preparation time could be explained as athletes possibly using self-defeating behavior by getting the shot over with quickly without considering the impact of their decisions. Jordet's supposition about self-defeating behavior has also been confirmed by Gucciardi et al. (2010), who found qualitative evidence that quicker preparation times may result in choking. Gucciardi et al. interviewed golfers that had experienced a self-confessed choking episode in the past two years and found that under the central category of *choking event*, a subcategory *departure from the normal routine* emerged. Apparently, during their choking experience, the golfers had difficulty maintaining a consistent and slower (than normal) PPR. Participants explained the anxiety experienced led them to speed up their PPR time.

The intervention groups in the current study inherently, or by instruction, increased the PPR temporal duration and also performance under pressure. Arguably, other psychological and behavioral factors could have explained the positive performance effects in the high-pressure situation; however, when comparing the temporal consistency and pressure control groups in the high-pressure phase, increasing the time duration alone could potentially improve performance. The results of the pressure control group are contradictory to research by Beilock, Bertenthal, McCoy, and Carr (2004) who found that reducing the amount of execution time available prior to expert performance may be beneficial to performance. It should be noted, however, that in the Beilock et al. study, a high-pressure phase was not used, which limits the generalizability of the results to pressure situations. That is, the combination of a high-pressure situation and limited time available to perform the task may produce different experimental results. Thus, future research is needed to differentiate the equivocal results of time duration under pressure.

During our study, the temporal consistency group decreased variability and increased performance in the high-pressure phase, whereas the pressure control group (the only group without intervention development) increased variability and decreased performance, which may also provide evidence that PPR consistency is important to successful performance under pressure. These findings support Boutcher and Crews (1987) who found that golfers with high PPR consistency improved performance. Similarly, Boutcher and Zinsser (1990) also found that elite golfers used a time-consistent PPR 62% of the time compared to beginners who used a time-consistent PPR only 35% of the time. The main difference between the current study and that of Boutcher and colleagues is performance using the PPR under a high-pressure situation was assessed in our research.

Limitations

Although the current study was carefully designed, methodological limitations should be discussed. Environmental factors could have played a role in the performance accuracy. That is, familiarity with the audience was a potential issue that could have influenced participants' performance because the audience members were teammates rather than impartial spectators. This was a potential limitation as indicated by Butler and Baumeister (1998) who conducted a series of experiments investigating the performance effects of supportive audiences. They found that a supportive audience creates friendly faces, but paradoxically may be debilitative to performance. The use of teammates was unavoidable and it was not logistically possible to use a neutral audience, thus adding a potential confounding variable. Another potential limitation was the possibility of learning (or order) effects. We acknowledge that learning effects cannot be ruled out; they are, however, relatively unlikely for two reasons. First, the football players had at least 5 years playing experience, which implies their skill level (and performance curves) should be stabilizing, and thus, 20 kicking attempts would not result in learning effects. Similarly, considering Masters (1992) found that 400 golf putts were enough to show learning effects for unskilled golfers, and Mesagno (2001) failed to show learning in 80 ten-pin bowling deliveries for inexperienced bowlers, it can be indirectly implied that experienced football players attempting 20 kicks per phase would not exhibit learning curves. In hindsight, we realize that using a counterbalanced design could have decreased the likelihood of learning effects; however, we did not use counterbalancing for two reasons. First, through unpublished pilot testing, we determined that a high-pressure phase preceding a low-pressure phase may alter the motivation levels of participants in the low-pressure situation, especially if they do not perform well in the high-pressure phase. Second, we were testing choking interventions; thus, if counterbalancing was used, other confounding variables could have affected the results such as intervention usage in both phases. That is, prior use of the high-pressure (and intervention) could potentially benefit participants in the low-pressure phase. Thus, for the aforementioned reasons, counterbalancing was deemed unsuitable for the current design.

Future Research

Based on the current results, and in addition to the future research already suggested, other avenues for future research on choking could be undertaken. In our study, the deep breath and cue word groups only improved performance modestly; however, these results may be magnified in future research if the intervention is correctly matched to the particular anxiety or attentional problem experienced. For example, matching an athlete that has concentration difficulties under pressure with a cue word intervention to focus his or her attention more appropriately may provide an applied method of understanding the benefits of different interventions. Additionally, researchers could observe performance effects in a high-pressure situation after the longitudinal development of a PPR. During our study, we purposely used an ephemeral period (approximately 15 min) for the development and maintenance of the PPR to maintain attention on the routine rather than the participant's becoming distracted by the pressure manipulations. This approach was adopted from Dale's (2004) suggestion that regular PPR modification might be important to reduce the likelihood of the PPR becoming automatic. When the PPR remains accessible to attention, less attentional resources are available to process irrelevant information, indirectly increasing the likelihood of task-relevant focus and continued proficient performance (Dale, 2004). Nevertheless, future PPR research should explore whether developing a PPR over a longer timeframe (e.g., hours or weeks) would be fruitful (or potentially detrimental) for performance under pressure. Finally, Lonsdale and Tam (2008) questioned the external validity of PPR data collected under laboratory conditions. Thus, researchers should supplement our results with more ecologically valid PPR studies in "real world" competitions.

Applied Implication

Based on the results of our study, suggestions should be offered to help sport psychologists better consult with athletes who experience choking or that may prescribe a PPR for pressure situations. One recent construct that is gaining momentum as a factor that may predict performance under pressure is perceived control (Cheng, Hardy, & Markland, 2009; Otten, 2009). Cheng et al. explained that "perceived control . . . is used as a regulatory element and refers to the perception of one's capacities to be able to cope and attain goals under stress" (p. 273). Perceived control is related to how much adaptive potential the athlete possesses to deal with anxiety-provoking events. If perceived control is important to predicting performance under pressure, applied sport psychologists should use interventions that increase perceived control. Some applied sport psychologists (e.g., Dale, 2004) have proposed that by using a PPR athletes might perceive (and experience) more control over situations and, thus, manage pressure more effectively. Apparently, the individual's belief of control over what is happening may have anxiety-reducing benefits (Bandura, Cioffi, Barr-Taylor, & Brouillard, 1988). The perception of control may reduce anxiety even though actual control of the situation is not possible (Averill & Rosenn, 1972). Research investigating perceived control on competitive anxiety is in its infancy with no universally accepted operational definition; therefore, empirically tested explanations for perceived control as a predictor of performance under pressure remain a future research question. Nonetheless, applied sport psychologists should develop choking interventions that increase perceived control, or at least the belief of perceived control, to facilitate performance under pressure.

For the applied sport psychologist, we do not expect a 15-min PPR education and development session will miraculously minimize choking for all athletes. Choking is an idiosyncratic phenomenon that athletes experience differently, sometimes through acute or chronic choking episodes (e.g., Gucciardi et al., 2010). For athletes that experience acute choking that may only occur sporadically, a 15-min PPR education and development session may help to de-automatize the pre-existing PPR so that the modified (or extensive PPR in our study) routine remains in attentional awareness in the high-pressure situation, with only minimal cognitive anxiety disruption. For chronic chokers, an extensive PPR may not decrease the likelihood of choking re-occurring because more underlying, potentially clinical, issues may be the source of the dysfunctional performance. A recent self-presentation model of choking proposed by Mesagno (2009) provides the basis for this suggestion. Mesagno explained that choking-susceptible athletes experience self-presentation concerns as an antecedent to the anxiety increase in a choking episode. That is, the anxiety increase is a result of impression management issues and may stem from social anxiety and fear of negative evaluation. If Mesagno's proposed choking model is relevant, a more intense therapeutic athlete-consultant alliance can be developed, underlying sources of the anxiety understood, and appropriate theory-matched intervention applied. In this context, the extensive PPR could be used as a supplement to manage underlying issues of the chronic choker, but may not improve performance by itself.

Conclusions

In summary, the present study extends the choking literature into additional theory-matched interventions based on the distraction model (Nideffer, 1992). The outcomes of our study indicate that occupying attention with task-relevant cognitions alleviate (or at least reduce) choking. Although temporal duration and consistency play important roles in minimizing choking, a non-automated PPR that has both psychological and behavioral components that occupy attention prior to execution, and decrease involuntary shifts to pressure-related threat, is the most beneficial to performance under pressure especially for the choking-susceptible athlete.

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