A Comparison of Self-Focus Versus Attentional Explanations of Choking

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This study examined attentional processes underlying skilled motor performance in threatening situations. Twenty-four trained participants performed a simulated rally driving task under conditions designed either to direct the focus of attention toward the explicit monitoring of driving or a distracting secondary task. Performance (lap time) was compared with a “driving only” control condition. Each condition was completed under nonevaluative and evaluative instructional sets designed to manipulate anxiety. Mental effort was indexed by self-report and dual-task performance measures. The results showed little change in performance in the high-threat explicit monitoring task condition, compared with either the low-threat or the high-threat distraction conditions. Mental effort increased, however, in all high- as opposed to low-threat conditions. Performance effectiveness was therefore maintained under threat although this was at the expense of reduced processing efficiency. The results provide stronger support for the predictions of processing efficiency theory than self-focus theories of choking.

Key Words: attention, mental effort, processing efficiency, explicit monitoring, secondary tasks

Anxiety’s influence on performance continues to be one of the main research interests for sport psychologists (Janelle, 2002). Much of this research has focused on the disruptive influence of self-focused attention on the performance of well-learned motor skills under pressure (e.g., Baumeister, 1984; Beilock & Carr, 2001; Lewis & Linder, 1997; Masters, 1992). It is suggested that increased anxiety and self-consciousness cause performers to turn attention inward to the skill processes underlying performance (Carver & Scheier, 1978; Lewis & Linder, 1997). In extreme cases, this step-by-step attention to execution can lead to choking—acute performance decrements despite the ability and incentives for good performance (Baumeister, 1984).
Self-focus theories of choking are closely linked with theoretical accounts of stages of skill learning (e.g., Fitts & Posner, 1967). Skill acquisition begins with declarative, explicit encoding of knowledge in which the demands on cognitive processing are high and performance is typically slow, erratic, and requiring conscious effort. As learning progresses, the need to attend to the step-by-step processes involved in performance diminishes, as components of the skill become proceduralized (Anderson, 1982). Refocusing attention on specific components of the skill interferes with the automatic nature of skilled performance, causing performance quality to decline (e.g., Beilock, Carr, MacMahon, & Starkes, 2002; Masters, 1992).

A number of self-focus theories have received support in the literature, including the conscious processing hypothesis (CPH; Masters, 1992) and the explicit monitoring hypothesis (EMH; Beilock & Carr, 2001). Although there are a number of similarities between these theoretical positions (see Masters & Maxwell, 2004), there are important conceptual distinctions related to the specific mechanisms implicated in choking. In the EMH, the act of monitoring the step-by-step procedures underlying performance is predicted to be counterproductive to skilled performance. Masters proposed that performance degradation is due to attempts to apply explicit rules to control movements underpinning performance. Jackson, Ashford, and Norsworthy (2006) have suggested that explicit monitoring may therefore have a general disruptive effect on motor control and that additional disruption might occur when performers attempt to consciously control, as well as monitor, their movements.

Additional support for the debilitating influence of explicit monitoring has come from research examining the attentional demands of skilled performance. For example, Beilock et al. (2002) examined the performance of both skilled and less skilled performers in golf putting and soccer ball dribbling under two conditions. In a distraction task condition, participants had to perform an auditory-tone monitoring task while performing the primary task. In a skill-focused attention task condition, participants were prompted to attend to a specific component of their performance: the exact moment that the club head stopped its follow-through in the putting task and the side of the foot that was last in contact with the ball in the dribbling task. When skilled performers attended to a component of the primary task, they experienced performance decrements in comparison to both single-task and distraction conditions performance. It was claimed that these results demonstrated that performance of well-learned tasks could be compromised by attending to skill execution, whereas attention was available for the processing of distracting secondary task information.

A recent study by Jackson et al. (2006) extended Beilock et al.’s (2002) study by incorporating a pressure manipulation, in order to investigate pressure-induced explicit monitoring effects. Skilled field hockey players were required to perform a ball dribbling task while carrying out concurrent secondary tasks that were based on those used by Beilock et al. In the skill-focused condition, participants were prompted to attend to the position of their hands throughout the dribbling task so that they could verbally indicate (by saying up or down) whether their left hand was in a supine or prone position each time they heard a tone. In the dual-task condition, participants were instructed to generate a random letter of the alphabet
every time they heard a tone that sounded on the same variable-interval schedule used in the skill-focused condition.

The results lent support to Beilock et al.'s (2002) findings, as performance was worse in the skill-focused compared with distraction (tone-monitoring) condition. The results also supported explicit monitoring accounts of choking under pressure, as performance deterioration in the skill-focused condition was compounded by high pressure. Jackson et al. (2006) suggested that there may therefore be an additive effect of explicit monitoring, caused by both attentional and pressure influences.

A limitation of the previous research adopting attentional focus manipulations is that the resource characteristics of each of the secondary tasks adopted are not assessed (Barber, 1988). If the general resource-performance requirements of each task are not known, significant problems arise when attempting to attribute differential effects to the type of attentional processing (distraction or skill-focused) involved. Indeed, Jackson et al.'s (2006) results could also be explained by attentional theories of choking, such as Eysenck and Calvo’s (1992) processing efficiency theory (PET). First, the skill-focused tasks used may simply have been more attentionally demanding than the distraction tasks, leaving fewer resources for the completion of the primary task. Second, as worry also preempts attentional resources, this may explain why performance was most affected in the high-pressure condition.

Processing efficiency theory predicts that cognitive anxiety in the form of worry has two main effects. First, it reduces the processing and storage capacity of working memory, thereby reducing the resources available for the task at hand. Second, worry can have a motivational role, stimulating increases in on-task effort, which may partially or totally compensate for reduced performance effectiveness (Eysenck & Calvo, 1992). A contention of PET is that there is a control or self-regulatory system (Hockey, 1986) that is involved in mediating the effects of anxiety on processing and performance (Eysenck, 1992). The system performs the task of coordinating resource allocation based on outcome probabilities and relies on negative feedback resulting from the detrimental effects of anxiety on performance as a trigger for its activation.

One of the central predictions of PET is that the adverse effects of anxiety on performance effectiveness are often less than those on processing efficiency, where processing efficiency refers to the relationship between the effectiveness of performance and the effort or processing resources invested (Eysenck & Calvo, 1992). This central prediction has been supported in the sport psychology literature using dual-task designs (e.g., Murray & Janelle, 2003; Williams, Vickers & Rodrigues, 2002). For example, in the Murray and Janelle study, performance in a primary driving task was maintained under pressure, although performance of a concurrent visual search task was negatively affected. In common with other research adopting dual-task methods, this result is assumed to reflect increased effort being applied to the primary task in high-pressure situations, leaving less attention available to perform the secondary task (e.g., Meshkati, Hancock, Rahimi & Dawes, 1995).

The main aim of the current study was to extend previous research adopting dual-task designs to test the predictions of explicit monitoring accounts of performance degradation. In line with the findings of Jackson et al. (2006), it was predicted that driving performance should be most disrupted in the skill-focused
high-pressure condition owing to the additive effects of explicit monitoring. By assessing the attentional demands of the various tasks and examining the role of effort in threatening situations, the predictions of PET could also be tested. First, PET would predict that driving performance in both dual-task conditions would be similar if the attentional demands of both tasks are similar. Second, increased effort is viewed as a positive effect of increased anxiety in PET, as it may compensate for the preempt of attentional resources. Processing efficiency theory would therefore also predict that driving performance under high pressure may be maintained at low-pressure performance levels, but this would require additional mental effort and be at the expense of secondary task performance.

**Method**

**Participants**

Twenty-four female undergraduate students (mean age 19.04 years, $SD = 1.05$) volunteered to take part in the study. All held full U.K. driving licenses and had been driving for more than 1 year, with a mean driving experience of 1.91 years ($SD = 0.74$). Participants had never played the specific driving game used and had little or preferably no general video game usage (less than once per week) in the previous 6 months (see Green & Bavelier, 2003). Local ethical committee approval was obtained prior to testing and participants had the general nature of the study explained to them and provided informed consent before taking part. Female participants were selected because it was believed that the particular manipulation of anxiety might be more meaningful to them. First, it has been highlighted that women tend to report higher state and trait anxiety scores than do men (see Egloff & Schmuckle, 2004) and are also more likely to show concern for others than men (e.g., Broidy, Cauffman, Espelage, Mazerolle, & Piquero, 2003).

**Apparatus**

The driving task was undertaken in a purpose-built driving simulator incorporating a 42-inch plasma screen, force feedback steering wheel, pedals, rally car seat, and the Colin McRae Rally 2 PC software (Codemasters, Warwickshire). A potentiometer in the steering column measured the wheel movement in degrees either side of 0° (the straight-ahead position). The wheel could potentially be turned through ±120° to keep the car on the road. The steering wheel movement during the completion of a lap was digitized at 200 Hz using a CED 1401 A/D converter (Cambridge Electronic Design, Cambridge, U.K.), for offline analysis using Spike 2 software. A trace of wheel position was plotted against time, enabling momentary wheel position to be determined in relation to tone presentations (see Measures subsection).

The experimenters and the data analysis hardware were situated in an adjoining room separated from the participant by a one-way mirror. The chosen track was a 3-km-long tarmac circuit with 32 bends and no long straight sections. Because the completion time was shorter than in previous studies (e.g., Murray & Janelle, 2003), participants completed the circuit twice to count as a lap in both the training and the testing phases of the study. The course adopted was driven as a time trial (i.e., only the test car was on the road) in dry, daylight conditions, so environmental
concerns, such as other cars and changing weather, would not confound results. The car selected was a Ford Focus operated with automatic gears.

**Design**

Following a training phase (see Procedure), participants were tested using a neutral and evaluative instructional set, administered in counterbalanced order. Within each instructional set, participants were required to complete two laps of the course in single task, distraction (tone recognition) task, and skill-focused (hand position) task conditions, resulting in a fully within-subjects design ($2 \times 3; \text{Threat} \times \text{Task}$).

**Experimental Conditions**

In the low-threat condition, nonevaluative instructions were provided to participants, which asked them to do their best and drive the course as quickly as possible while responding as rapidly and as accurately as possible to the presentation of the secondary task. To further emphasize the nonevaluative nature of the environment, participants were also told that the purpose of this part of the study was to collect data on the characteristics of the driving simulator. The manipulation used to elicit anxiety was based on the one adopted by Beilock and Carr (2001) in their study of golf putting under pressure. In the high-threat condition, participants were informed that their mean driving and secondary task performance during training (see Procedure) had been calculated. Participants were told that if they could improve their performance by an average of 20% they would receive £10.

Participants were informed that this test performance score would be an amalgamation of performance in the driving task and the secondary tasks and calculated using a formula to standardize all participants’ performance. However, participants were also informed that the monetary reward was a team effort, in that they had been randomly paired with another participant. In order to receive £10, not only did they have to improve by 20%, but also their partner had to improve by 20% as well. Next, participants were informed that the individual they had been paired with had already completed the experiment and had improved by more than 20%. Therefore if the present participant improved by 20% they would both receive £10. However, if the present participant did not improve by the required amount, neither participant would receive the money.

**Measures**

**Competitive State Anxiety.** The Mental Readiness Form–Likert (MRF-L) was developed by Krane (1994) as a shorter and more expedient alternative to the CSAI-2 (Martens, Burton, Vealey, Bump, & Smith, 1990). The MRF-L has three bipolar 11-point Likert scales that are anchored between worried–not worried for the cognitive anxiety scale, tense–not tense for the somatic anxiety scale, and confident–not confident for the self-confidence scale. As with previous research investigating the effect of worry on sporting performance (e.g., Smith, Bellamy, Collins, & Newell, 2001), the cognitive anxiety scale provided the focus for the research. Krane’s validation work on the MRF-L revealed a correlation between the MRF-L and the CSAI-2 cognitive anxiety subscales of .76.
Self-Reported Effort. Self-reported mental effort was measured using the Rating Scale for Mental Effort (RSME; Zijlstra, 1993). The scale has robust psychometric properties and has undergone extensive validation in a range of settings (Zijlstra, 1993). The reliability of the scale across a range of laboratory and real-life settings has been shown to be acceptable ($r = .88$ in the laboratory and $r = .78$ in work settings). It consists of a vertical axis scale with a range of 0 to 150 with nine descriptive indicators along the axis ranging from 3 (not effortful) to 114 (awfully effortful). Participants are asked to mark a point on the scale that reflects the amount of mental effort invested in task performance.

Secondary Task Performance. Two secondary tasks were used to test explicit monitoring and attentional accounts of choking, and were adapted from those used by Beilock et al. (2002) and Jackson et al. (2006). They were designed to require the same verbal responses to help control against general resource requirement differences in the tasks. The distraction secondary task (tone recognition) required the participants to listen to a reference tone of a certain pitch before commencing the driving task. They were informed that they must remember this pitch and were told that they will be presented with a series of tones during their driving task. One of three tones (one higher, one lower, and one the same pitch as the reference tone) were played randomly; a tone presented randomly every 2–6 s while they drove. The participants were asked to respond as accurately and quickly as possible as to whether the presented tone was lower (by saying low), higher (by saying high), or the same pitch (by saying same) as the reference tone.

The skill-focused secondary task (hand position) required the participants to respond to a single tone that occurred at the same random time period (once during every 2- to 6-s interval) as the previous secondary task. Participants were instructed to attend to the position of their left hand on the steering wheel throughout the driving trial so that upon hearing the tone, they could verbally indicate whether their left hand was higher than the right (by saying high) or lower than the right (by saying low) or at the same height (by saying same) on the steering wheel.

Performance in both secondary tasks was measured in terms of response accuracy and response time (milliseconds). Response time was measured as the time taken to produce an oral response to the presented tones. The tones were created within a Spike 2 program and presented simultaneously to the participant (through an amplifier and speaker) and to the DAC, where it registered as a coded event within Spike 2. The response from the participant was detected verbally via a collar microphone and digitized at 20 kHz. Offline analysis was then carried out in Spike 2 using an algorithm that detected the onset of each response pulse (Marple-Horvat, Gilbey, & Hollands, 1996). The response time for each presentation was calculated within Spike 2, and all response times for a particular condition were transposed into an Excel spreadsheet for further analyses.

Response accuracy was determined in a slightly different way for each task. For the tone recognition task, participants’ responses could be replayed in Spike 2 (as a sound file) and checked against the corresponding tone for accuracy. The task requiring the participants to report the position of their left hand at the moment a tone was presented also required offline analysis. The response was again replayed in Spike 2 and checked against the wheel position data at that time. As participants’ hands stay fixed on the wheel and the wheel itself is moved, wheel position reflects
hand position (i.e., if the wheel is turned to the left, the left hand would be low, and on a turn to the right, the left hand would be high). A degree of tolerance was required for the hand task for small wheel movements around the straight-ahead position. Movements of up to ±10° from the straight-ahead wheel position were considered to be straight-ahead (“same”). Figure 1 shows a section of a Spike 2 data file for one participant, as an example of how this procedure was performed.

**Primary Task (Driving) Performance.** Completion time for the two laps driven in each condition was used as a measure of primary task performance in the current study.

**Procedure**

Participants attended individually and were instructed that the purpose of the study was to examine driving ability over a number of different conditions. Following completion of an informed consent form, the specific measures and testing protocol to be adopted were explained to the participant. The participants then performed the tone secondary tasks alone (counterbalanced) to ensure that they could satisfactorily differentiate between the pitches of the tones used and report the position of their hands on the wheel. This process also provided the opportunity for an estimation of the attentional demands of the secondary tasks to be assessed.

For the hand position task, it was necessary to get the participants to move the wheel but not to have to concentrate on controlling the car. A metronome was set to measure 50 beats per minute and participants moved the steering wheel to the left and right on each prompt from the metronome (as a flashing LED). Participants responded to their hand position when the target tone was presented while moving

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**Figure 1** — A 50-s section of a Spike 2 data file showing the tone presentations (keyboard: top), the participant responses (response: middle), and the wheel position (wheel: bottom) for one participant in a skill-focus condition.
the wheel in this rhythmic manner. The tone recognition task was also performed while the participants moved the wheel to the beat of the metronome, in order to ensure that resource characteristics due to moving the wheel were controlled for. Following two 3-min attempts at each of the secondary tasks, the last attempt was used as a baseline measure of performance. The duration of 3 min was chosen as the testing duration because this was similar to the lap times recorded. Only two attempts were used because participants made few errors during their second attempt, suggesting that the tasks had been learned satisfactorily (see Results). Self-reported effort using the RSME was also taken at this stage to provide information about how effortful each individual task was perceived to be.

At this point, the driving game was switched on and participants were instructed to complete laps of the course as quickly as they could until the experimenter asked them to stop, or until they felt they needed a break. No specific information was provided to the participants regarding how they should drive. Instead, as suggested by Maxwell, Masters, and Eves (2003), the participants were allowed to develop explicit knowledge during learning by testing hypotheses about how best to perform the skill and use sensory feedback to assess the success of their actions.

Because performers had to be well trained in driving in the simulator before the testing phase of the experiment, a criterion lap time (220 s) derived from pilot testing by the experimenters, had to be maintained for at least three consecutive laps (cf. Murray & Janelle, 2003). Drivers completed up to 14 double-laps of the selected course (mean number of completed laps 12.08, SD = 1.72) during this training, or learning, phase. Completion times across the training period improved by approximately 60 s. A paired samples t test revealed that there was a significant reduction in completion time from first to final training lap, t(22) = 8.34, p < .005.

Simply achieving a criterion performance level would not reveal whether participants were still improving and still learning the task at the end of the training session. For this reason, drivers were requested to complete laps of the circuit until times started to plateau, even when the criterion level had been attained. A plateau was acknowledged during the training period when participant’s last three lap times fell within 5 s of each other. This gave an indication that asymptote had been reached and the task of driving in the simulator had been learned to a satisfactory level. A one-way ANOVA of the completion times for the last three drives of all the participants supported the fact that a plateau had been reached, as there were no significant differences, F(2, 46) = 2.04, p = .15, found between completion times. The completion times for all drivers’ last ten laps are shown in Figure 2.

Although the drivers in this study were clearly not professional rally drivers, the degree of training performed would appear to match up against that of other studies testing self-focus explanations of choking. For example, the novice golfers in Masters’s (1992) seminal study completed 400 discrete putts by way of training. In the continuous task of driving, it is corner handling that is the most important discrete element. Because each double-lap consisted of 64 corners, each driver completed over 800 practice attempts at corner handling during the training phase. There were a similar number of left- and right-hand bends on the track, meaning that each driver had approximately 400 attempts at steering around left- and right-hand corners. From a temporal perspective, completing 400 putts would take approximately 40 min, which is similar to the time taken by these drivers to reach a plateau in learning.
Following training, participants were given a 5-min comfort break and told that the experimenter needed to make some calculations based on their performance during the practice session. On returning to the driving seat, participants were informed that the aim of the task was to drive around the course as quickly and with as few errors (crashes, spin-offs, etc.) as possible in each of the conditions presented. Each test drive consisted of two laps of the course. With the exception of the content of the evaluative instructions and the secondary task being carried out, the procedure was identical for all conditions. Each participant provided a self-report of their preperformance anxiety levels by completing the MRF–L before commencing the course, and then completed the course. Following completion, participants reported the mental effort they invested in the drive using the RSME.

At the end of the testing period, participants were debriefed about the purpose of the study and were informed that all participants were paid irrespective of performance. They were asked to maintain the confidentiality of the testing arrangements to ensure that subsequent participants had no previous information about the manipulations involved in the experimental conditions.

**Results**

The resource demands of both secondary tasks were calculated from baseline performance when they were completed on their own. Response accuracy, response latency, and self-reported effort values were subjected to paired samples t test analyses. Anxiety, performance, and self-reported effort scores from the testing period were subjected to fully repeated measure 2 × 3 ANOVA analyses (Threat × Task). For the secondary task response latency and accuracy data, fully repeated
measures $2 \times 2$ ANOVA (Threat $\times$ Task) analyses were carried out. There were only three occasions throughout the entire testing period (over 7,000 presentations) when a participant did not make a response to a presented tone. The effect of such “misses” were therefore not analyzed further. Effect sizes ($\omega^2$) were calculated as outlined in Howell (2002) and Tukey post hoc tests were used to follow-up significant effects.

**Baseline Secondary Task Data**

There were no significant differences in response accuracy between the hand task (mean percentage correct 91.18%, $SD = 5.45$) and tone task (mean percentage correct 89.23%, $SD = 8.19$) during the training phase of the experiment, $t(22) = 1.32$, $p = .26$, $\omega^2 = .21$. There were also no significant differences in the reported effort (RSME) ratings for each task: hand task (mean rating 66.73, $SD = 23.16$) and tone task (mean rating 72.07, $SD = 27.34$), $t(22) = 1.03$, $p = .32$, $\omega^2 = .19$. Both tasks were therefore equally effortful when completed alone.

**Cognitive State Anxiety: MRF–Likert**

There was a significant main effect for threat, $F(1, 22) = 339.15$, $p < .001$, $\omega^2 = 2.48$, with higher cognitive anxiety scores being reported in the high threat conditions (mean rating 5.08, $SD = 1.75$) than low-threat conditions (mean rating 2.31, $SD = 1.14$). There was no significant main effect for task, $F(2, 44) = 0.58$, $p = .57$, $\omega^2 = .06$, nor was there a significant interaction effect, $F(2, 44) = 1.98$, $p = .16$, $\omega^2 = .18$.

**Performance: Completion Time**

The ANOVA identified a significant main effect for task, $F(2, 44) = 16.07$, $p < .001$, $\omega^2 = .52$. Subsequent follow-up tests showed that there was no significant difference between the completion times in the conditions where drivers had to perform the concurrent secondary tasks ($p = .20$). However, the single task condition (none) drives were significantly quicker than the tone task drives ($p < .005$) and the hand task drives ($p < .001$). There was no significant main effect for threat, $F(1, 22) = 0.60$, $p = .45$, $\omega^2 = .06$, nor was there a significant interaction effect, $F(2, 44) = 0.32$, $p = .73$, $\omega^2 = .03$. The completion time data is presented in Figure 3.

**Self-Reported Effort: RSME**

There was a significant main effect for threat, $F(1, 22) = 15.99$, $p < .001$, $\omega^2 = .44$, with higher effort being reported in the high-threat condition. The task independent variable violated the sphericity assumption ($W = 0.56$, $p < .05$, $\varepsilon = 0.69$); therefore, the Greenhouse-Geisser correction was applied. There was also a main effect for task, $F(1.39, 30.51) = 26.90$, $p < .001$, $\omega^2 = .69$. Subsequent Tukey follow-up tests showed that there was no significant difference between the effort reported in the conditions where drivers had to perform the concurrent secondary tasks ($p = .33$). However, drivers reported significantly lower effort levels in the single task condition (none) drives compared with the tone task drives ($p < .001$) and the hand task drives ($p < .001$). The self-reported effort data is presented in Figure 4.
Secondary Task Accuracy

There was a significant main effect for threat, $F(1, 22) = 37.63, p < .001$, $\omega^2 = 1.11$, with poorer performance in the secondary tasks in the high threat condition. There
was also a significant main effect for task, $F(1, 22) = 20.38, p < .001, \omega^2 = 1.00,$ with performance in the tone recognition task being better than in the hand position task. The interaction effect was not significant, $F(1, 22) = 2.21, p = .15, \omega^2 = .20.$ The secondary task accuracy data is presented in Figure 5 (Top).

**Figure 5** — Mean secondary task performance (with standard error bars), as indexed by response accuracy (% correct: top) and response latency (in milliseconds: bottom), in the three attention conditions under low and high threat.
Secondary Task Latency

There was a significant main effect for task, $F(1,22) = 20.47, p < .001, \omega^2 = 1.27$, with responses to the hand stimulus tones being significantly quicker than responses to the tone recognition stimulus tones. There was also a significant Threat × Task interaction effect, $F(1, 22) = 7.18, p < .05, \omega^2 = .36$. In the high-threat condition, responses to the hand task were slower, whereas responses to the tone task were quicker, compared with the low-threat condition. The main effect for threat was not significant, $F(1, 22) = 1.71, p = .20, \omega^2 = .17$. The secondary task latency data is presented in Figure 5 (Bottom).

Discussion

This study aimed to test the predictions of the EMH (Beilock & Carr, 2001) and PET (Eysenck & Calvo, 1992) with regards to how performance might be affected in threatening situations when the focus of attention is manipulated. Although the EMH would predict that driving performance should be most degraded in the high pressure, skill-focused condition, PET would predict that driving performance might be maintained under pressure at the expense of processing efficiency.

Cognitive Anxiety

Notwithstanding concerns regarding the efficacy of artificially manipulating cognitive state anxiety in laboratory-based studies (e.g., Mullen & Hardy, 2000), the cognitive state anxiety data supports the effectiveness of the experimental manipulation in elevating worry. Participants reported higher levels of cognitive anxiety in the high-threat as opposed to low-threat conditions. Although they were not prompted, a number of participants reported that it was the thought of letting someone else down that was more threatening than losing the money themselves (cf. Broidy et al., 2003).

Driving Performance

The driving performance results were more supportive of the predictions of PET than the EMH. The participants did not drive significantly slower in the high-threat condition in either of the two dual tasks, or the control (single task) drives (Figure 3). Performance was therefore maintained in the high-threat conditions, despite the participants reporting increased cognitive anxiety. Explicit monitoring accounts could explain performance maintenance in the high-threat distraction (tone recognition) drive, because the tone task would primarily prevent drivers from explicitly monitoring their driving. However, performance maintenance in the other conditions cannot be explained from this perspective. The skill-focused task required participants to attend to an explicit component of the driving task (i.e., the position of their hands on the wheel), so it should have induced explicit monitoring related performance degradation (cf. Jackson et al., 2006). According to the EMH, choking should also have occurred in the control task condition under high threat, as participants lapsed into pressure-induced explicit monitoring (cf. Beilock & Carr, 2001).
Mental Effort

Processing efficiency theory predicts that as well as occupying working memory capacity, worry may also stimulate increases in on-task effort, which may partially or totally compensate for reduced performance effectiveness (Eysenck & Calvo, 1992). The self-reported effort data (Figure 4) indicated that effort was greater in the high-threat as opposed to low-threat conditions. The participants also made significantly more mistakes in both secondary tasks in the high-threat as opposed to low-threat conditions (Figure 5, top). Performance degradation on a secondary task is indicative of more effort being applied to maintaining performance of the primary task (Meshkati et al., 1995). Both these findings therefore support PET’s central prediction that the adverse effects of anxiety on performance effectiveness are often less than those on processing efficiency (Eysenck & Calvo, 1992).

Skill Level Concerns

Even though the driving performance and mental effort results support the predictions of PET over those of the EMH, it is important to consider other potential explanations. In order to test the predictions of the EMH, primary task performance must be sufficiently skilled to require little online attention. It is only when performers are at this skilled level that explicit monitoring is counterproductive (e.g., Beilock et al., 2002). It could be argued that the participants in the current study may not have been sufficiently skilled for the driving task to have become automated. However, the participants were required to reach a performance plateau during training to indicate that learning had stabilized (Figure 2; cf. Hardy, Mullen, & Jones, 1996; Masters, 1992).

Additional support that learning had stabilized was provided by the completion times in the low-threat single task condition during testing (Figure 3). Performance did not continue to improve between the end of training (Figure 2, last drive) and the completion of this condition. If performance was not automated to a degree, learning would have continued to occur during the testing phase and performance in the low-threat single task condition would have improved (cf. Masters, 1992). A paired samples \( t \) test of the two sets of completion times revealed no significant difference, \( t(22) = 0.56, p = .69 \). The lack of improvement in performance time after the break in learning also suggests that the plateau in performance during the training phase was not caused by fatigue. Annett (1989) has suggested that a reminiscence effect should occur if fatigue has caused a performance plateau during learning. This would be evident if performance following rest was better than that at the end of the previous practice period—an effect not shown here.

Secondary Tasks

Primary task performance in low-threat distraction task conditions has also been used as a stricter measure of automaticity (e.g., Jackson et al., 2006). If primary task performance is automated, attention should be available for the processing of secondary task information (Beilock et al., 2002). In the current study, participants performed worse in the distraction task compared with the single task (control) drives, even in the low-threat condition (Figure 3). However, other researchers have been unable to satisfy this criterion, despite efforts to either control learning
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(e.g., Maxwell, Masters, & Eves, 2000), or recruit already trained performers (e.g., Mullen & Hardy, 2000). Maxwell et al. (2000) suggested that if the secondary task adopted is too difficult, primary task performance may be negatively affected.

An estimation of the difficulty of the secondary tasks in this study can be provided by examining the RSME values for when the secondary tasks were carried out alone (see Results). During its development and validation, the RSME was demonstrated as being sensitive to increases in task difficulty and attentional demand (see Zijlstra, 1993). It is hard to assess the difficulty of secondary tasks used in other attentional focus studies, as their resource demands tend not to be analyzed prior to being combined with the primary task. However, the RSME ratings for the secondary tasks in this study (66.7 for the hand task and 72.1 for the tone task) were similar to that of single task driving (RSME rating of 70.0). This score has a verbal label of rather effortful on the scale and is of a similar magnitude to scores reported by pilots performing tasks in a flight simulator (RSME ratings from 60 to 70; Veltman, 2002; Veltman & Gaillard, 1996). The degree of difficulty of the secondary tasks adopted may therefore explain why participants performed worse in all dual-task, as opposed to single-task, conditions.

Whereas the secondary task training data and the RSME scores during the testing period for the concurrent tasks (Figure 4) would support an interpretation that both tasks were equally difficult, drivers made significantly more mistakes in the hand position task as opposed to the tone recognition task (Figure 5, top). The difference in secondary task performance may be explained by a speed-accuracy trade-off effect being present during the testing phase. Participants were quicker in the hand task than in the tone task condition but were correspondingly less accurate (Figure 5). Eysenck (1992) has previously discussed the potential for speed–accuracy trade-off effects to confound results in dual-task studies. A strength of the current study is that by examining response latency, as well as response accuracy, differences in the way in which individuals managed performance of the concurrent tasks can be identified.

Explicit Monitoring

A potential limitation of the current study, and previous studies using this type of dual-task attentional manipulation (e.g., Beilock et al., 2002; Jackson et al., 2006), is that the hand position secondary task may not necessarily have induced a focus on the step-by-step explicit monitoring of performance. As highlighted by Jackson et al., participants are only required to report one feature of their movement in response to a tone. It is possible that participants use an attentional switching strategy, whereby they only focus on hand position upon hearing the tone, and not continually throughout the trial. Although this concern cannot be discounted, the high response accuracy figures and the fact that minimal “misses” occurred in the current study somewhat mitigates this possibility.

A further concern is that skill-focus instructions may also be distracting to primary task performance. Performance decrements in previous studies (e.g., Beilock et al., 2002; Jackson et al., 2006) may have been due to attentional, in addition to explicit monitoring, mechanisms. The current study attempted to limit this disruption by enabling performers to practice all tasks separately during the training phase. Perhaps this early training in monitoring performance may explain
why driving performance was not more disrupted in skill-focused, compared with
distraction, conditions.

Although the tasks were practiced individually, there is a cost associated with managing concurrent task performance, which is in addition to the costs associated with performing the two tasks separately (Barber, 1988). The additive effect of concurrent task performance may change the dynamics of each task in such a way that the combined task is novel, although its constituent parts have been practiced (Meshkati et al., 1995). Jackson et al. (2006) also commented that an explanation for explicit monitoring effects could be the novel fashion by which the task is performed in skill-focused conditions. As negative effects of explicit monitoring are only associated with well-learned performance, future studies should provide the opportunity for extended concurrent task practice before attempting to test the predictions of the EMH.

Research adopting longer practice periods of dual-task performance would perhaps overcome some of the discussed limitations of attentional-manipulation paradigm research. However, it may be questioned to what extent such research can be generalized to the experience of elite performers who choke in real sport settings. As well as concerns over the effectiveness of laboratory-based anxiety manipulations (e.g., Mullen & Hardy, 2000), the dual tasks employed are somewhat contrived and arbitrary. In reality, we know little about what task foci, or changes therein, are really important in producing performance disruption. There is therefore a need for future research to examine attentional and behavioral changes in performers in more ecologically valid tasks, which require less “forced” attention manipulations (see Wilson, Smith, & Holmes, 2006).

Conclusions

The main purpose of this study was to test the predictions of the EMH and PET as they relate to how differences in attentional focus and changes in effort might affect performance in threatening situations. On balance, the results of this study tend to lend greater support to the predictions of PET over those of the EMH. Performance was maintained at the expense of processing efficiency, as indexed by self-reported effort and secondary task accuracy measures. Furthermore, there were no differential effects on performance owing to the type of secondary task carried out. Completing both tasks concurrently with driving caused lap time to increase compared with single-task conditions. Although not discounting the EMH as an explanation of the choking phenomenon, it would appear that PET holds promise as a framework for understanding both the negative and positive influences of anxiety on sporting performance.

References


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