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Effect of Type of Feedback on the Relationship Between State Anxiety and Performance

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Abstract: One purpose of the present study was to examine the effects of feedback on successful versus unsuccessful trials upon the strength and the direction of relationships among components of the Competitive State Anxiety Inventory-2 (CSAI-2) with performance. The second purpose was to determine the relationship between somatic anxiety and the Skin Conductance Level (SCL). On Day 1, participants (n=40; mean age=21.3) performed 60 trials on a golf putting task under one of two conditions: After each block of six trials, group 1 received feedback on the three most accurate trials, whereas group 2 received feedback on the three least accurate trials. One Day 2, participants first completed the CSAI-2 and then performed a retention test without feedback. SCL was recorded constantly during the retention test. The results indicated that type of feedback as a moderator variable affects the strength and the direction of all three relations. Somatic anxiety did not correlate with arousal level, but correlated significantly with arousal variations relative to a baseline level. Theoretical implications of the findings are discussed.

Key words: Type of feedback · Golf putting · CSAI2 · Arousal · Retention · Anxiety

INTRODUCTION

A wealth of research in sport psychology has been devoted to the study of the relationship between anxiety and sport performance [1]. Considerable understanding of this relationship has been achieved through the development of the competitive state anxiety inventory-2 [2] and the subsequent theoretical prediction of multidimensional anxiety theory [2]. The multidimensional anxiety theory describes the relationship between the CSAI-2 subcomponents (cognitive anxiety, somatic anxiety and self-confidence) and performance. According to this theory, there is a series of two-dimensional relationships between cognitive anxiety, somatic anxiety, self-confidence and performance. Cognitive anxiety is viewed as the mental component of anxiety typified by negative expectations of performing a task and cognitive concern [2], while somatic anxiety is conceptualized as the physical component of anxiety. It refers to performers' perceptions of physical arousal changes [1]. Finally, self-confidence is conceived of as one's belief of being able to successfully perform a specific activity [2].

In multidimensional anxiety theory, cognitive anxiety is assumed to have a negative liner relationship with performance; somatic anxiety is hypothesized to have an inverted-U relationship with performance; and self-confidence is hypothesized to have a positive linear relationship with performance [2].

Craft, Magyar, Becker and Feltz (2003) carried out a meta-analysis based on multidimensional approach and suggested that the studies investigating the relationship between anxiety and performance emerged inconsistent results [3]. For example, Burton (1988) asked two samples of elite swimmers to complete the CSAI-2 just prior to the competition [4]. Their findings showed an inverted-U trend between somatic anxiety and swimming performance, a negative linear trend between cognitive anxiety and performance and a positive linear trend between self-confidence and performance. Gould *et al* (1984) found a negative linear trend between cognitive anxiety and wrestling performance but they did not find any significant trend between self-confidence and performance [5]. Conversely, Gould *et al.* (1987) found a significant negative relationship between self-confidence and pistol shooting performance [6]; but they found no significant relationship between cognitive anxiety and performance. Thus, the relative impact of anxiety and self-confidence upon performance remains unclear. Also, LeUnes and Nation (2002) suggested that the relative impact of anxiety and self-confidence upon performance is complex and needs further investigation [7].

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In discussing the relationship between cognitive anxiety, somatic anxiety and self-confidence with performance, Woodman and Hardy (2003) also suggested that the moderating variables such as sex and the level of expertise might influence these relationships [8]. In an attempt to clarify the effects of the moderating variables on the relationships between anxiety and self-confidence with performance, Woodman and Hardy (2003) carried out a meta-analysis [8]. This meta-analysis revealed that the mean effect sizes for cognitive anxiety and self-confidence were significantly higher for men than women and for high-standard athletes than for low-standard athletes. Another meta-analysis study also showed that the relationships depend on type of sport (individual versus team sport) and type of skill (open versus closed sport) [2]. The present study was designed to determine whether the relationships between subscales of CSAI-2, namely cognitive anxiety, somatic anxiety and self-confidence with performance can be affected by the type of feedback and knowledge of results (KR). Since, Amorose and Horn (2000) found that negative feedback, as opposed to positive feedback, results in higher tension-pressure and Woodman and Hardy (2003) found that the subscales of CSAI-2 were more strongly associated with performance in increased pressure conditions, we hypothesized the relationships between subscales of CSAI-2 with performance would differ for different feedback conditions [8, 9].

Furthermore, according to multidimensional anxiety theory, we hypothesized a negative linear relationship between cognitive anxiety and performance, a curvilinear relationship between somatic anxiety and performance and a positive linear relationship between self-confidence and performance [2].

In addition to psychological assessment of anxiety (e.g., cognitive worry, perceived somatic anxiety) and behavioral assessment (effect of anxiety on sport performance), physiological assessments (e.g., muscle tension, palmar sweating) provide further information about the nature of state anxiety [10]. This assessment technique ensures more valid and accurate measures of anxiety [11]. Thus, in the present study, in addition to psychological and behavioral assessment of anxiety, skin conductance level (SCL), as a measure of arousal, was determined. SCL is a sensitive measure of the tonic modulation of sympathetic activity [12] and continues to regard as the "gold standard" in the measurement of arousal [13]. The arousal refers to the phasic physiological changes that occur in the organism as part of the anxiety response [14]. Somatic anxiety refers to performers' perceptions of these physiological changes [15]. Gould *et al.* (1984) suggested that somatic anxiety as assessed by the CSAI-2 and physiological measures of anxiety should increase similarly [5]. Thus, in this study, we predicted a positive correlation between SCL level and somatic anxiety.

MATERIALS AND METHODS

Participants: Participants were 40 female students with a mean age of 21.3 years (SD=2.1). All participants provided informed consent. They had no prior experience with the experimental task and were not aware of our specific study purpose. The experimental protocol was reviewed and approved by the university's Advising Committee of science and Research.

Apparatus, Task and Procedure: The task required participants to putt a golf ball to a target placed on the floor. The circular target had a radius of 5 cm and was placed at a distance of 4 m from the participant. Fourteen concentric circles with radii of 10, 15, 20, 25 ... 75 cm were drawn around the target [16, 17]. The circles were labeled with capital letters. Specifically, the inner circle was labeled A, the next circle B, etc. and the last circle was labeled O. These served as zones to assess the accuracy of the strokes. If the ball came to rest on the target (A), 150 points were awarded. If it ended up in one of the other zones, or outside the circles, 140 (B), 130 (C) .... 10 (O), or 0 points, respectively, were recorded. Even though participants were able to see the path of the ball, it was difficult to see the letter from a distance. In fact, the circles were labeled with letters (A, B, C), which were relatively small. This procedure was used to reduce the redundancy of feedback. Also, two previous studies confirmed that this procedure reduced participants' becoming aware of the trials (good or poor) on which they were given feedback [16, 17].

To assess multidimensional anxiety, the Competitive State Anxiety Inventory-2 (CSAI-2) was used [2]. This 27-item inventory (9 for each subscale) assesses three subscales: cognitive anxiety, somatic anxiety and self-confidence. Athletes are asked to indicate "how you feel right now" for each item on a 4-point Likert scale ranging from "not at all" to "very much so", producing score ranging from 9 to 36 for each subscale. Reliability coefficients for the CSAI-2 subscales ranges from 0.7 to 0.9.

Skin conductance level was recorded from 7.5 mm diameter Ag/AgCl electrodes on the sole of the participant's foot, with an electrolyte of 0.05 M NaCl in an inert viscous ointment base. A constant voltage device (Model 2701SC for SCL/SCR data collection system; UFI, Morro Bay, CA), set at 0.5 V was used to record electrodermal data [14, 18].

Participants were randomly assigned to the "feedback on successful trials" and "feedback on unsuccessful trials" groups. After each block of six trials, participants in the feedback on successful trials group received KR on their 3 best (i.e., most accurate) putts in that block, whereas those in the feedback on unsuccessful trials group received KR on their 3 poorest putts [17-20].

Participants in both groups were informed that, at the end of each block of six trials, they would receive KR on 3 of those trials. However, they did not know for which trials they would receive KR. KR was written on a board and presented to them for a period of 15 s. It consisted of the trial number and respective score. Although circles had been marked with English letters (e.g., A, B, C), participants received quantitative feedback. Participants were aware that scores ranged between 150 and 0. A + or – sign was included with each score to indicated whether the target was overshot or undershot, respectively [17]. All participants performed 60 trials during the practice phase and on the following day they performed a retention test consisting of 10 trials without KR. Participants completed Competitive State Anxiety Inventory-2 (CSAI-2) prior to the retention test. Skin conductance level was also constantly recorded during retention test.

Data Analysis: Pearson correlations were conducted to examine correlations among measures. Also, three scatter plots were made to exhibit performance against cognitive anxiety, somatic anxiety and self-confidence for each group. Using the linear trend, the relationships between self-confidence and cognitive anxiety with performance were examined to determine possible linear trends between performance and self-confidence and between performance and cognitive anxiety. Also, a quadratic trend was used for examining a possible curvilinear relationship between performance and somatic anxiety. In each case, the regression coefficient was obtained. Because the sign of all correlation was predicted, they were tested using one-tailed significance tests.

RESULTS

Correlations among Measures: The relationships between cognitive anxiety and performance ($r_{(18)}$ = -.36 versus $r_{(18)}$ =.14), between somatic anxiety and performance ($r_{(18)}$ = -.35 versus $r_{(18)}$ =.13) and between self-confidence and performance ($r_{(18)}$ =.30 versus $r_{(18)}$ = 0) were stronger for "feedback on unsuccessful trials" group than "feedback on successful trials" group. The "feedback on unsuccessful trials" group showed a few relationship between somatic anxiety and arousal level ($r_{(18)}$ =.12), but was found no relationship between somatic anxiety and arousal level in "feedback on successful trials" group ($r_{(38)}$ = 0).

Linear and Quadratic Trend Analyses: The "feedback on unsuccessful trials" group showed a negative linear relationship between cognitive anxiety and performance ($r_{(38)}$ =.36, p <.05), a inverted-U relationship between somatic anxiety and performance ($r_{(38)}$ =.49, p <.05) and a positive linear relationship between self-confidence and performance ($r_{(38)}$ =.30, p <.05). The "feedback on successful trials" group showed a positive linear relationship between cognitive anxiety and performance ($r_{(38)}$ =.14, p >.05), a U-shaped relationship between somatic anxiety and performance ($r_{(38)}$ =.24, p >.05), but was found no relationship between self-confidence and performance ($r_{(38)}$ = 0).

DISCUSSION

The present study examined whether type of feedback could influence the relationships between subscales of the CSAI2 and performance. The findings demonstrated that the relationships between subscales of CSAI2 and performance were stronger for feedback on unsuccessful trials condition than feedback on successful trials condition. Considering that Amorose and Horn (2000) found that negative feedback, as opposed to positive feedback, results in higher tension-pressure, it may associate with increased pressure in feedback on unsuccessful trials condition [9]. This is in line with recent studies [3, 8] that demonstrated the strength of relationships between cognitive anxiety and performance, between somatic anxiety and performance and between self-confidence and performance enhanced with increased pressure (e.g. high-standard competition versus low-standard competition, open skills versus closed skills).

Surprisingly, the curvilinear relationship between performance and somatic anxiety showed two opposing trends in different groups. The "feedback on unsuccessful trials" group showed the expected inverted-U, but the feedback on successful trials group showed U-shaped relationships between these two variables. Also, the linear relationship between performance and cognitive anxiety showed two opposing trends in different groups. The "feedback on unsuccessful trials" group showed the expected negative linear relation, but the "feedback on successful trials" group showed positive linear relation between these two variables. Finally, the "feedback on unsuccessful trials" group showed the expected positive linear relation between performance and self-confidence, but was found no relationship between these two variables in another group.

The inverted-U relationship between somatic anxiety and performance in "feedback on unsuccessful trials" group is supported by past research, which predicts that athletes perform best when anxiety is moderate and that performance deteriorates when anxiety increases or decreases from this optimal level [4]. The U relationship, contrary to the inverted-U, suggests that the "feedback on successful trials" group have no single level of optimal anxiety leading to maximum performance. Explanation of such different optimal levels of anxiety may require taking into account the subjective interpretation of elevated arousal. Because none of the anxiety models take into consideration the influence of positive and negative feedback on level of optimal anxiety and subjective interpretation of elevated arousal, future research should attempt to discern the influence of type of feedback on level of optimal anxiety and subjective interpretation of elevated arousal.

The different directions of relationships between cognitive anxiety and performance in different groups indicate that cognitive anxiety plays two roles in relation to performance. This result is consistent with processing efficiency theory [21-23], which predicts that worry is the key dimensional in the anxiety response and exerts an effect on performance via two mechanisms. First, a reduction in the storage and processing capacity of the working memory system available for performing the task in hand. This reduction should lead to anxiety-induced decrements in performance. Second, worry signals the importance of the event to the performer and, thereby, serves a motivational function via an increment in on-task effort and activities designed to improve performance. According to this theory, performance can be enhanced, provided the performer is moderately confident of success. Recent study by Badami and colleagues [17], who used a design similar to that used in the present study, found individuals' self-confidence and motivation to be indeed higher when feedback was provided on successful trials (feedback after trials with high accuracy scores), compared to unsuccessful trials (feedback after trials with low accuracy scores). It suggest that under condition of high self-confidence (feedback on successful trials condition), symptoms associated with anxiety were viewed as facilitative to performance as this was suggested to enhance the individuals' levels of motivation. Similarly, the experience of increasing anxiety in low self-confidence condition was reasoned to contribute to a loss in the athletes' concentration. It hypothesis would be more strongly when that Badami *et al* [17] study is taken into account. Findings in that study indicated that retention performance was enhanced when feedback was provided after successful rather than unsuccessful trials.

The present findings indicated that there is a positive relationship between performance and self-confidence in the "feedback on unsuccessful trials" group. This result is line with some previous studies [4, 26, 27, 28]. However, the relationship between performance and self-confidence was not significant in the "feedback on successful trials" group. The most viable explanation for this lack of effect may be related to the individuals' level of self-confidence in this group. The most individuals' level of self-confidence was high. It suggests that beliefs induced through feedback from a coach influence on self-confidence level.

Gould *et al.* (1984) suggested that somatic anxiety as assessed by CSAI-2 and physiological measures of anxiety should increase similarly. Thus, we hypothesized a positive correlation between SCL level and somatic anxiety [5]. However, we found a significant relationship between these two variables. Consistently, Caruso *et al.* (1990) found no insignificant relationships between psychological (subscales of the CSAI2) and physiological (frontalis muscle activity) measures of anxiety [21]. Interestingly, we found a significant relationship between somatic anxiety and activation (or arousal variations relative to a baseline level; Barry, Clarke, McCarthy, Selikowitz, and Rushby, 2005; VaezMousavi, Barry, Rushby, and Clarke, 2007a, 2007b) [14, 24, 25]. In a series of recent studies (Barry, Clarke, McCarthy, Selikowitz, and

Rushby, 2005; VaezMousavi, Barry, Rushby, and Clarke, 2007a, 2007b; 2008) [14, 18, 24, 25] it was demonstrated that task performance is dependent on activation rather than the current arousal level. So, in future experiments, it might be fruitful to examine relationships between activation and psychological measures of anxiety.

In conclusion, the present findings demonstrated that type of feedback as a moderator variable affects the strength and even the direction of all three relations. Since the present design did not induce high levels of anxiety, care needs to be taken in generalizing these results to extremely-arousing situations, such as might be found in competitive sport. So, future research should attempt to discern the influences of positive or negative feedback on the strength and the direction of all three relations within actual competitive settings [29, 30]. Since, Eysenck and Calvo (1992) [23] proposed that anxiety influences upon effort level and processing capacity of the working memory system, it might also be fruitful to assess the effect of type of feedback on effort level and availability of storage and processing resources [23].

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