The relationship between Sport Competition Trait-Anxiety and Frontal EEG Asymmetry

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Introduction

It's well known anxiety affects sport performance and sport learning. Spielberger (1966) proposed the state-trait theory of anxiety which divided anxiety into state and trait anxiety. In his definition, trait anxiety is a motive or acquired behavioural disposition that predisposes an individual to perceive a wide range of objectively nondangerous circumstances as threatening and to respond to these with state anxiety reactions disproportionate in intensity to the magnitude of the objective danger. Competitive trait anxiety is a situation-specific trait anxiety that was defined as the "tendency to perceive competitive sport situations as threatening and to respond to these situations with feelings of apprehension and tension" (Martens, 1977). Accordingly, those individuals with high competitive trait anxiety are more likely to respond with high state anxiety in sport competition, and this response tendency makes these individuals more vulnerable to the debilitating effect of state anxiety. Therefore, a better understanding of competitive trait anxiety will help us dealing with anxiety more effectively.

To know anxiety, we should first understand how anxiety developed in one's mind. According to the psychoanalytical approach, anxiety results from the confliction between individual's ego and id, and which confliction then evoke the inappropriate defense mechanisms to cause syndrome and obstacle in one's body and mind. The development of anxiety is closely connected with the development of defense mechanisms. In order to reduce anxiety, the ego develops so-called defense mechanism, such as repression, regression, denial, postponing, and so on. In the view of learning theory approach, anxiety is a consequence of conditioning, whereas anxiety is viewed as an emotion triggered by a person's expectations and appraisals with environment in cognitive approach. To the physiology approach, it is inheritance to evoke the anxiety tendency. In conclusion, the process of anxiety begin with individual perceive a large number of stimulus from environment and transmit the information to the central nervous system. During the central nervous appraising period, the brain cortex command and execute all kind of activities in psychology, physiology and behavior, while the autonomic nerves, hypothalamus, pituitary gland and immune system mediated to produce physical responds. Then, the physical responds conversely offer feedback to affect the function of nerves system, endocrine system and immune system. The proper functions of this neurocircuitry loop help the organism to adapt and return from disorder and inconsistent situation to normal.

In neuroscience, anxiety is a subjective emotion and the limbic system in brain is the major areas involving in control emotions. The limbic system consists of frontal lob, temporal lob, hypothalamus, amygdale, septum and so on. Among them, the study of the association between the activities in frontal area and emotion receive most attention. According to the frontal asymmetry theory, proposed by Davidson and his colleagues, the anterior regions of the left is specialized for approach behavior and related emotion (e.g., happy and excited), whereas the anterior regions of the right is specialized for withdrawal behavior and related emotion (e.g., anxiety and depressed) (Davidson, 1984). For EEG measurement, baseline or resting levels of activation in the left and right frontal regions constitute a major substrate of individual differences in affective reactivity, and resting anterior EEG asymmetry in the alpha (8-13Hz) frequency band may be a biological marker of emotional predispositions or traits (Tomarken, Davidson, Wheeler, & Kinney, 1992).

Empirically, the frontal EEG asymmetry hypothesis was supported in both infants (Davidson & Fox, 1989) and adults (Davidson & Tomarken, 1989). In another study, Schaffer, Davidson, and Saron(1983) selected subjects on the basis of their scores on the Beck Depression Inventory and compared those stable high scorers with those stable low scorers on resting frontal symmetry. They found that the depressed subjects had less left frontal activation compared with the nondepressed subjects. Furthermore, Fox, Henderson, Rubin Calkins, and Schmidt (2002) found that as early as 9 months of age, there is a physilolgic pattern reflective of the disposition toward sociability and approach in children with frontal asymmetry. Some studies have proved that measures of activation asymmetry based upon power in the alpha band from prefrontal scalp electrodes showed both high internal consistency reliability and acceptable test-retest reliability to be considered a traitlike index. Hagemann, Naumann, Thayer, and Bartussek(2002) used the Latent State-Trait Theory to examine the frontal EEG asymmetry. They suggested that about 40% of the variance of all asymmetry measures was determined by occasion-specific fluctuations and 60% of the manifest variance was due to a latent trait with nearly perfect temporal stability. Therefore, frontal EEG asymmetry could be a trait-like marker that distinguish individual's approach-withdraw related emotion (Tomarken, Davidson, Wheeler, and Kinney, 1992).

A sizable literature, in the past, supports the approach/withdrawal model of frontal EEG alpha asymmetry. Also, it has been reported that frontal asymmetry could be changed by intervention of psychological skills training. Davidson (2003) found that a short program in mindfulness meditation could increase left-frontal activation, reduce anxiety and negative affect. Meditation could also increase the influenza vaccine antibody titers. As mentioned above, persons high in competitive trait anxiety tend to perceive more situations as threatening, respond with withdrawal-related emotion (e.g., worry, nervous, fear). This kind of behaviour and emotion seems have high association with approach-withdrawal theory. In this study, we plan to examine the relation between frontal asymmetry and sport competition anxiety using the frontal asymmetry hypothesis. We believe that this study not only can help us understand trait anxiety better but also can provide us with intervention strategy. The aim of this study is to investigate the correlation between resting EEG frontal approach/withdrawal affective system and sport competition trait anxiety.

Methods

Participants. Forty-one participants were selected from a pool of 540 college athletes representing a variety of sport based on their score on the Sport Competition Anxiety Test. Twenty-two of them score within the first quartile and nineteen score within the last quartile.

Procedure. EEG activity was obtained with monopolar recordings using an electrode-cap at 11 electrode sites(Fz,F3,F4,T3,T4,Cz,Pz,P3,P4,O1,O2), referenced to linked earlobes, with a Fpz ground and impedances at 10 kΩ or less. EOG activity was assessed with bipolar recording of two electrodes placed at the outer canthus and supraorbitally to the dominate eye. All participants were assessed individually on two occasions of measurement each separated by one week. EEG was recorded during 12 1-min resting baseline periods, six with eyes open and six with eyes closed. There was a 1-min break after four subsequent baseline recordings. On the first occasion of measurement, each participant was randomly assigned to one of two counterbalanced orders of the eyes open (O) and eyes closed (C) conditions (OCCO-COOC-OCCO or COOC-OCCO-COOC). On the second occasion, the other eyes order was applied. Asymmetric activation was indexed using an asymmetry score that is computed by subtracting log-transformed left hemisphere 〔alpha〕-power densities from the comparable measure derived from homologous right-sided electrodes.

Result

The difference between the frontal EEG asymmetry for the high competitive anxiety group and the low competitive anxiety group was not significant. Neither left-frontal α nor

the right-frontal α are significantly different. (see Table 1)

Table 1. Comparisons of Frontal EEG Asymmetry of High competitive anxiety (n=20) and Low competitive anxiety (n=19)

Measure	High competitive anxiety group	Low competitive anxiety group	*t*	*p*
Frontal EEG asymmetry	.04±.13	.01±.13	-7.52	.46
Left-frontal α	2.63±.55	2.78±.65	.78	.44
Right-fronatl α	2.70±.55	2.79±.69	.60	.55

$^{*}p < .05$

Discussion

The present study is to examine the relationship between sport competition trait anxiety and frontal EEG asymmetry. Comparison of the left-frontal α, right-frontal α and frontal asymmetry between high competitive trait anxiety group and low competitive trait anxiety group revealed no significant difference. We speculated the reason for the results were as follow.

First, the reason for the results may be the discrepancies between trait anxiety and sport competition trait anxiety. The frontal asymmetry could be a general trait marker, but not a sport competition trait anxiety marker. Petruzzelo & Landers (1994) and Tomarken & Davidson (1994) found a positive relation between trait and relative right-sides activation. However, the present study found no relationship between sport competition trait anxiety and frontal activities. We inferred that trait anxiety and sport competition trait anxiety may be different in nature. In related general trait anxiety scales and sport competition trait anxiety scale researches, Levy (1958); Sarason, Davidson, Lighthall, Waite, and Ruebush (1960), and Spielberger (1973) all found that in children's version general anxiety inventories yield low to moderate positive correlations with SCAT(r=.28-.46). Similar finding were shown in study of the scales for adult , Spielberger, Gorsuch, and Lushene (1970); Spielberger (1973) and Ostrow and Ziegler (1978) also found that general anxiety inventories yield low to moderate positive correlations with SCAT(r=.41-.44). In the personality inventories domain, the correlations between general trait anxiety and self-esteem showed also low or no relation at all (Passer, 1983; Eidson, 1997). The implications of these researches confirmed that general trait anxiety and sport competition trait anxiety are indeed different. The sport competition anxiety cannot predict the frontal asymmetry which represents the general trait

Secondly, the unexpected outcome may come from the variety of experiment situation. Hagemann, Naumann, Thayer, and Bartussek (2002) suggested that about 40% of the variance of all asymmetry measures was determined by occasion-specific fluctuations and 60% of the manifest variance was due to a latent trait with nearly perfect temporal stability. In the process of the experiment, the place for athletes to fill out the scale were not the same, prior to the EEG recording objects faced different situation that may evoked different emotion to cause the occasion-specific fluctuations higher than a latent trait, all this may influence the outcome of the study. We suggested that if future related study can't control the situation properly, the issue of state fluctuation would still exert an influence on trait frontal EEG asymmetry.

Conclusion

Comparison of the left-frontal α, right-frontal α and frontal asymmetry between high competitive trait anxiety group and low competitive trait anxiety group revealed no significant difference. This finding may be attributed to the difference between the general trait anxiety and the sport competition anxiety. We speculate a higher association between the frontal asymmetry and the more general trait than the situation specific sport competition trait

anxiety.

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