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Neuroticism predicts resting frontal EEG asymmetry variability

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Abstract

Research has shown that high levels of neuroticism (i.e. emotional lability) are related to emotional upset, sensitivity to negative affect, and worry. In addition, previous studies have found conflicting evidence that right frontal hemispheric activation is related to neuroticism/negative affect. Accordingly, this study investigated the relation of neuroticism to variability in frontal asymmetry within college students in the attempt to better understand the relation between frontal asymmetry and neuroticism. As predicted, higher levels of neuroticism were associated with greater mid-frontal asymmetry variability. This finding may explain, in part, why researchers have reported inconsistent results regarding the relation of neuroticism to right frontal activation and provide a novel measure that may be helpful in predicting and identifying related psychopathology.

Keywords: Neuroticism; EEG asymmetry; EEG variability; Anxiety; Negative affect

1. Introduction

Neuroticism (N) is an extremely robust personality trait (Zuckerman, Kuhlman, Joireman, Teta, & Kraft, 1993) that has been associated with an increased sensitivity to fear, anxiety, and distress. Those who score high on neuroticism scales have been described as more ''labile,'' possessing more negative affect than their ''stable'' counterparts (Hagemann, Naumann, Lurken, Becker, Maier, & Bartussek, 1999). These individuals are more responsive to emotional stimuli and possess a low threshold for negative affect (Smith, Kline, Lingren, Ferro, Smith, & Nespor, 1995). Studies have shown that items tending to load highly on neuroticism include emotional upset, tension, worry, and obsessive indecision (Zuckerman et al., 1993), similar to trait anxiety. Neuroticism appears to be a construct related to many forms of psychopathology, including

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mood and anxiety disorders (Clark & Watson, 1991a). It is composed of several facets, including anxiety, hostility, depression, self-consciousness, impulsiveness, and vulnerability.

Not surprisingly, neuroticism (N) and negative affectivity (NA) have been shown to correlate highly across numerous samples (Hagemann et al., 1999; Watson & Clark, 1992), such that NA comprises a central and organizing feature of N. Abbreviated as NA/N, this factor has been described as a "general distress factor" that is stable and heritable (Clark, Watson, & Mineka, 1994). In the Tripartite model of anxiety and depression (Clark & Watson, 1991b), NA/N is posited to be a general factor that is associated with high levels of both anxiety and depression (Clark & Watson, 1991a). Other researchers have investigated the relation between these personality constructs and psychophysiological measures, including hemispheric asymmetry in the electroencephalogram (EEG).

The literature on frontal asymmetry has undergone a substantial metamorphosis since its inception. What began as a theory of positive and negative emotion (valence model) has evolved in the face of data to a motivational model pertaining to behavioral approach and behavioral withdrawal (see Davidson, 1995; Davidson, Jackson, & Kalin, 2000). Positive emotions, as well as negative yet approach-related emotions are typically associated with relative left-frontal and anterior-temporal activity,[1] while negative, withdrawal-related emotion has been associated with higher relative activity of the right frontal and anterior-temporal regions (Ahern & Schwartz, 1985; Davidson, 1995; Harmon-Jones & Allen, 1997; Heller, 1990; Tomarken, Davidson, & Henriques, 1990).

A substantial portion of the EEG research has focused on the hypothesis that resting anterior asymmetry relates to a stylistic tendency toward emotional reaction that is present during infancy and early childhood (Davidson & Fox, 1989; Fox et al., 1995). Anterior asymmetries recorded during baseline conditions have been used to predict emotional responses and have been correlated with personality traits. In addition, left frontal activity has been associated with personality factors related to decreased vulnerability to depression (Harmon-Jones & Allen, 1997; Kline, Allen, & Schwartz, 1998; Kline, Blackhart, & Schwartz, 1999; Tomarken & Davidson, 1994), whereas relative left frontal hypoactivity has been associated with increased vulnerability to depression (Davidson, 1995; Henriques & Davidson, 1990). Based on the literature linking N with NA and measures of depression, one might predict that N would also be associated with relative right-frontal activation. However, investigators have reported inconsistent results in this area.

In general, studies within the normal population have not been particularly successful in linking N with psychophysiological measures of activation (see Eysenck, 1990, for a review). Kline, Blackhart, and Joiner (2002) found no correlation between N and frontal asymmetry. However, right hemisphere lesions have been associated with higher levels of N, suggesting that N might be related to the under-activation of the right hemisphere (Flor-Henry, 1969). This is consistent with another study that reported an association between N and a relatively less activated right hemisphere (Gale, Edwards, Morris, Moore, & Forrester, 2001). These findings contradict the general

[1] Alpha power has been found to be inversely related to the activation of the corresponding region of the brain, anterior alpha asymmetry measurements tend to reflect relative differences in activation between the left and right hemispheres (Davidson, 1995). As such, we use the term "activation" throughout this manuscript to refer to decreases in alpha power. "Relative activation" refers to a situation wherein activation in one hemisphere is greater than in the homologous region of the other hemisphere. For example, "relative left frontal activation" refers to less alpha in a left than in a homologous right frontal electrode site.