



## The influence of emotional intelligence and perfectionism on Error-Related Negativity: An event related potential study



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### ABSTRACT

In the present study, we examined group differences in Error-Related Negativity (ERN) based on perfectionism and emotional intelligence (EIQ). ERN is an ERP component that is generated in the anterior cingulate cortex and peaks 60–150 ms after making an error response on a task. The amplitude of the ERN after making a mistake reflects individual differences in emotional traits and performance concerns. Past researchers have found that participants higher in perfectionistic doubts displayed larger ERN amplitudes; however, researchers have not yet differentiated between type of perfectionism (i.e., adaptive or maladaptive) in relation to ERN. Additionally, previous researchers have found affective processes are reflected in ERN, but have not yet examined whether differences in ERN could be influenced by EIQ. Participants in the present study were 34 adults who responded to surveys and completed a computerized ERN paradigm utilizing a flanker task while neural activity was recorded using EEG. The paradigm was designed to elicit a high error rate, thereby allowing capture and measurement of the ERN component. ANOVA results indicated maladaptive perfectionists had the greatest negativity, followed by adaptive perfectionists, followed by nonperfectionists. ANOVA results indicated individuals with high EIQ had lower ERN than individuals with low EIQ.

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### 1. Introduction

Error-Related Negativity (ERN) is a neural component of electro-physiological event-related potential (ERP) recordings that is generated by the anterior cingulate cortex after an individual makes an error on a task. The anterior cingulate cortex is a well-known cortical source of self-monitoring and emotional regulation that occurs about 60–150 ms after an error-response. Larger ERN amplitude has been related to negative mental health outcomes, including anxiety and depression (Chiu & Deldin, 2007; Weinberg, Olvet, & Hajcak, 2010). Other studies have supported a relationship between ERN amplitude and affective traits; adaptive affective traits have been associated with lower ERN whereas maladaptive traits have been associated with larger ERN (Boksem, Tops, Koster, & De Cremer, 2008).

There is still much to be understood about the specific cognitive and affective processes that affect ERN. Specifically, since the ERN is tied to self-monitoring of task-performance and to emotional regulation processes, we seek to examine if positive factors (i.e., EIQ) can attenuate the ERN and if negative factors (i.e., maladaptive perfectionism) increase ERN. While EIQ and perfectionism have been linked to affective and cognitive processes and mental health outcomes, we were unable

to find any researchers who examined these variables as they relate to ERN.

Previous researchers have studied ERN as a mechanism of cognitive control called action monitoring, which is a process of making behavioral adjustments when a conflict or error is detected (Schrijvers, De Bruijn, Destoop, Hulstijn, & Sabbe, 2010). Issues with action monitoring have been related to depression and anxiety (Schrijvers et al., 2008). In addition, the anterior cingulate cortex in which the ERN is generated, has been found to be hyperactive in individuals with anxiety, suggesting that dysfunction in this area may be related to the development of anxiety disorders (Malizia, 1999).

ERN has also been linked to motivational and evaluative processes. For example, researchers have found that ERN amplitude is higher when errors are more personally significant or when participants are more certain that they made a mistake (Hajcak, Moser, Yeung, & Simons, 2005). These evaluative processes may be reflected differently in ERN for individuals with higher perfectionistic doubts; maladaptive perfectionists have been found to be hypervigilant in their concerns for outcomes of events and may selectively attend to experiences of failure (Shafraan, Cooper, & Fairburn, 2002). Past researchers have found that participants higher in perfectionistic doubts about their actions displayed larger ERN amplitudes than those lower in perfectionistic doubts (Schrijvers et al., 2010). However, researchers have not differentiated between types of perfectionism (i.e., adaptive, maladaptive) and

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nonperfectionism when examining ERN, and there are likely differences between these three types regarding their emotional and mental reactions to mistakes.

EIQ may be an aspect of action monitoring, as the ERN signal reflects emotional processes (Pailing & Segalowitz, 2004). EIQ has been positively correlated to amplitudes of the P1, P2, N2, and P3 ERP components after the presentation of emotion-related stimuli, indicating individuals with higher EIQ devote more neural resources to processing emotional stimuli (Raz, Dan, & Zysberg, 2014). However, EIQ has not yet been studied in relation to ERN. We postulate that EIQ is related to the emotional processes involved in ERN, because it has been found to act as a buffer against experimentally induced negative states (Schutte, Malouff, Simunek, McKenley, & Hollander, 2002).

Understanding the emotional and evaluative processes that are related to ERN may help us understand the neurological sources of negative affect that contribute to psychiatric disorders. Therefore, the purpose of this study is to utilize ERP techniques to understand the effects of perfectionism and EIQ on ERN. Understanding how perfectionism and EIQ relate to ERN will enhance our understanding of the implications of ERN for emotional and evaluative processing and inform clinical diagnosis and treatment.

### 1.1. Perfectionism

Slaney, Rice, Mobley, Trippi, and Ashby (2001) described perfectionism as a multidimensional construct consisting of two factors: standards and discrepancy. The first factor involves setting high personal standards. This factor is considered to be adaptive and motivational, and is linked to subjective well-being. The second factor is defined as the discrepancy between one's performance and unrealistically high expectations. This factor is considered to be maladaptive because psychological distress is caused by individuals' perceptions of not meeting their own standards (Slaney et al., 2001). According to Slaney et al.'s (2001) definition, Rice, Richardson, and Tueller (2014) conceptualize that maladaptive perfectionists have high standards and high discrepancy, adaptive perfectionists have high standards and low discrepancy, and nonperfectionists do not have elevated scores on the standards subscale.

Adaptive perfectionism is related to positive mental health outcomes and well-being, whereas maladaptive perfectionism is correlated with psychological distress (Öngen, 2009). Adaptive perfectionists set healthy, high, achievable personal standards without having excessive self-criticism. Maladaptive perfectionism has been linked to a wide range of problems in children and adolescents, including academic underachievement, depression, suicidal ideation, and anxiety (Hewitt et al., 2002).

Few studies have examined perfectionism in relation to ERP outcomes. In one ERP study, researchers found larger ERN amplitudes for perfectionists who were high in both evaluative concern perfectionism (ECP), related to worry about being poorly evaluated, and personal standard perfectionism (PSP), related to intrinsic motivation for error-free performance. Smaller ERN amplitudes were found for perfectionists who were high in ECP and low in PSP (Stahl, Acharki, Kresimon, Völler, & Gibbons, 2015). While this study examined facets of perfectionism similar to the discrepancy and standards factors of maladaptive and adaptive perfectionism, no studies have specifically looked at adaptive and maladaptive perfectionism in relation to ERN.

We posit that making mistakes will elicit stronger negative reactions, as exhibited by ERN, in individuals who bear the traits of maladaptive perfectionism, as these individuals have more difficulty coping with making mistakes because of the discrepancy between their performance and high standards. The discrepancy between perceived standards and performance is thought to be the key factor related to higher levels of depression and anxiety and lower self-esteem and life satisfaction in maladaptive perfectionists (Rice, Ashby, & Gilman, 2011). Achtziger and Bayer (2013) studied perfectionism and stress in

college students and found that high discrepancy was related to higher levels of stress. High discrepancy may be related to poorer coping strategies in general, as maladaptive perfectionists (in comparison to nonperfectionists or adaptive perfectionists) have higher anxiety due to a fixation on a fear of making mistakes (Schuler, 2000), as well as a greater difficulty coping when mistakes are made (Rice & Richardson, 2014). Researchers have found that maladaptive perfectionists may exhibit avoidant coping and poor emotion regulation that ultimately may lead to negative affect and poor emotional adjustment (Rice & Richardson, 2014).

### 1.2. Emotional Intelligence

Salovey and Mayer (1990) have conceptualized emotional intelligence (EIQ) as a subset of social intelligence, which overlaps with Gardner's (1983) intrapersonal intelligence. Salovey and Mayer's conceptualization of EIQ consists of the ability to verbally and nonverbally appraise one's own and others' emotions, regulate one's own emotions, and use emotions to solve problems. EIQ has demonstrated significant correlations with mental health, psychosomatic health, and physical health (Schutte, Malouff, Thorsteinsson, Bhullar, & Rooke, 2007), as well as greater positive affect, life satisfaction, optimism, and self-esteem, and lower negative affect (Schutte et al., 2002). While EIQ has yet to be studied in its relationship to ERN, it has been positively associated with adaptive coping styles, and negatively associated with maladaptive coping styles (Mavroveli, Petrides, Rieffe, & Bakker, 2007). We can extrapolate from these findings to consider adaptive and maladaptive perfectionism in relation to ERN, and past research supports the relationship between EIQ and adaptive emotion regulation processes (Feldman Barrett & Gross, 2001).

We posit that EIQ is related to the emotional processing involved in ERN, and acts as a buffer against negative reactions to making mistakes, as it has been related to adaptive coping and emotion regulation abilities during stressful tasks. Research supports that EIQ is related to lower subjective experiences of stress in individuals (Slaski & Cartwright, 2003) and lower emotional reactivity in experimentally induced stressful situations (Mikolajczak, Luminet, Leroy, & Roy, 2007). Schutte et al. (2002) found that individuals with higher EIQ reported less of a decrease in positive mood and self-esteem after a negative state induction and showed more of an increase in positive mood, but not self-esteem, after a positive state induction. In addition, Mikolajczak and Luminet (2008) found that higher EIQ was related to greater self-efficacy to cope and appraise a stressful experimental task as a challenge rather than as a threat. These results indicate that those with higher EIQ may be less reactive to negative events, as they may be better able to cope and maintain positive emotions when faced with stressors.

### 1.3. EIQ and perfectionism

We sought to study EIQ and perfectionism together because we wanted to assess a factor we predicted would decrease ERN (i.e., EIQ) and a factor we predicted would increase ERN (i.e., perfectionism). Researchers have recently found evidence suggesting individuals with lower EIQ may have higher perfectionistic concerns (Smith, Saklofske, & Nordstokke, 2014). We sought to build on the seminal work of Smith and colleagues by examining neural correlates of EIQ and perfectionism and, although their findings were based on perfectionism as a continuous variable, we sought to determine in the present study whether we might find a similar effect regarding group differences between individuals categorized as maladaptive perfectionist, adaptive perfectionist, or nonperfectionist. EIQ encompasses an examination of emotional management, which is a necessary element regarding the extremity of response when a person makes an error on a task. EIQ thus may also be an important attribute in understanding how individuals

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