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Personality and Individual Differences 41 (2006) 685–695
PERSONALITY AND INDIVIDUAL DIFFERENCES
www.elsevier.com/locate/paid

Emotional abilities and cortical activation during emotional information processing

H. Harald Freudenthaler *, Andreas Fink, Aljoscha C. Neubauer

Department of Psychology, University of Graz, Universitaetsplatz 2/III, A-8010 Graz, Austria

Received 6 September 2005; accepted 16 February 2006
Available online 4 May 2006

Abstract

In the physiological study of cognitive intelligence there is sound evidence of a more efficient use of the brain in brighter individuals (the neural efficiency hypothesis). However, scarcely anything is known with respect to physiological correlates of emotional abilities. To overcome this limitation, we analyzed the relationship between interpersonal emotional management abilities (EMA) and the extent of event-related desynchronization (ERD) in the EEG during the performance of an emotional face processing task (and a control task) in a sample of 65 participants (31 males, 34 females) with low ($n = 31$) versus high ($n = 34$) emotional management abilities. In the emotional face processing task (judging the equivalence of two simultaneously presented facial emotions), significant ERD-differences between the EMA-groups (with a larger amount of ERD in the low versus high EMA-group) were found in both sexes. In the control task (requiring participants to judge the equivalence of the faces' sex without considering their emotional expressions), an inverse EMA-activation relationship was found only in men, but not in women. Overall, the results indicate that the neural efficiency phenomenon is not restricted to the cognitive ability domain but might also play an important role in the emotional ability domain.

Keywords: Emotional intelligence; Emotion perception; Neural efficiency; EEG; ERD

* Corresponding author. Tel.: +43 316 380 8532; fax: +43 316 380 9811.
E-mail address: heribert.freudenthal@uni-graz.at (H.H. Freudenthaler).

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doi:10.1016/j.paid.2006.02.016

1. Introduction

The study of individual differences in human mental abilities has become a matter of particular interest inasmuch as technological improvements allow for looking at the brain when engaged in performing cognitively demanding tasks. In this context, physiological measurement methods like EEG, PET or fMRI have produced sound evidence of a more efficient use of the cortex (or even the brain) in brighter as compared to less intelligent individuals (e.g., Haier et al., 1988; Neubauer, Freudenthaler, & Pfurtscheller, 1995).

Evidence in favour of this relationship (*neural efficiency*) comes for the most part from EEG studies which analyze the event-related desynchronization (ERD) of electro-cortical activity in the EEG (for review see Neubauer & Fink, 2005). In this context, research has shown that *neural efficiency* (i.e., inverse IQ–brain activation relationship) is more likely related to fluid rather than crystallized abilities (Grabner, Fink, Stipacek, Neuper, & Neubauer, 2004; Neubauer & Fink, 2003). More recently, we found that the magnitude of the IQ–brain activation relationship is highest when considering visuo-spatial IQ in males and verbal IQ in females (Neubauer, Grabner, Fink, & Neuper, 2005), herewith suggesting that neural efficiency varies with the specific ability domain.

Scarcely anything is known with respect to neural efficiency in the emotional ability domain, which has become a hot topic in the scientific literature in recent years. Several conceptualizations of emotional intelligence (EI) have been proposed, which can be divided into "ability or information processing models" and "mixed or trait models" (cf. Neubauer & Freudenthaler, 2005).

Mixed or trait-based models regard EI as a trait within the framework of personality and allow for a broad combination of diverse cognitive, personality, motivational, and affective attributes under the umbrella term EI. This approach relates EI to typical performance and tends to rely on self-report measures (e.g., Bar-On, 1997; Schutte et al., 1998).

In contrast, the ability approach upholds a cognitive view of EI and separates it from personality traits. According to Mayer and Salovey (1997), EI represents a collection of emotion-related abilities that can be divided into four hierarchically arranged branches (i.e., perception of emotion, emotional facilitation of thought, understanding emotions, and reflective regulation of emotions). The lowest branch (perception of emotion) involves the most basic input processes, which are necessary for the further processing of emotional information in order to solve problems. The highest branch (reflective regulation of emotions) which comprises the most advanced skills (i.e., managing emotions in oneself and others), represents an interface of motivational, emotional, and cognitive factors that must be recognized and balanced in order to manage and cope with feelings successfully (Mayer, Salovey, Caruso, & Sitarenios, 2001).

Moreover, a cognitive view of EI suggests that its components should be operationalized by maximum-performance techniques (e.g., Mayer, Caruso, & Salovey, 1999; Mayer, Salovey, Caruso, & Sitarenios, 2003).

Regarding the construct validity, both self-report and performance-based EI-measures tend to have satisfactory internal reliabilities (e.g., Mayer et al., 2003; Schutte et al., 1998). Additionally, performance-based measures provide some evidence for their convergent and discriminant validity (e.g., Freudenthaler & Neubauer, 2005; O'Connor & Little, 2003; Roberts, Zeidner, & Matthews, 2001). In contrast, self-report measures showed no correlations with cognitive intelli-