Personality and Individual Differences 65 (2014) 75–80

Contents lists available at ScienceDirect

Personality and Individual Differences

journal homepage: www.elsevier.com/locate/paid

Trait Meta-Mood, gender and EEG response during emotion-regulation

Aliya A. Tolegenova [a], Almira M. Kustubayeva [a], Gerald Matthews [b,*]

[a] Al-Farabi Kazakh National University, Almaty, Kazakhstan
[b] University of Central Florida, Orlando, United States

ARTICLE INFO

Article history:
Available online 20 February 2014

Keywords:
Emotional intelligence
EEG
Emotion regulation
Fear induction
Reappraisal
Suppression

ABSTRACT

Effective emotion-regulation is central to emotional intelligence. Relationships between the Trait Meta-Mood Scale (TMMS) and wellbeing may reflect individual differences in the strategies used for regulating negative emotions. The present study ($N = 136$) manipulated emotion-regulation strategy during viewing of a fear-inducing film clip. EEG response was assessed across five frequency bands in reappraisal, suppression and control conditions. The TMMS predicted higher power in theta and gamma bands, a pattern of response that may represent directed attention to emotional processing. Gender differences included elevated theta in females in the reappraisal condition, but effects of gender and Trait Meta-Mood appeared to be dissociable.

1. Introduction

One of the primary functions attributed to emotional intelligence (EI) is emotion regulation (Wranik, Barrett & Salovey, 2007). More emotionally intelligent individuals should be better able to recognize and understand their emotional states, and to modify them to support their current goals. The broad tendency for EI to be associated with a variety of measures of emotional wellbeing and adaptive coping is consistent with this hypothesis (Zeidner, Matthews, & Roberts, 2012). Scales for EI correlate with self-report measures of emotion-regulation (Mikolajczak, Nelis, Hansenne, & Quoidbach, 2008), but rather little research has addressed the relationship between EI and specific emotion-regulation processes. Gross (2002) discriminated several strategies that support emotion-regulation, including reappraisal and suppression of emotions. The aim of the present study was to use electroencephalographic (EEG) methods to determine whether relevant facets of EI are associated with the neural processes underpinning emotion-regulation.

EI refers to a multitude of constructs that are only loosely related (Matthews, Zeidner & Roberts, 2002). Emotion-regulation may be supported by both ability EI, especially objective emotion knowledge (Wranik et al., 2007), and personality factors described as 'trait EI'. The present study focused on a trait EI measure, Salovey, Stroud, Woolery, and Epel's (1995) Trait Meta-Mood Scale (TMMS), because it assesses three facets of EI that are directly associated with emotion-regulation. The first is *attention*; regulating emotion requires that the person is aware of their emotional experience. Next is *clarity*, referring to discriminating and understanding one's different emotions clearly. The third aspect is *repair*, being able to change one's emotional state constructively, for example, through reappraisal. The TMMS is quite effective in predicting scales for wellbeing and coping (Extremera, Salguero, & Fernández-Berrocal, 2011; Matthews & Fellner, 2012; Zeidner et al., 2012). Salovey, Mayer, Goldman, Turvey, and Palfai (2002) found that the TMMS was associated with reduced psychophysiological reactivity to laboratory stressors, assessed using cortisol and blood pressure response, with attention being the most predictive subscale. The TMMS also has the advantage of being only moderately correlated with the Big Five traits (e.g., Bastian, Burns, & Nettelbeck, 2005). However, with a few exceptions (Salovey et al., 2002), the validation evidence for the TMMS is limited by its reliance on self-report criteria.

We based this study on Gross's (2002) theory of emotion-regulation for three reasons. First, the theory specifies different regulative strategies in terms of information-processing model. *Reappraisal* is a strategy that modifies the encoding of an emotive stimulus, typically towards constructing a more positive meaning. By contrast, *suppression* operates later in processing, following extraction of meaning, such that the person attempts to inhibit behavioral expressions of emotion. Consistent with the Gross (2002) theory, use of reappraisal tends to be related to mental health, and suppression to psychopathology (Nolen-Hoeksema, 2012). Second, building on Lazarus' (1966) early work on appraisal and emotion, Gross and his colleagues have developed methods for manipulating strategies experimentally. Thus, we could test

* Corresponding author. Address: Institute for Simulation and Training, University of Central Florida, Orlando, FL 32826, United States. Tel.: +1 (407) 882 0119.
E-mail address: gmatthews@ist.ucf.edu (G. Matthews).

http://dx.doi.org/10.1016/j.paid.2014.01.028
0191-8869/

whether EI moderated responses to experimentally-induced regulative strategies.

Third, studies have addressed the neuroscience of emotion regulation. Brain imaging studies (Buhle et al., 2013) suggest that reappraisal is supported by cognitive control regions, including lateral areas of prefrontal cortex, and lateral temporal cortex. Reappraisal may then actively modify semantic representations of emotional stimuli, leading to changes in emotional experience via modulation of activity in the amygdala (Buhle et al., 2013). The neural bases of suppression have been much less researched (see Ochsner, Silvers, & Buhle, 2012).

Reappraisal has also attracted more attention than suppression in EEG studies. Reappraisal instructions tend to elevate the late positive potential (LPP) evoked response, and to suppress event-related frontal alpha, especially in the left hemisphere (Parvaz, MacNamara, Goldstein, & Hajcak, 2012). The lateralization may reflect verbal mediation of reappraisal. Dennis and Solomon (2010) suggested a capability model of frontal EEG. Individual differences in response reflect the interaction between the emotional demands of a specific situation and the person's capabilities for regulation. Dennis and Solomon (2010) used film clips to induce emotion. Individual differences in change in frontal alpha, relative to a baseline measure, were associated with attentional interference, taken as an index of emotional dysregulation. This experimental methodology is straightforward to adapt to examine effects of EI on multiple spectral bands of the frontal EEG response.

Studies of EI and EEG have focused mostly on evoked responses to emotive stimuli. Jaušovec and Jaušovec (2005) and Jaušovec and Jaušovec (2010) showed that an ability test for EI predicted greater event-related gamma activity, together with upper alpha desynchronization, during an emotion perception task. Freudenthaler, Fink, and Neubauer (2006) obtained a similar result for event-related alpha, and Aftanas and Varlamov (2007) found elevated alpha response in alexithymics exposed to emotive films. Trait EI measures, including the TMMS, are positively associated with amplitudes of P2 and P3 evoked potential components during processing of emotive stimuli, suggesting heightened attention (Raz, Dan, Arad, & Zysberg, 2013). These effects may reflect individual differences in elaborative emotional information processing, which may support cognitive reappraisal of emotional stimuli. Studies of event-related responses demonstrate that EI is associated with immediate stimulus processing. However, efforts at mood-regulation are often more protracted in time, lasting for minutes or longer. Also, the target of emotion-regulation is often internal affective states rather than external stimuli, so that it is difficult to examine the event-related response. Thus, the present study assessed EEG continually during exposure to a fear-inducing film clip.

We also aimed to investigate gender differences in emotion-regulation capability, as indexed by the EEG. Typically, both ability and trait EI measures show higher mean scores for females, although gender differences vary across different facets of trait EI (Fernández-Berrocal, Cabello, Castillo, & Extremera, 2012). On the TMMS, only the attention scale reliably shows female superiority (Bastian et al., 2005; Thompson, Waltz, Croyle, & Pepper, 2007). Gender differences in both emotion-regulation and in regulative brain activity are complex. Gross, Richards, and John (2006) found only limited gender differences in regulation. More recent research (Nolen-Hoeksema, 2012) shows that women report higher usage of reappraisal (along with various other regulative strategies), but there is no reliable gender difference in suppression.

Studies of the EEG also suggest that gender may play a role in both EI and emotion-regulation, but findings are somewhat inconclusive. For example, Parvaz et al. (2012) failed to find any gender difference in LPP and frontal alpha responses to cognitive reappraisal. Jaušovec and Jaušovec (2010) reported complex gender differences in their studies of EEG responses evoked by processing emotive stimuli. They found that relationships between both cognitive and emotional intelligences and EEG may vary with gender. They also reported evidence for higher early gamma amplitude in females, a finding they attribute to enhanced early visual processing of emotion in females. Thus, it remains unclear whether gender differences in emotion-regulation, where found, can be attributed to higher EI in females.

The aim of the current study was to investigate whether the TMMS and gender predicted frontal EEG response to reappraisal and suppression emotion-regulation strategies. Following baseline recording, participants viewed a fear-inducing clip from the film, the 'Silence of the Lambs'. Three participant groups were instructed to use one of the two strategies, or no instruction was given (control group). It was hypothesized that the mood-repair subscale of the TMMS would predict EEG response, given that mood-repair refers to active management of emotive state. It was further hypothesized that mood-repair would predict EEG during reappraisal, because this strategy is more effective in up-regulating a negative mood than is suppression (Gross et al., 2006). Previous studies of evoked responses have most commonly implicated alpha activity in emotion-regulation (e.g., Parvaz et al., 2012), but theta and gamma bands are also sensitive to cognitive processing of emotive stimuli (Aftanas & Varlamov, 2007; Balconi & Pozzoli, 2009; Jaušovec & Jaušovec, 2010). Given the inconsistency of previous findings, we did not make specific predictions of gender differences. We aimed to test the extent to which females showed EEG responses similar to those associated with higher EI, as assessed by the TMMS.

2. Method

2.1. Participants

136 participants, 71 females and 65 males, were recruited from different Universities in Almaty, Kazakhstan, via advertisement. Their ages ranged from 18 to 27 years. Participants were required to be fluent in Russian, to have no history of psychiatric and medical disorders, and to have normal or corrected-to-normal vision. They were randomly allocated to one of three experimental groups: control (i.e., no instruction), reappraisal or suppression instruction. All participants provided written informed consent according to the procedures of the Ethics Committee of the Kazakh National Medical University.

2.2. Questionnaire

The 30-item TMMS (Salovey et al., 1995), in Russian translation, was completed prior to EEG recording. The TMMS includes three subscales: (1) attention to emotion (e.g., "I often think about my feelings"); (2) clarity of emotions (e.g., "I am rarely confused about how I feel"); and (3) mood repair (e.g., "I try to think good thoughts no matter how badly I feel."). A 1–7 response scale was used for each item. Reliability and validity data are reported by Salovey et al. (1995) and Salovey et al. (2002).

2.3. EEG data collection

A "Neuron-Spectrum-1" electroencephalograph (Neurosoft Company, Ivanovo, Russia) was used for monopolar recording of EEG from Fp1, Fp2, F3, F4, F7, F8, C3, C4, P3, P4, T3, T4, T5, T6, O1, and O2 according to the International 10–20 system in a dark room isolated from environmental noise and electromagnetic waves. The referent electrodes were placed on ears. Signals were sampled at 256 HZ; impedance quality was checked during