Biological Psychology 84 (2010) 531–540

Contents lists available at ScienceDirect

Biological Psychology

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

Cardiac vagal control predicts spontaneous regulation of negative emotional expression and subsequent cognitive performance

Jie Pu [a], Brandon J. Schmeichel [b], Heath A. Demaree [a,*]

[a] Department of Psychology, Case Western Reserve University, Mather Memorial Building, Room 109, 11220 Bellflower Road, Cleveland, OH 44106-7123, USA
[b] Department of Psychology, Texas A&M University, USA

ARTICLE INFO

Article history:
Received 20 August 2008
Accepted 14 July 2009
Available online 22 July 2009

Keywords:
RSA
Cardiac vagal control
Emotion regulation
Expression suppression
Cognition

ABSTRACT

The present research investigated whether cardiac vagal control (as measured by respiratory sinus arrhythmia, RSA) predicts an individual's predisposition to suppress negative emotional expressions. One hundred thirty-six participants watched either a negative film or a neutral film. Facial expressions were recorded during the film and subjective emotional responses were assessed afterwards. Participants performed verbal and spatial working memory tasks both before and after the film clips. We found that resting RSA modulated the degree of coherence between facial expressions of emotion and subjective emotional experience in the negative film condition. Specifically, participants with higher resting RSA expressed less but reported feeling just as much negative emotion as those with lower resting RSA. Moreover, higher resting RSA predicted smaller pre-film to post-film improvements in spatial working memory performance in the negative film condition, suggesting that expressive suppression among high RSA participants temporarily undermined the operation of working memory. In the neutral film condition, resting RSA did not relate to expressive or subjective responses or subsequent working memory performance. These results support the notion that cardiac vagal control reflects an internal marker of self-regulatory tendencies and suggest that spontaneous self-regulation associated with individual differences in resting RSA may temporarily deplete self-regulatory resources.
© 2009 Elsevier B.V. All rights reserved.

In the past two decades, cardiac vagal control has received increasing attention as a psychophysiological marker of self-regulation, the capacity to modulate one's thoughts, emotions, or behaviors in order to develop and pursue goals (Karoly, 1993). Respiratory sinus arrhythmia (RSA), the oscillation of heart rate that accompanies breathing, has been widely used as a non-invasive measure of cardiac vagal control (Berntson et al., 1997, 1993). During inspiration, heart rate speeds up as vagal influence on the heart is temporarily reduced. During exhalation, heart rate slows down as vagal influence is increased. Although cardiac activity is affected by both the sympathetic (SNS) and parasympathetic (PNS) branches of the autonomic nervous system (ANS), beat-to-beat variations in heart rate (i.e., heart rate variability; HRV) associated with the respiratory cycle are predominantly controlled by the parasympathetic branch via the vagus nerve (Berntson et al., 1997). Because RSA arises from respiratory inhibition of vagal activity, it is commonly considered an index of vagal control of cardiac activity (Berntson et al., 1993, 1997; Porges et al., 1994).

Decreased cardiac vagal control has been linked to several forms of psychopathology that reflect dysregulation of negative emotion, including panic anxiety (Friedman and Thayer, 1998), generalized anxiety disorder (GAD, Thayer et al., 1996), posttraumatic stress disorder (PTSD, Cohen et al., 1999), and depression (Carney et al., 1995; cf. Rottenberg, 2007). Similar relationships have also been found in non-disordered children and adults. In children, for example, higher cardiac vagal control generally has been found to predict fewer psychiatric symptoms (Pine et al., 1998), less personal distress and better social competence (Fabes et al., 1993). When exposed to a crying baby, kindergarten and second-grade children with greater HRV exhibited more comforting behaviors (Fabes et al., 1994). Similarly, third-grade boys with greater HRV facially expressed greater concerned attention (a marker of sympathy) to others in distress (Fabes et al., 1993). In the adult literature, one study found that people with higher RSA levels exhibited more constructive coping responses and less negative emotional arousal in response to moderate-to-high intensity stressors in daily life (Fabes and Eisenberg, 1997). Researchers have also observed that, among adults who are sensitive to signs of interpersonal rejection, those with higher resting RSA reported more success at emotion regulation during confrontations with their romantic partners relative to those with lower resting RSA (Gyurak and Ayduk, 2008). Another study found that higher resting

* Corresponding author. Tel.: +1 216 368 6468; fax: +1 216 368 4891.
E-mail address: Heath.Demaree@Case.edu (H.A. Demaree).

0301-0511/$ – see front matter © 2009 Elsevier B.V. All rights reserved.
doi:10.1016/j.biopsycho.2009.07.006

RSA predicted less expression of negative emotion in response to an aversive film, suggesting that higher RSA individuals down-regulate the expression of unwanted negative emotions more than people with lower RSA levels (Demaree et al., 2004).

In the present study, we further tested the hypothesis that cardiac vagal control is associated with the down-regulation of negative emotional expression by examining whether resting RSA modulates the coherence between emotional experience and expression. Emotions are often said to involve the coordination of responses across experiential, behavioral, and physiological systems (Dolan, 2002; Ekman, 1992; Lang, 1988; Lazarus, 1991; Levenson, 1994). The degree to which these systems cohere during an emotional event may vary as a function of self-regulation. For example, the coherence between outer expressions of emotion and inner emotional experience is reduced by the suppression of emotional expressions. Several experiments have observed that expressive suppression effectively minimizes outer manifestations of an emotional response, but that suppression does not reliably alter inner emotional experience (e.g., Gross, 1998; Gross and Levenson, 1993; Schmeichel et al., 2008). Further, Mauss et al. (2005) proposed that the coherence among different components of emotional response might be influenced by individual differences in emotion regulation. Similarly, insofar as high RSA individuals spontaneously suppress negative emotional expressions, we predicted that higher resting levels of cardiac vagal control would be inversely related to the coherence between emotional expression and experience. The first aim of the present study was therefore to test the extent to which resting RSA modulates the coherence between what people feel and what they reveal on their faces.

The second aim of the present research was to determine whether higher resting RSA predicts reduced working memory performance following exposure to a negative stimulus. Although hiding negative emotional expressions is often socially desirable, expressive suppression may exact a psychological cost. Numerous studies have found that, compared to those who simply watch an emotional film and express their reactions, participants who are instructed to suppress their emotional reactions perform less well both on simultaneous tasks (Richards and Gross, 1999, 2000; Bonanno et al., 2004; Richards et al., 2003) and on subsequent tasks (Baumeister et al., 1998; Muraven et al., 1998). Expressive suppression likely impairs performance on simultaneous tasks because suppression relies on an internal dialogue through which individuals remind themselves to suppress facial expressions of emotion (Richards and Gross, 1999). Hence, suppressing an emotional response requires individuals to devote at least some attention to the act of suppression. Consistent with this divided attention view, people who suppress their emotional expressions recall fewer details of the emotional event compared to those who simply express their responses (Richards and Gross, 1999). Moreover, expressive suppression may impair subsequent task performance because suppression temporarily reduces the capacity for self-control. According to a limited resource model of self-control (Muraven et al., 1998), effortful emotion regulation (including expressive suppression) depletes a limited inner resource required for further volitional efforts. In the interim (i.e., before the resource is replenished), further efforts at self-control are prone to failure. For example, the regulation of emotional expressions has been shown to undermine performance at subsequent self-control tasks involving physical stamina (Muraven et al., 1998) and cognitive control (Schmeichel, 2007).

Although most previous research on expressive suppression has examined instructed or intentional suppression (e.g., Gross, 1998; Muraven et al., 1998), one study found that spontaneous or uninstructed suppression also exacts a cost. (Richards and Gross (2000, Study 3) observed that participants who reported habitual efforts to hide their emotional responses also reported more memory problems. However, the extent to which spontaneous suppression of emotion influences performance on subsequent tasks in a controlled laboratory setting has not been established. We reasoned that, insofar as individuals with higher resting RSA spontaneously suppress their negative emotional expressions, higher resting RSA should predict poorer performance on a working memory task following a negative emotional event. Such a pattern would suggest that individuals with higher resting RSA engage in a spontaneous regulation of negative emotional expressions that temporarily depletes self-regulatory resources.

In the present study, half of the participants watched an aversive film clip and half watched a neutral film clip. All participants performed working memory tasks both before and after the film clip. Pre-film working memory performance was assessed to control for individual differences in working memory ability. In addition to the cognitive performance measures, we also assessed resting RSA (i.e., RSA data collected for 2 min prior to the film clip), self-reported affective response to the film, and facial emotional responses during the film. Hypotheses were as follows:

1. Insofar as individuals with higher cardiac vagal control spontaneously suppress facial expressions of negative emotion during an aversive event, participants higher in resting RSA will exhibit less coherence between their emotional expressions and their self-reported emotional experience in response to the negative film clip.
2. If cardiac vagal control is associated with the tendency to suppress negative emotional expressions, then participants higher in resting RSA should perform less well on the working memory tasks after the negative film clip. We anticipated a practice effect among all participants such that performance would improve from the pre-film to the post-film assessment of working memory. However, we expected that higher resting RSA would predict lesser improvements in working memory performance from pre-film to post-film due to the cognitive costs associated with spontaneous suppression.

1. Method

1.1. Participants

One hundred and sixty-nine undergraduate students from Case Western Reserve University participated in the present study and received course credits for their participation. Participants had no history of psychiatric or cardiovascular disorder, nor were they taking any prescription medications that might impact their emotional and/or autonomic functioning. Data from 33 participants were excluded from the analyses due to (1) incomplete data in self-reported affective experience (5 participants); (2) high error rate on the working memory tasks (close to or greater than 50%, 11 participants); or (3) unreadable physiological data (17 participants). Participants were randomly assigned to watch either a negative film clip or a neutral film clip. The study was approved by the Case Western Reserve University Institutional Review Board.

1.2. Emotion-eliciting stimuli

Two 2-min film clips, negative and neutral, were used in the present study. The negative film clip depicted scenes from an animal slaughterhouse. Previous research observed that this film reliably elicits a high degree of negative emotion, and especially disgust (e.g., Schmeichel et al., 2006). The neutral film clip depicted a succession of colored lines and has been found to produce no emotional response (Gross and Levenson, 1995).

1.3. Procedure

During the study, participants were first briefed about the procedures of the experiment and then provided written consent if they agreed to participate. After participants signed the consent form, they received instructions regarding the two 2-back working memory tasks (verbal and spatial, please see Section 1.4 for details) and given an opportunity to practice those two tasks (12 trials for each task, repeated if the subject requested more practice). Instructions were given both

متن کامل مقاله ← دریافت فوری

ISIArticles
مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات