International Journal of Psychophysiology 91 (2014) 225–231

Contents lists available at ScienceDirect

International Journal of Psychophysiology

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

Controlling the emotional heart: Heart rate biofeedback improves cardiac control during emotional reactions

Nathalie Peira [a,b,*], Mats Fredrikson [a], Gilles Pourtois [b]

[a] Department of Psychology, Uppsala University, Sweden
[b] Department of Experimental Clinical & Health Psychology, Ghent University, Belgium

ARTICLE INFO

Article history:
Received 17 June 2013
Received in revised form 20 November 2013
Accepted 20 December 2013
Available online 27 December 2013

Keywords:
Biofeedback
Heart rate
Arousal control
Cardiac control
Emotion regulation

ABSTRACT

When regulating negative emotional reactions, one goal is to reduce physiological reactions. However, not all regulation strategies succeed in doing that. We tested whether heart rate biofeedback helped participants reduce physiological reactions in response to negative and neutral pictures. When viewing neutral pictures, participants could regulate their heart rate whether the heart rate feedback was real or not. In contrast, when viewing negative pictures, participants could regulate heart rate only when feedback was real. Ratings of task success paralleled heart rate. Participants' general level of anxiety, emotion awareness, or cognitive emotion regulation strategies did not influence the results. Our findings show that accurate online heart rate biofeedback provides an efficient way to down-regulate autonomic physiological reactions when encountering negative stimuli.
© 2014 Elsevier B.V. All rights reserved.

1. Introduction

In some situations, a full blown uncontrolled emotional reaction may obstruct goal-directed behavior, for example when giving a speech in front of an audience and suddenly experiencing intense anxiety. In such situations, a good option is to try to regulate the emotional reaction. Emotional reactions are multifaceted and can be divided into three fundamental components: behavioral expression, subjective experience and physiological reaction, such as arousal or tension. Different regulation strategies target one or several of these components and have different success rates in regulating them (John and Gross, 2004). For example, regulating emotions by means of suppression has been found to have no or even opposite effect on physiological reactions (Gross and Levenson, 1993; Demaree et al., 2006; Roberts et al., 2008). In addition, the perception of physiological reactions seem altered in individuals with anxiety disorders and has been proposed to be a key vulnerability factor in the etiology and maintenance of state and trait anxiety as well as anxiety sensitivity and anxiety disorders (Domschke et al., 2010). It has also been suggested that unregulated physiological reactions increase the long-term risk for cardiovascular disease (John and Gross, 2004).

These findings emphasize the need to develop ways by which physiological reactions during the experience of negative emotions can be regulated efficiently in order to prevent the organism from prolonged experience of arousal and negative affect. In this context, biofeedback appears especially valuable because it consists of directly feeding back relevant information about the current state of physiological reactions evoked by specific stimuli or situations to the individual. This information usually conveyed by sight or hearing, can be for example muscle activity (Electromyography, EMG), heart rate (HR), blood pressure, or skin conductance (SC). Through biofeedback, the individual can get online information about physiological activity and eventually learn to use this information in order to regulate it, and in turn influence emotion processing.

There are numerous studies that have shown that physiological reactions can be controlled by means of biofeedback in non-emotional situations (Blanchard and Young, 1973; Critchley et al., 2002; Futterman and Shapiro, 1986; Heffernan-Colman et al., 1992). Regarding emotional situations, biofeedback has been used in different ways in clinical settings. Biofeedback has been utilized to train participants to control their heart rate and influence it later during a speech task performed without feedback (Gatchel and Proctor, 1976; Gatchel et al., 1979). Compared to training with an active control condition, biofeedback training resulted in a lower heart rate and reduced self-reported anxiety (Gatchel and Proctor, 1976). Compared to false biofeedback training and relaxation training, biofeedback training resulted in lowered heart rate but self-reported anxiety was the same in these three groups (Gatchel et al., 1979). Biofeedback has also been used to bring attention to the process of habituation during an exposure session and was found to reduce participants' claustrophobic fear ratings compared to paced tone and exposure only (Telch et al., 2000).

Another way of using biofeedback to reduce emotional arousal is to use it as a feedback informing about the actual efficiency of the emotion

* Corresponding author at: Institutionen för psykologi, Box 1225, 751 42 Uppsala, Sweden. Tel.: +46 18 471 2158; fax: +46 18 471 24 00.
E-mail address: nathalie.peira@gmail.com (N. Peira).

0167-8760/$ – see front matter © 2014 Elsevier B.V. All rights reserved.
http://dx.doi.org/10.1016/j.ijpsycho.2013.12.008

regulation strategy used by the participant at a given moment in time. If the strategy happens to be inefficient, the psychophysiological information fed back online to the participant will encourage him/her to change his/her strategy. As such, a successful regulation can be achieved through the use of a flexible strategy. In such scenario, biofeedback needs to be provided online to the individual in order to immediately link this bodily information to the efficiency of the current regulation strategy used by him/her. Recent technological advancements (e.g., portable pulse watches) make it possible nowadays to rely on the online monitoring of physiological responses to implement regulation processes aimed at downplaying bodily arousal. The added value of this approach is that the best regulation strategy can be optimized for each and every individual, despite a large variability across individuals in their physiological responses to arousal. Accordingly, the present study might therefore complement these earlier studies by showing that heart rate biofeedback provides a valuable tool to down-regulate physiological responses to evocative visual stimuli in healthy participants.

To investigate if online biofeedback of heart rate can improve regulation of emotional physiological reactions, regulation of heart rate reactions to standardized emotional stimuli were measured during real and false online biofeedback. We contrasted an active heart rate regulation condition to a control condition with a simple monitoring of heart rate. Importantly, to rule out the possibility of unspecific effects during the regulation of the heart rate, we used a stringent cross-over design and unknown to the participants alternated real accurate heart rate feedback and fake feedback between blocks. We used standard (i.e. previously validated) neutral vs. negative emotion-eliciting pictures. Neutral stimuli were used as a control condition and directly compared to unpleasant pictures for which a clear directional effect in terms of physiological reactions was expected a priori (unlike the neutral pictures for which we did not predict any change along this dimension). In the study, we considered potential moderating effects of general anxiety and emotion awareness, measured using standard questionnaires, on the regulation of the heart rate. Likewise, given that different emotion regulation strategies may have different effects on the success to control physiological arousal (John and Gross, 2004), we also assessed whether inter-individual differences in emotion regulation strategies may have influenced the ability to regulate heart rate during negative affect.

In this study, biofeedback was explicitly based on heart rate, as opposed to skin conductance for example, in order to minimize the delay between the changes in physiological activity and the visual feedback information provided to the participants. Heart rate as feedback measure also has the advantage over skin conductance of being more available in real life through portable devices such as pulse watches. However, while skin conductance responses to negative arousing stimuli are unidirectional, heart rate responses are not. Heart rate responses to negative arousing stimuli first decelerate after stimulus onset (reflecting an orienting response). After this initial deceleration, with increased arousal, heart rate then accelerates and later decelerates again (Fredrikson, 1981; Lang et al., 2000). Heart rate accelerations are related to fear and are exaggerated in disorders such as specific phobia, social anxiety, post-traumatic stress disorder and panic disorder (Cuthbert et al., 2003), as well as during distress and forms an integrated part of the stress response (Al'Absi et al., 1997). Accordingly, decreasing heart rate might very well affect core physiological reactions associated with stress and anxiety. For all these reasons, we therefore instructed participants to decrease heart rate in our study.

To summarize, the aim of the present study was to investigate whether online heart rate biofeedback could improve control over physiological responses to standard negative stimuli. We predicted that regulation of heart rate to negative pictures would improve with real as compared to fake feedback of heart rate.

2. Method

2.1. Ethics statement

The study was approved by the local ethics committee (Faculty of Psychology — Ghent University) and conducted in accordance with the declaration of Helsinki. Participants were informed about the voluntary nature of participation, signed an informed consent form prior to the experiment, and were fully debriefed about the purpose of the study at the end of the experiment. No participants were under the age of 18.

2.2. Participants

Twenty-three undergraduate students from Ghent University were recruited for the experiment. Participants were compensated 12 euros for participating and the experiment lasted about 1.5 h. The data from one participant were discarded because of disbeliefs in the feedback and a regulation strategy consisting of looking away from all negative pictures. Thus, the final sample included twenty-two participants (20 women).

2.3. Apparatus and materials

2.3.1. Set up

The experiment was conducted in a sound-attenuated room with the experimenter sitting in a separate room. Pictures were presented at a distance of 0.6 m on a cathode ray-tube (CRT) monitor (21 in., 1024 × 768 pixels resolution) with software written in Presentation 10.3 (Neurobehavioral Systems, www.neurobs.com). Refresh rate was set at 80 Hz. ECG was recorded with Biopac MP150 system with a sampling rate of 200 Hz in standard lead II configuration: The right arm electrode was placed near the right collarbone, and the left and right leg electrodes on the right and left side of participants' ribcage. Heart rate was calculated online with Acqknowledge software. For triggers and heart rate feedback, the experiment computer and the computer hosting Acqknowledge software were connected with each other using a parallel port.

2.3.2. Picture material

Forty negative and 40 neutral pictures were selected from the IAPS (Lang et al., 2008) based on the normative ratings provided for this data base. Negative pictures (arousal between 6.3 and 10, valence between 3.8 and 1.7) were pre-selected in such a way to include as many fear related pictures as possible and avoid mutilations because these are related to disgust responses and as such general deceleration in heart rate (Rozin et al., 2000). Neutral pictures had arousal values ranging between 1 and 3 and valence values between 5.6 and 4.6. Pictures were 1024 × 768 pixels and scaled to 0.7 of the standard size in Presentation software (i.e. 717 × 538 pixels). The space left on the edges was used for the biofeedback information. IAPS numbers of the selected pictures were: 1050, 1052,1120,1201, 1300, 1304, 1525, 1930, 2811, 3500, 3530, 6210, 6230, 6231, 6250, 6250.1, 6260, 6263, 6300, 6313, 6315, 6350, 6360, 6370, 6510, 6520, 6540, 6550, 6560, 6563, 8485, 9163, 9187, 9250, 9413, 9414, 9635.1, 9810, 9908, 9921, 2038, 2190, 2393, 2397, 2411, 2570, 2840, 2880, 2890, 5390, 5510, 5520, 5530, 5731, 5740, 7010, 7026, 7030, 7035, 7040, 7041, 7050, 7053, 7059, 7080, 7090, 7100, 7140, 7150, 7161, 7179, 7187, 7205, 7217, 7233, 7235, 7490, 7491, 7705, and 7950.

2.3.3. Biofeedback

Biofeedback was given to the participants by changing the background color of the screen every 500 ms. The target picture was presented in the center of the screen and did not change, only the color of the edges (top and bottom: 115 pixels or 4.8 cm; right and left edges: 153 pixels or 6.4 cm) and changed according to the updated

دریافت فوری ← متن کامل مقاله

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