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INFLUENCE OF LONG-TERM SAHAJA YOGA MEDITATION PRACTICE ON EMOTIONAL PROCESSING IN THE BRAIN: AN ERP STUDY

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Abstract—Despite growing interest in meditation as a tool for alternative therapy of stress-related and psychosomatic diseases, brain mechanisms of beneficial influences of meditation practice on health and quality of life are still unclear. We propose that the key point is a persistent change in emotional functioning, specifically the modulation of the early appraisal of motivational significance of events. The main aim was to study the effects of long-term meditation practice on event-related brain potentials (ERPs) during affective picture viewing. ERPs were recorded in 20 long-term Sahaja Yoga meditators and 20 control subjects without prior experience in meditation. The meditators' mid-latency (140–400 ms) ERPs were attenuated for both positive and negative pictures (i.e. there were no arousal-related increases in ERP positivity) and this effect was more prominent over the right hemisphere. However, we found no differences in the long latency (400–800 ms) responses to emotional images, associated with meditation practice. In addition we found stronger ERP negativity in the time window 200–300 ms for meditators compared to the controls, regardless of picture valence. We assume that long-term meditation practice enhances frontal top-down control over fast automatic salience detection, based on amygdala functions.

Key words: meditation, mindfulness, emotion, ERP, affective images.

INTRODUCTION

Recent years have seen growing interest in meditation as a tool for alternative therapy of stress-related and psychosomatic diseases (for reviews see Barnes and Orme-Johnson, 2012; Chen et al., 2012; Hagins et al., 2013; Khoury et al., 2013), although little is known about underlying brain mechanisms. According to a transactional model of stress and coping (Lazarus and Folkman, 1984), individuals on an unconscious level, or deliberately, produce appraisals of events with respect to their importance for well-being and the availability of resources necessary for coping with these events. When a given stimulus is initially appraised as challenging, harmful, or threatening, an activation of physiological systems involved in the stress response co-occurs with a subjective experience of distress. A persistent trend of overestimating the significance of the negative events leads to excessive emotional reactivity and to wear-and-tear of visceral systems (McEwen and Gianaros, 2010).

It is likely that the beneficial effects of meditation practices on health may be mediated by reduction of negative affect along with an increase in positive emotional attitude toward oneself and others, i.e. positive affectivity (Cahn and Polich, 2006; Wadlinger and Isaacowitz, 2011). A plausible way to reach this state is the reduction of the significance of negative events during the evaluative stage of emotional response. Indeed, the metacognitive stance of mindfulness, inherent in many meditative styles, can moderate the impact of potentially distressing psychological content. It may be assumed that the process of mindfulness extricates attention from being fixated on evaluative language, enabling nonjudgmental, metacognitive awareness of thoughts and feelings, so one is able to let go of clinging to memories of the past and hopes and fears of the future, based on habitual patterns of thought (Garland et al., 2009). Therefore, we assume that due to meditation practice the process of appraisal of an event's motivational significance undergoes a change which allows an individual to control emerging emotions; moreover, this change gradually becomes automatic.

The event-related brain potential (ERP) findings of Sobolewski et al. (2011) provide some support for different emotional processing in Buddhist meditation practitioners: meditators were less affected by stimuli with adverse emotional load (the effect of greater late positive potential (LPP) amplitude for negative International Affective Picture System (IAPS) images was not replicated in the case of meditators' frontal scalp regions), while processing of positive stimuli remained unaltered. In another ERP research[1]

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Abbreviations: ANOVAs, analysis of variances; C, central; CP, centroparietal; Cz, central midline; EEG, electroencephalography; ERPs, event-related brain potentials; F, frontal; FC, frontocentral; Fz, frontal midline; IAPS, International Affective Picture System; LPP, late positive potential; P, parietal; P3a, early P300.

[1] The research was not published as a journal article.

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(Marhe, 2007) no effects of meditation on emotional processing were indicated for Sudarshan Kriya Yoga. Thus, the data obtained are insufficient to draw any conclusions about the impact of meditation practice on the evaluative component of emotional responses.

Therefore in this study we aimed to investigate the influence of long-term Sahaja Yoga meditation on the ERP response to affective pictorial stimuli. This technique, more related to mindfulness than a concentrative type of meditation, is characterized by a mental state of ''thoughtless awareness'', or ''mental silence'' and is accompanied by the experience of bliss. In general, the outcome of this meditative technique, as most others, is a sense of relaxation and positive mood and a feeling of benevolence toward oneself and others (Rai, 1993; Aftanas and Golocheikine, 2001; Manocha et al., 2012). Moreover, in recent eye-tracking research the shift of attention toward happy faces was obtained for Sahaja Yoga meditators, evidencing positive affective bias (Pavlov et al., 2014a).

Because it was recently shown that within the scope of standard categories the amplitude of the LPP significantly depends on the image content (Anokhin et al., 2006; Weinberg and Hajcak, 2010; Ferri et al., 2012), we used a homogeneous set of images depicting people (the objects for empathy) in appropriate life situations (Pavlov et al., 2014b).

We assume that in the case of negative emotions the arousal-related increase in positive components of ERP, in particular LPP, will be reduced, reflecting less motivational significance of this stimuli for Sahaja Yoga meditators. Since long-term meditation practice favors developing of positive affective bias, we assume higher ERP reactivity (increase in positivity) in response to positive images in Sahaja Yoga meditators versus controls.

EXPERIMENTAL PROCEDURES

Participants

Two groups of healthy right-handed males participated in our study. The experimental group included 20 experienced long-term Sahaja Yoga meditators (meditators, mean age = 36.30, SD = 9.41; mean meditation experience = 11.45 years, SD = 4.35) and 20 age-matched healthy controls with no meditation experience (controls, mean age = 33.55, SD = 5.48). The age difference between meditators and controls was insignificant (two tailed t-test, $t = 0.99$, $p < 0.33$). All the subjects gave written informed consent and were paid for participation.

Stimuli

One hundred and sixty images (151 from free websites, 9 from the International Affective Picture System (IAPS, Lang et al., 1999)), including 32 neutral (people in emotionally neutral situations), 64 negative (loss, accidents), and 64 positive (attractive women, family) photos were selected for the study. All pictures included people with well-distinguishable facial expressions, experiencing negative or positive emotions or being in a neutral emotional state.

Procedure

It should be noted that this study was a part of the emotional regulation study, so rationale for block-wise stimulus presentation and cueing was defined by task requirements (for details see Pavlov et al., 2014b). Only unregulated trials were analyzed in this study.

During the experiment participants sat in a comfortable chair in a dimmed room. After attachment of the sensors, a 7-min resting period (2 min with closed eyes and 5 min with open eyes) was recorded. Then, participants were given instructions describing the experimental procedure and performed a practice block (not used for further analyses) including 10 trials. Each trial was composed of four events: cue word (look, increase, decrease) (2.5 s), image (neutral, negative, positive) (5 s), subjective emotional report (3–4 s), blank screen (2.5 s). While the image remained on the screen, participants performed the operations specified by the prior instructional cue. During unregulated trials (cue word ''look'') participants were instructed simply to look at the image and let themselves respond naturally. All trials were broken down into four experimental blocks. Each of the four experimental blocks included five sequentially presented series, consisting of eight trials with similar instructional cues (i.e., eight unregulated neutral, eight unregulated positive, eight unregulated negative, eight regulated positive, and eight regulated negative trials). Series of sequences were counterbalanced across blocks. There was a break of 5 min after each experimental block.

MEASURES

Subjective emotional report

After the image offset, two dimensions of valence and arousal (in a nine-point scale for each dimension) were assessed using a computerized Self-Assessment Manikin (SAM) (Bradley and Lang, 1994).

Electroencephalography (EEG)

EEG recordings (62-channel, bandpass 0.08–120 Hz, sampling frequency 1000 Hz) were obtained monopolarly using the BrainProduct Acquisition 1.1 program and a QuickAmp (Brain Products GmBh, Munich, Germany) system via a modified 64-channel cap with inbuilt Ag/AgCl electrodes (QuikCap, NeuroSoft, Inc., Charlotte, NC, USA). A common average reference was used. Electrode impedances were kept at $< 5\,\text{k}\Omega$. Horizontal and vertical electrooculographic activity (EOG) was measured in a bipolar configuration laterally at the outer canthi of each eye and above and below the right eye, off-line correction of EEG recordings was performed with Gratton's algorithm (Gratton et al., 1983). ERP epochs were extracted from −200 to 2000 ms relative to stimulus presentation onset, visually checked for residual oculomotor, myographic, motor, DC-drift and other artifacts,