Biological Psychology 94 (2013) 221–227

Contents lists available at SciVerse ScienceDirect

Biological Psychology

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

Neural and behavioral associations of manipulated determination facial expressions

Tom F. Price[a,*], Ruud Hortensius[b], Eddie Harmon-Jones[c]

[a] The Athinoula A. Martinos Center for Biomedical Imaging, United States
[b] Tilburg University, The Netherlands
[c] The University of New South Wales, Australia

ARTICLE INFO

Article history:
Received 4 January 2013
Accepted 3 June 2013
Available online 10 June 2013

Keywords:
EEG
Emotion
Motivation
Embodiment

ABSTRACT

Past research associated relative left frontal cortical activity with positive affect and approach motivation, or the urge to move toward a stimulus. Less work has examined relative left frontal activity and positive emotions ranging from low to high approach motivation, to test whether positive affects that differ in approach motivational intensity influence relative left frontal cortical activity. Participants in the present experiment adopted determination (high approach positive), satisfaction (low approach positive), or neutral facial expressions while electroencephalographic (EEG) activity was recorded. Next, participants completed a task measuring motivational persistence behavior and then they completed self-report emotion questionnaires. Determination compared to satisfaction and neutral facial expressions caused greater relative left frontal activity relative to baseline EEG recordings. Facial expressions did not directly influence task persistence. However, relative left frontal activity correlated positively with persistence on insolvable tasks in the determination condition. These results extend embodiment theories and motivational interpretations of relative left frontal activity.

Published by Elsevier B.V.

1. Introduction

Starting from observations that lesions to the left vs. right frontal cortex influenced emotive responses (Goldstein, 1939), much research has revealed that greater relative left frontal cortical activity is associated with positive affect and/or approach motivation, whereas greater relative right frontal cortical activity is associated with negative affect and/or withdrawal motivation (Silberman & Weingartner, 1986; for a more recent review, see Harmon-Jones, Gable, & Peterson, 2010). Because most research prior to 2000 had confounded affect with motivation by examining, for example, only positive affects high in approach motivation, it was unclear whether positive affect or approach motivation was the psychological variable that best related to asymmetric frontal cortical activity. To address this confound, research over the last decade has examined anger, a negatively valenced state that is often associated with approach motivation (Harmon-Jones, 2003, 2004). This research has revealed that anger is associated with greater relative left frontal cortical activity, suggesting that asymmetric frontal cortical activity is best characterized by motivational direction rather than affective valence. The present research sought to extend this past research by examining motivational intensity within positive affective states.

1.1. Positive affects that vary in approach motivational intensity

Positive affects vary in approach motivation, with some being lower and some higher in approach motivation or the urge to move toward a stimulus (Harmon-Jones, Harmon-Jones, & Price, 2013). Researchers often make a distinction between high approach, appetitive, or pre-goal positive states as being different from low approach, consummatory, or post-goal positive states, which can be conceptualized as the difference between "wanting" and "liking" (Berridge, 2007). The feeling of determination is an example of a positive affective state that is high in approach motivation. Determination is a word on the widely used Positive Affect sub-scale of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). Situations that evoke positive approach motivation also cause individuals to report feeling determined (Harmon-Jones, Schmeichel, Mennitt, & Harmon-Jones, 2011, Study 1).

The feeling of satisfaction, on the other hand, is an example of a positive affective state that is lower in approach motivation. Satisfaction is often thought of as a positive, yet distinct emotion (i.e., dissimilar from other positive emotions). Satisfaction has been defined as a positive emotional response to obtaining some desired goal or event (Ortony, Clore, & Collins, 1988). As such,

* Corresponding author.
E-mail address: pricth02@gmail.com (T.F. Price).

0301-0511/$ – see front matter. Published by Elsevier B.V.
http://dx.doi.org/10.1016/j.biopsycho.2013.06.001

satisfaction occurs once a goal has been accomplished, that is, post-goal (Harmon-Jones, Gable, & Price, 2012).

1.2. Preliminary EEG asymmetry evidence for low vs. high approach positive affect

Although some correlational studies provide evidence suggesting a link between approach-motivated positive affect and asymmetric frontal cortical activity (Gable & Harmon-Jones, 2008; Harmon-Jones & Gable, 2009), only one experiment has tested whether positive affective states varying in approach motivational intensity influence relative left frontal cortical activity. In this experiment, participants were assigned to one of three mindset conditions: a positive action-oriented (think of steps toward a goal; implemental mindset of Gollwitzer, 1990), neutral (describe normal day), or positive non-action condition (think of good past event without personal action; Harmon-Jones, Fearn, Sigelman, & Johnson, 2008, Experiment 2). As expected, self-reported positive affect was greater in the action and non-action positive conditions compared to the neutral condition. More importantly, relative left frontal cortical activity was greater in the positive action condition compared to the positive non-action and neutral conditions.

One could question whether the emotive state induced by the positive-action-oriented mindset manipulation or another aspect of this cognitive manipulation, such as planning (which may not be associated with approach motivation), caused the differences in relative left frontal activity in this experiment. In emotive research, it is imperative to utilize multiple manipulations of emotive states. This insures that the emotive state, and not another aspect of the manipulation, is causing the differences.

1.3. Embodying low vs. high approach positive affect

One way to deal with this issue is to use embodied emotional manipulations. James (1890) proposed that bodily manipulations, such as facial expressions, share inherent connections with emotions. The facial feedback hypothesis (Laird, 1974), furthermore, suggests that manipulated facial expressions of emotion cause emotional changes. It is important to note, however, that most research supporting the facial feedback hypothesis measured self-reported emotional responses to mildly affective stimuli (e.g., cartoons; Strack, Martin, & Stepper, 1988). Also, a meta-analysis of studies assessing self-reported emotional reactions found that the effect size was only small to moderate in magnitude (Matsumoto, 1987). Emotive bodily manipulations have also been found to influence cognitive processes related to emotions (Price & Harmon-Jones, 2010).

Studies have also assessed the effects of manipulated facial expressions on psychophysiological responses (e.g., Levenson, Ekman, & Friesen, 1990). For instance, approach-oriented facial expressions (e.g., joy and anger) manipulated with directed facial action tasks (as in Levenson et al., 1990) have been found to cause greater relative left frontal cortical activity (Coan, Allen, & Harmon-Jones, 2001). Withdrawal-oriented facial expressions (e.g., sadness and disgust) have been found to cause less relative left frontal activity (Coan et al., 2001). This past experiment did not compare positive facial expressions varying in approach motivation, however. Thus, in the present study, we addressed this lacuna in research by manipulating low vs. high approach positive affect via facial expressions of satisfaction vs. determination.

1.4. Molar behaviors associated with approach motivation

In addition, we tested whether the manipulation of approach positive affect would influence molar motivational behaviors, something rarely done in past research on asymmetric frontal cortical activity. One molar motivational behavior related to approach is task persistence on insolvable tasks. Consistent with this idea, slumped/helpless postures, which are associated with lower approach motivation, caused less persistence on insolvable tasks, compared to more upright and expansive postures. The two postures did not produce differences on solvable task performance (Riskind & Gotay, 1982). Thus, in the present study, we tested if emotive facial expressions varying in positive approach motivational intensity would influence persistence on insolvable tasks. In line with past research, we anticipated that they would have no effect on solvable tasks, as their completion is often relatively quick without much variance across participants. In addition to examining if these facial expressions influence task persistence, we will examine the relationship between relative left frontal cortical activity and task persistence.

In accordance with motivational interpretations of asymmetric frontal cortical activity (Harmon-Jones et al., 2010) and previous work on determination (Harmon-Jones, Schmeichel, et al., 2011) and satisfaction (Ortony et al., 1988), three primary predictions were tested. Determination facial expressions should cause greater relative left frontal activity compared to satisfaction and neutral facial expressions, which should not differ from one another (consistent with the results of Harmon-Jones et al., 2008). Determination facial expressions should cause greater persistence compared to satisfaction and neutral expressions, which should not differ from one another. Finally, relative left frontal activity should be directly related to behavioral persistence, especially for participants in the determination facial expression condition.

2. Method

2.1. Participants

Forty-nine (31 women) right-handed university students aged 18–24 years participated. One participant in the satisfaction condition was excluded from EEG analyses due to excessive noise in baseline EEG recordings. One participant in the determination and satisfaction conditions lacked self-report data. The total sample sizes for each condition were as follows: determination ($n = 16$, 5 men, 11 women), satisfaction ($n = 15$, 7 men, 8 women), neutral ($n = 18$, 6 men, 12 women).[1]

2.2. Materials and procedures

The participant was informed that the experiment involved facial expressions, cognitive tasks, and brain activity. After providing informed consent, the participant was fitted with an EEG electrode cap and a stereo headset with attached microphone. This allowed the experimenter to hear participant's responses from an adjacent control room. Each participant sat in a stationary chair. In front of them, there was a table with four stacks of puzzle tasks labeled 1–4 [in order from first to last consistent with Glass and Singer (1972): insolvable, solvable, insolvable, solvable] and a computer monitor on a separate desk. Tasks were face down, printed on three by five inch cards, with 30 puzzles in each stack. In this experiment, participants attempted to solve the one puzzle from each stack of the four stacks.

The experimenter explained that the participant would attempt to solve four different puzzles. Participants (1) could not retract any lines or lift their pen from the card while working on a puzzle, (2) could take as many attempts (max 30) as desired at a particular puzzle (if they were unable to complete a puzzle, they could move on), and (3) could not return to a previously attempted puzzle stack. Individual puzzle attempts were limited to 30 s (see Glass & Singer, 1972). Participants were directed to say the number of a stack each time they took a card from it, "Solved" upon solving a puzzle, and "I'm finished" after their last desired attempt at the fourth puzzle. Finally, participants were told to wait to begin working on tasks until instructed to do so. After answering any questions, the experimenter left the room and closed the door. The experimenter entered the adjacent control room. At this point, the experimenter randomly assigned participants to condition via a randomization sheet. Thus, the experimenter was blind to condition while interacting with the participant.

The participant then saw on the computer monitor text instructions that restated details of the tasks. Participants were then asked to make and maintain a

[1] The current sample sizes are consistent with other research examining the effects of between-subjects emotion embodiment manipulations on relative left frontal cortical activity (Harmon-Jones, 2006).