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Short Report

Supine Body Position Reduces Neural Response to Anger Evocation

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Body movements affect emotional processes. For example, adopting the facial expressions of specific emotions (even via unobtrusive manipulations) affects emotional judgments and memories (Laird, 2007). Manipulated body postures can affect behavior: slumped postures lead to more "helpless behaviors" (Riskind & Gotay, 1982).

Simple body postures may also affect other emotive responses and the neural activations associated with them. Lying flat on one's back may be antithetical to approach motivation (i.e., the urge to move toward something). We sought to address this issue, which has implications not only for the study of embodiment, but also for the study of neural processes, because some neuroscience techniques rely on individuals being in supine positions.

More than 15 studies using electroencephalographic (EEG) and repetitive transcranial magnetic stimulation (rTMS) methods have suggested that the left prefrontal cortex is more activated than the right prefrontal cortex during the experience of anger, particularly anger associated with approach motivational inclinations (Carver & Harmon-Jones, 2009; van Honk & Schutter, 2006). Tomarken and Zald (2009), however, questioned these effects when they reviewed some functional magnetic resonance imaging (fMRI) studies that failed to find greater relative left prefrontal cortical activations during anger. One possible explanation of the divergence of the EEG-rTMS and fMRI studies on anger is that the fMRI studies did not evoke anger associated with approach motivation. Research has shown that mild anger cues only evoke greater relative left frontal cortical activation when approach motivation is also activated (Harmon-Jones, Lueck, Fearn, & Harmon-Jones, 2006).

Another possibility for the diverging findings is that the EEG-rTMS studies test participants in an upright body position, whereas fMRI studies test participants in a supine body position. We measured relative left frontal EEG activity to an anger-inducing insult while participants were upright or reclined. We expected the reclined position to produce less relative left frontal cortical activation than the upright position because a supine position may be antithetical to approach motivation.

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METHOD

Forty-six (23 females, 23 males) introductory psychology students participated to fulfill a course requirement. Under the guise of a test of how personality variables affect essay content and impressions of others, participants were told that they had been randomly assigned to write an essay and that another participant, ostensibly in an adjacent room, would evaluate it. Participants wrote a 10-min essay supporting their side of an issue (e.g., smoking in public). Then, the essay was collected and brought to the "other participant" for evaluation.

EEG sensors were attached to the participant. Then, the experimenter explained that, at some point, the chair would need to be reclined and demonstrated how to recline the chair. Stereo headphones were placed on the participant, who was left sitting upright. In the control room, the experimenter randomly determined whether the participant would remain upright or recline. The participant then heard the experimenter prompt the "other participant" to rate the participant on six characteristics (e.g., intelligence; 1 = *unintelligent*, 9 = *intelligent*); voice recordings were used to eliminate experimenter bias. All participants in the reclined condition and half the participants in the upright condition heard negative ratings and statements about the essay and their personality. In the neutral-upright condition, participants heard slightly positive ratings (Harmon-Jones & Sigelman, 2001; Harmon-Jones, Vaughn-Scott, Mohr, Sigelman, & Harmon-Jones, 2004). Male participants heard feedback from a male, and female participants heard feedback from a female. Immediately following the feedback, 2 min of EEG were recorded. Then, participants completed a self-report emotions scale and were debriefed (5 participants, randomly distributed across conditions, were suspicious; data for these participants were excluded from analysis).

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EEG, recorded from 27 tin electrodes mounted in a stretch-lycra electrode cap (Electro-Cap, Eaton, OH), was referenced to the left ear (A1); data were acquired from the right ear (A2) so that, off-line, averaged-ears reference could be computed. Impedances were under 5,000 ohms; homologous sites were within 1,000 ohms of each other. Signals were amplified (60-Hz notch filter), bandpass filtered (0.1–100 Hz), and digitized at 500 Hz. Signals were manually scored for artifacts. Then, a regression-based eye movement correction was applied (Semlitsch, Anderer, Schuster, & Presslich, 1986). All 1.02-s epochs were extracted through a Hamming window. A fast Fourier transform extracted power within the alpha band (8–13 Hz). Asymmetry indices were created for homologous sites (natural log right minus natural log left). Because alpha power is inversely related to cortical activity, higher scores indicate greater left than right activity (Davidson, Jackson, & Larson, 2000).

RESULTS AND DISCUSSION

Replicating past research, greater relative left lateral frontal cortical activity occurred in the insult-upright condition compared to the neutral-upright condition. Consistent with our embodied motivation prediction, the insult-upright condition produced greater relative left lateral frontal activity than the insult-reclined condition, which did not produce greater relative left lateral frontal activity than the neutral-upright condition. A planned comparison pitting the insult-upright condition against the other conditions (2, −1, −1) was significant, $t(38) = 2.70$, $p_{rep} = .95$, $r = .40$. Follow-up tests revealed that each condition differed from the insult-upright condition, $ts > 2.10$, $p_{rep}s > .89$, $rs > .32$. No other asymmetry indices differed between conditions, $p_{rep}s < .80$.

One-way analyses of variance on reported emotions revealed that anger increased and happiness decreased after the insult, but these emotions did not differ between the upright and reclined insult conditions (see Table 1). The results are consistent with past experimental manipulations showing that angry states can differ in the degree to which they are associated with approach motivation and that relative left frontal cortical activity varies with approach motivational manipulations, whereas self-reported anger does not (Harmon-Jones et al., 2006). However, it is also possible that some yet-to-be-discovered incidental physiological process occurred as a result of the supine manipulation and affected the EEG data. Future research should incorporate other measures of motivation in examinations of the effects of supine body position.

Because proving the null hypothesis is impossible, our results do not indicate that approach-motivational processes can never be activated when individuals are in supine positions. Instead, our results suggest that supine body positions likely reduce approach-motivational responses, a point consistent with embodiment accounts. These results are worth considering when evaluating neuroimaging techniques that require a supine position.

TABLE 1
Means for Dependent Variables as a Function of Condition

Dependent variable	Condition: Neutral-upright	Condition: Insult-upright	Condition: Insult-reclined	$F(2, 38)$
Lateral frontal asymmetry	$-0.21\ (0.08)_a$	$0.15\ (0.10)_b$	$-0.10\ (0.08)_a$	3.68
Anger	$1.41\ (0.32)_a$	$3.00\ (0.26)_b$	$2.84\ (0.23)_b$	8.68
Happiness	$2.47\ (0.20)_a$	$1.34\ (0.16)_b$	$1.27\ (0.14)_b$	13.63
Fear	$1.35\ (0.16)_a$	$1.55\ (0.13)_a$	$1.59\ (0.11)_a$	0.76

Note. Standard deviations are given in parentheses. For lateral frontal asymmetry, higher means reflect greater left than right frontal activity. Within rows, means with different subscripts differ significantly, $p_{rep} > .88$.

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