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Threat, high self-esteem, and reactive approach-motivation: Electroencephalographic evidence

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ABSTRACT

High self-esteem predicts personal resilience but also predicts zealous and antisocial reactions to various threats, such as, failure, uncertainty, and mortality salience. The present research supports a basic motivational interpretation of high self-esteem that can account for its resilient but also its zealous and antisocial tendencies. An experimentally manipulated uncertainty threat caused participants with high self-esteem to react with heightened Relative Left Frontal (F7/F8) EEG Activity, a common neural marker of resilient approach-motivation. As predicted by past theorizing on offensive defensiveness (McGregor, 2006), the obtained pattern of neural results mirrors the interaction effect of self-esteem and threat on various antisocial defenses. It is accordingly suggested that reactive approach-motivation processes may help provide an integrative account for some of the angry, zealous, proud, risky, ideological, meaning-seeking, and worldview defense reactions to various threats that have been reported in the social psychological literature.

In North America high self-esteem is widely assumed to be an unmitigated virtue and the backbone of good character. Parents lavish affirmation on their children and school boards tailor policy to build self-esteem (reviewed in Baumeister, Smart, & Boden, 1996; Crocker & Park, 2004). Despite such popular devotion, and evidence that high self-esteem can indeed be associated with personal and relational resilience (e.g., Murray, Holmes, MacDonald, & Ellsworth, 1998; Stinson et al., 2008; Trzesniewski et al., 2006), research also persistently reveals an antisocial side of high self-esteem. After experiencing threat, people with high self-esteem can tend to become antagonistic and self-righteously dismissive of others who hold alien perspectives (e.g., Heatherton & Vohs, 2000; McGregor, Nail, Marigold, & Kang, 2005; Park & Crocker, 2005; Vohs & Heatherton, 2001). Findings like these have led some reviewers to conclude that, on balance, high self-esteem burdens society (Baumeister et al., 1996; see also Crocker & Park, 2004).

The present research tests a *reactive approach-motivation* account of high self-esteem that holds potential for informing both its resilient and antisocial aspects. Building on past suggestive research linking high self-esteem to approach-motivated personal goals (Heimpel, Elliot, & Wood, 2006; McGregor, Gailliot, Vasquez, & Nash, 2007; see also Leonardelli, Lakin, & Arkin, 2007), we predicted that people with high self-esteem would tend to react to threat with neural activity characteristic of approach-motivation. Such heightened states of reactive approach-motivation could confer rewarding personal resilience by decreasing preoccupation with threats: Past research shows that neural, behavioral neuroscience, and self-report indices of approach-motivation are associated with attenuated startle-reflex, less negative reactions to aversive stimuli, more happiness and meaning, and less depression and negative affect in general (Drake & Myers, 2006; Elliot, 2008; Gianotti et al., 2009; Jackson et al., 2003; Urry et al., 2004). However, approach motivated states also constrict attention and intention to personal goals (Gable & Harmon-Jones, 2008; McGregor et al., 2007) and could thereby mute sensitivity to others' perspectives. Indeed, the approach-motivation-related phenomenon of power (Keltner, Gruenfeld, & Anderson, 2003) is associated with impaired perspective-taking and objectification of others in service of personal goals (Galinsky, Gruendeld, & Magee, 2003; Galinsky, Magee, Inesi, & Gruenfeld, 2006; Gruenfeld, Inesi, Magee, & Galinsky, 2008). Accordingly, it could be that reactive approach-motivation after threat confers powerful insulation from threat but with the antisocial side effect of myopic unconcern for others.

To test the basis of this account—our hypothesis that people with high self-esteem respond to threat with reactive approach-motivation—we assessed left frontal electroencephalographic (EEG) asymmetry as a neural marker of approach-motivation. Motivational asymmetry is a fundamental property of brain organization that allows for some specialized regulation of goals related to approaching incentives and avoiding threats (Elliot, 2008). Links between left-frontal asymmetry and approach-motivation were first noticed in patients with focal lesions to the left

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or right hemisphere, which tended to result in depressive or manic symptoms, respectively (Elliot, 2008). More recently, in dozens of studies Relative Left Frontal EEG Activity has consistently been associated with approach motivation and related constructs, such as behavioral activation, risk-taking, positive mood, and anger (e.g., Coan & Allen, 2003a; Harmon-Jones & Allen, 1997; Harmon-Jones, Lueck, Fearn, & Harmon-Jones, 2006; Harmon-Jones, Peterson, Gable, & Harmon-Jones, 2008; Sutton & Davidson, 1997; for reviews see Coan & Allen, 2003b; Elliot, 2008). In the present research we assess the precise pattern of EEG activity that has been associated with these approach-related phenomena—relative activity in the left (as compared to right) dorsolateral prefrontal cortex, as recorded by electrodes at sites F7 and F8 of the International 10–20 system of EEG electrode placement. We expected it to peak after threat among individuals with high self-esteem.

Method

Thirty-seven right-handed, University of Toronto Scarborough psychology students completed the materials. Data from 30 (21 female) remained for analyses after exclusions due to excessive artefacts ($n = 2$), malfunctioning equipment ($n = 2$), and outlier EEG scores ($n = 3$). Participants rated their dispositional Self-Esteem (Rosenberg, 1965), then completed an average of 20 min and 33s worth of questionnaires related to other hypotheses and 8 min worth of Baseline EEG assessment before turning to the randomly assigned academic Threat (vs. No-Threat) materials. Finally, for the dependent variable we assessed the specific kind of frontal EEG asymmetry that has been associated with approach-motivation in past research.

Self-esteem

Participants rated their self-esteem on the 10 Rosenberg (1965) self-esteem scale items, including, "I take a positive attitude toward myself" and "I feel I do not have much to be proud of" (reversed). The scale consistently yields Cronbach alpha reliabilities over .80. In past work, highest scores on this scale have predicted not only healthy resilience (e.g., Stinson et al., 2008) but also the most extremely self-serving and closed-minded reactions to experimentally induced uncertainty threats, relationship threats, and mortality salience threats (reviewed in McGregor, 2006).

Threat manipulation

In the Threat condition, participants were given two minutes to summarize an incomprehensible paragraph about statistics that was presented as something common in their field of psychology and that they should understand. In the No-Threat condition, participants summarized a comprehensible statistics passage, instead. In a previous study with 117 participants, this same Threat manipulation caused significantly more uncertain, frustrated, and confused feelings ($ps < .001$) (in that order of effect magnitude) than in the No-Threat condition. It also caused participants to feel less good and successful ($ps < .005$) than participants in the control condition, who scored just below the scale midpoint on both feelings. Thus, past research has found that this threat manipulation is indeed threatening and that its effects are not likely due to affirmation effects of feeling particularly proud of oneself in the control condition.

In addition to being a poignant threat insofar as it that makes people feel bad and uncertain, this statistics threat manipulation has also reliably caused participants to react with defensive extremes that reflect impaired perspective-taking: It has caused them to hold more extreme social-issue opinions about capital punishment, war, and terrorism (McGregor & Jordan, 2007), to become more exclusive and militant in their religious beliefs (McGregor, Haji, Nash, & Teper, 2008), and to express exaggerated certainty and conviction for their opinions even after explicit reminders of diverse social opinion. Importantly for the present research, such myopic conviction reactions to this threat manipulation in past research have been most pronounced among participants with high self-esteem (McGregor et al., 2005, Study 1; McGregor, 2008).

It should be emphasized, however, that such zealous reactions by people with high self-esteem are not specific to this particular statistics threat. Participants with high self-esteem also tend to react to various other threats (e.g., mortality salience, personal uncertainty, relationship distress) with similarly exaggerated conviction for their own agendas and disregard for others' (reviewed in McGregor, 2006). The clear pattern across various threats manipulations is that participants with high self-esteem react to various threats by becoming more self-serving and dismissive of others who hold foreign perspectives. Accordingly, the threat used in the present research was chosen for its presumed poignancy rather than for its specific content domain, which we view as arbitrary.[1]

Dependent variable: Relative Left Frontal (F7/F8) EEG Activity

To assess approach-motivation-related patterns of brain activity we fitted participants with a stretch-lycra cap that had 32 embedded Ag/AgCl electrodes. Before the threat, eight 1 min baseline intervals of EEG recording were taken (four of them with eyes open, four with eyes closed). This baseline recording allows for statistical covariation of baseline patterns of brain activity, thus allowing us to more specifically isolate reactive approach-motivation caused by the threat. Post-threat EEG recordings were taken during three 1 min intervals (separated from each other by 30s breaks).

For both the baseline and dependent measure, relative left prefrontal EEG Activity was assessed and computed as follows. To obtain numerical representations of the electrical recordings, we digitized the continuous EEG voltages from all 32 cap electrodes and right-eye vertical electrooculogram (VEOG) at 560 Hz using an averaged ear reference and forehead ground. Electrode impedances were below 5 k Ohm for all recordings which ensured a clean signal at each electrode. The frequencies below 0.1 Hz and above 100 Hz typically represent noise, and thus a standard bandpass filter at 0.1–100 Hz was used (as by Harmon-Jones & Allen, 1997). We also applied a notch-filter at 60 Hz to remove ambient alternating current (AC) that could also introduce unwanted noise to the signal. The continuous EEG recordings were corrected off-line for eye-blinks using the VEOG channel and the Second Order Blind Identification procedure which is a signal processing method for isolating and removing ocular artifacts (Tang, Liu, & Sutherland, 2005). Additionally, movement artifacts were automatically detected and removed with a -75 μV and +75 μV threshold. We extracted artefact-free epochs of 2.048 s from each 1 min-long post-threat EEG recording interval through a Hamming window and overlapped contiguous epochs by 75% to minimize data loss (as

[1] Following Gray and McNaughton (2000) we take a goal-regulation view of threat, and define it as any experience that raises the spectre of important goal frustration. Our psychology student participants were presumably committed to their academic goals. Accordingly, we manipulated Threat by immersing them in an experience that undermined their academic goals. The goal-threat nature of the present Threat manipulation is supported by a recent finding showing that only when achievement (but not relationship) goals are implicitly primed do participants react defensively to this statistics-achievement threat. In contrast, only when relationship (but not achievement) goals are primed do participants react defensively to a relationship threat (Nash & McGregor, 2009, SPSP).

in Harmon-Jones & Allen, 1997). Power spectra (i.e. the squared magnitude of each frequency component) were calculated using a fast Fourier transform, and power values (in μV^2) were averaged across epochs within each post-threat interval.

Total power within the alpha band (8–13 Hz) was logarithmically transformed and asymmetry scores were calculated as right-site minus homologous left-site log alpha power. Higher alpha power is an inverse indication of cortical activity, thus higher scores (on the right minus left index) indicate relatively greater left-than-right cortical activation. We computed our main dependent variable, Relative Left Frontal (F7/F8) EEG Activity (in μV^2) by averaging the three 1 min post-threat asymmetry scores from frontal F7 and F8 sites, which sit over dorsolateral left and right prefrontal cortices, respectively. A baseline asymmetry score was similarly computed by averaging the eight 1 min baseline intervals at the same F7 and F8 sites. We used parietal (P3/P4), temporal (T7/T8), and occipital (O1/O2) asymmetry scores for comparison (following Coan & Allen, 2003a; Coan & Allen, 2003b).

Results

The regression of Relative Left Frontal (F7/F8) EEG Activity on Threat, Self-Esteem, and the Threat × Self-Esteem interaction (with Baseline F7/F8 EEG as a covariate) revealed the predicted interaction effect, $\beta = .33$, $t(25) = 2.44$, $P_{rep} = .93$, $d = .98$, with the expected peak in Relative Left Frontal (F7/F8) EEG Activity among participants in the Threat condition with high Self-Esteem (Fig. 1). There were no significant effects at the parietal, temporal, or occipital comparison sites. Relative Left Frontal (F7/F8) EEG Activity was highest at high Self-Esteem (+1 SD) in the Threat condition ($y' = .38$)—significantly higher than in the No-Threat condition ($y' = .14$), $t(25) = 2.74$, $P_{rep} = .95$, $d = 1.10$.

Discussion

The results support an understanding of high self-esteem that can account for both its resilient and antisocial aspects. The EEG pattern is consistent with the hypothesis that when threatened, participants with high self-esteem engage in reactive approach-motivation. Doing so may be rewarding because it mollifies threat. The approach-motivation-related pattern of EEG activity that was activated in the present research as a joint function of self-esteem and threat has been associated with various measures of resilience in past research, including happiness, meaning, and relative insensitivity to risk and discomfort. Given these benefits of approach-motivation for personal resilience, it is not surprising that people with high self-esteem, who have an affinity for approach-motivation, turn to reactive approach-motivation when threatened.

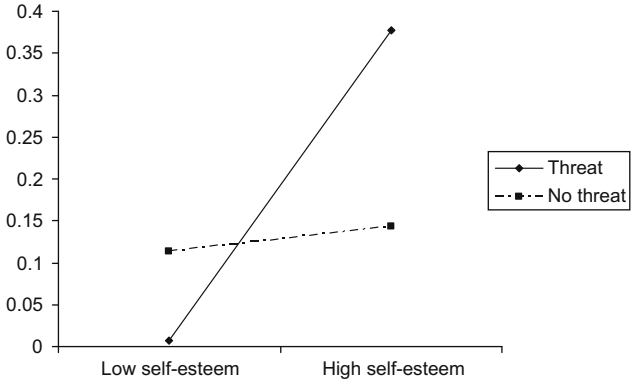

Fig. 1. Relative Left Frontal (F7/F8) EEG Activity (μV^2) as a function of self-esteem and threat.

As personally salutary as reactive approach-motivation may be, it may have a darker social side, however. The same resilience-associated pattern of approach-motivation-related EEG activity found in the present study has also been associated with anger, defensive rationalization, and a narrowing of attention to stimuli relevant to one's own personal goals. Angry, defensive, and selfish are states not conducive to thoughtful perspective-taking. Thus, alongside personal empowerment and resilience, the reactive approach-motivation of high self-esteem individuals may promote selfish and antisocial outcomes as well. Indeed, in past research participants with high self-esteem became particularly arrogant and obnoxious after a failure threat (Heatherton & Vohs, 2000; Vohs & Heatherton, 2001), narrowly opinionated after uncertainty threat (McGregor & Marigold, 2003; McGregor et al., 2005), and derogatory toward outgroups and defensively self-enhancing after mortality salience (McGregor et al., 2007, Study 1; Schmeichel et al., in press, Study 3). The present results provide neural evidence for a basic, reactive approach-motivation response to threat, capable of accounting for both the resilient and antisocial aspects of high, explicitly assessed self-esteem.[2]

Based on the present EEG results alone one can not definitively conclude that the high self-esteem reaction to threat reflects reactive approach-motivation. As with any neural correlate, there is not a one-to-one relation between relative left frontal activation and approach-motivation. Various other phenomena are also associated with relative left frontal EEG activity, such as positive affect and power. Another limitation of the present research is that it did not include a manipulation check of feelings caused by the threat vs. control condition manipulations. Although past research has found that the two strongest affective reactions to this threat are uncertainty and confusion (McGregor et al., 2008) and that it has also even caused a drop in implicit self-esteem (McGregor et al., 2005), it is possible that in the present, unique research context, different kinds of feelings may have been aroused. The present results should therefore be interpreted together with past research showing that individuals with high self-esteem react similarly to various threats (e.g., the one used in the present research, mortality salience, dilemma-related uncertainty, relationship attachment threats) with diverse outcomes (hostility, idealism, self-enhancement, meaning-seeking) which seem to share the common denominator of approach motivation. The current neural result supports the approach-motivation hypothesis that was derived from previous personality and social psychological research. It is this convergence that most strongly supports the reactive approach-motivation hypothesis.

On a practical level, the present results may hold promise for guiding interventions to relieve antisocial outcomes that can be associated with high self-esteem. If the basic defensive process that drives antisocial defenses is reactive approach-motivation, then if prosocial routes for approach were provided, threatened individuals might be inclined to promote them instead of more antisocial routes. Some evidence for this speculation comes from recent studies that have experimentally manipulated religious compassion primes. In the non-compassion-prime conditions, threats made people more vengeful. In the compassion-prime conditions however, threats made people more charitable (Pyszczyn-

[2] Low implicitly assessed self-esteem appears to be more a function of self-associations than of a tendency toward approach-motivation and motivated cognition. Accordingly, implicitly assessed self-esteem would not be expected to moderate reactive approach-motivation in the same way. Indeed, implicit self-esteem appears to moderate phenomena related to reactive approach-motivation in the opposite direction. In past research, high implicitly assessed self-esteem has been associated with less reactive defensiveness after the statistics threat used in the present research, and also after mortality salience, uncertainty, and relationship threats (see McGregor & Jordan, 2007; McGregor & Marigold, 2003; McGregor et al., 2005; Schmeichel et al., in press).

ski, Rothschild, & Abdollahi, 2008; Schumann, Nash, McGregor, & Ross, 2009).

The malleability of reactive approach-motivation may further account for why value-affirmation manipulations relieve extreme and defensive reactions to threats (e.g., McGregor et al., Study 1; Schmeichel & Martens, 2005; Sherman & Cohen, 2006). Value-affirmations may preemptively activate approach-motivation processes by focusing participants on promotion of their ideals and values, thereby relieving the need for more antisocial varieties of reactive approach-motivation (see Amodio, Shah, Sigelman, Brazy, & Harmon-Jones, 2004; Higgins, 1996; Higgins, 1997, for theoretical and empirical links between ideals and approach-motivation; see Harmon-Jones et al., 2008, for link between anger and approach-motivation). Future research should assess this approach-motivational account of self-affirmation theory.

Finally, and most generally, the present findings might be a first step toward greater integration of a wide variety of theories on fluid compensation reactions to diverse threats. In now hundreds of published experiments, various threats have been found to cause far ranging varieties of angry, self-serving, extreme, ideological, and meaning-seeking outcomes, and are currently explained by dozens of different theories (e.g., Fritsche, Jonas, & Fankhänel, 2008; Greenberg, Solomon, & Pyszczynski, 1997; Harmon-Jones & Harmon-Jones, 2002; Hart, Shaver, & Goldenberg, 2005; Heine, Proulx, & Vohs, 2006; Kay, Gaucher, Napier, Callan, & Laurin, 2008; McGregor, Zanna, Holmes, & Spencer, 2001; Mikulincer, Florian, & Hirschberger, 2003; Mullen & Skitka, 2006; Murray et al., 1998; Steele, 1988; Tesser, 2000; Twenge, Baumeister, & Stucke, 2001; van den Bos, van Ameijde & van Gorp, 2006). The present research findings suggest that a common denominator of much of this work may be that the defensive reactions, despite their ostensible differences (e.g., from anger to meaning), reflect reactive approach-motivation. Future research in the various threat-defense paradigms should measure approach-motivation-related dispositions and manipulate approach vs. avoidance motivation states to test whether they might moderate defensive reactions to the various threats.

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