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Attentional bias to negative emotion as a function of approach and withdrawal anger styles: An ERP investigation ☆

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ABSTRACT

Although models of emotion have focused on the relationship between anger and approach motivation associated with aggression, anger is also related to withdrawal motivation. Anger-out and anger-in styles are associated with psychopathology and may disrupt the control of attention within the context of negatively valenced information. The present study used event-related brain potentials (ERPs) to examine whether anger styles uniquely predict attentional bias to negative stimuli during an emotion–word Stroop task. High anger-out predicted larger N200, P300, and N400 to negative words, suggesting that aggressive individuals exert more effort to override attention to negative information. In contrast, high anger-in predicted smaller N400 amplitude to negative words, indicating that negative information may be readily available (primed) for anger suppressors, requiring fewer resources. Individuals with an anger-out style might benefit from being directed away from provocative stimuli that might otherwise consume their attention and foster overt aggression. Findings indicating that anger-out and anger-in were associated with divergent patterns of brain activity provide support for distinguishing approach- and withdrawal-related anger styles.

1. Introduction

Researchers have postulated approach- and withdrawal-related motivational systems that are implemented in several brain regions and that play a crucial role in the experience and expression of emotion. Anger, a feeling evoked when individuals believe that they or others are treated badly or unfairly (Averill, 2001), involves approach and/or withdrawal behavior depending on context (e.g., Berkowitz, 1990; Watson, 2009; though see Carver and Harmon-Jones, 2009). Spielberger (1988, 1999) developed the State-Trait Anger Expression Inventory (STAXI), which conceptualizes anger expression styles that occur in connection with angry feelings. The STAXI anger-out scale reflects aggression, defined as the expression of angry verbal or motor behavior directed toward people or objects, whereas the STAXI anger-in scale is conceptualized as measuring suppression or inhibition of outward signs of anger and/or withdrawing from an anger-inducing situation.

Approach (anger-out) and withdrawal (anger-in) anger styles may disrupt the control of attention in the context of negatively valenced information, interfering with successful emotion regulation. Several behavioral studies have indicated that angry individuals display an attentional bias toward negatively valenced stimuli (e.g., Cohen et al., 1998; Eckhardt and Cohen, 1997; Kirsch et al., 2005; Smith and Waterman, 2003, 2004; van Honk et al., 2001) that could underlie the potential for angry individuals to perceive ambiguous situations as hostile and/or threatening (e.g., Hazebrook et al., 2001; Wenzel and Lystad, 2005). Furthermore, approach and withdrawal anger styles may differ in the timing and activation of attentional bias to negative stimuli.

Unlike behavioral measures such as reaction time (RT), event-related brain potentials (ERPs) offer multiple, millisecond measurements of attentional processes. However, little research is available on ERP effects associated with an anger-out style (Patrick and Verona, 2007), and none has specifically examined ERPs associated with an

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anger-in style. ERP studies of aggression have primarily used oddball tasks consisting of either auditory or visual stimuli and have focused on the parietally distributed P300 component, typically in patient or inmate populations (e.g., Barratt et al., 1997; Bernat et al., 2007; Harmon-Jones et al., 1997; Stanford et al., 2003), although college and community populations have also been examined (e.g., Gerstle et al., 1998; Mathias and Stanford, 1999; Surguy and Bond, 2006). P300, a positive deflection typically occurring 300 to 600 ms post-stimulus-onset, is thought to reflect stimulus evaluation, attention allocation, and context updating (e.g., Coles et al., 2000; Donchin and Coles, 1988). Results of these P300 studies suggest a link between impulsive aggression and reductions in parietal P300 amplitude (Barratt et al., 1997; Harmon-Jones et al., 1997).

Most ERP studies of aggression have employed non-emotional words or sounds as oddball stimuli, so it is unclear whether the association between reduced P300 amplitude and aggression generalizes to or differs from anger- or aggression-related stimuli. The single ERP study incorporating negatively valenced stimuli found that male community members high in aggression displayed reduced frontal P3a in response to non-target aggressive words in a visual oddball task, but these P3a reductions were in the absence of parietal P300 decrements in response to target–neutral food-related words (Surguy and Bond, 2006).

Whereas P300 is thought to reflect evaluation of stimulus significance, N100 (a negative deflection occurring around or shortly after 100 ms) and P200 (a positive deflection occurring about 200 ms) are components with frontocentral scalp distributions thought to reflect attention to stimuli during relatively early, perceptual stages of processing (e.g., Hillyard et al., 1998; Junghöfer et al., 2001; Nätäänen et al., 1982). In contrast to earlier components like the N100 and P200, the visual N200 is a negative-going ERP component occurring 200–300 ms post-stimulus, with a right-lateralized frontocentral scalp distribution localized to a right prefrontal source (Strik et al., 1998), thought to reflect response inhibition and/or conflict monitoring (e.g., van Veen and Carter, 2002). N400 indexes elaborative stimulus processing in that it is modulated by semantic meaning. Larger N400 amplitude is associated with improbable words, whereas smaller N400 amplitude is associated with facilitated processing (e.g., for words of higher lexical frequency or words primed within a particular sentence context; Kutas and Hillyard, 1980; van Petten and Kutas, 1990). Although N400 is reduced for emotional stimuli that are primed (Schirmer et al., 2002, 2005), it is also attenuated for emotional stimuli compared to neutral stimuli in the absence of explicit priming (Kanske and Kotz, 2007). If amplitudes of earlier components such as N100 or P200 are reduced in size, conclusions about aggression and its relationship to attention cannot be limited to later, "top-down" processes involving attentional control such as N200, P300, or N400. ERP studies of aggression have not typically analyzed components other than P300, although one study using neutral stimuli found no relationship between aggression and N100, P200, or N200 amplitude (Barratt et al., 1997).

The present study examined whether approach and withdrawal anger expression styles were differentially associated with attentional bias to negative words in an emotion–word Stroop task above and beyond measures of negative affect that are highly comorbid with anger expression such as depression, anxiety, and trait anger (e.g., Deffenbacher et al., 1996). Neural mechanisms involved in attention to emotional stimuli were measured using N100, P200, N200, P300, and N400 amplitude scores. The specificity of any such effects to negative stimuli was evaluated by inclusion of positive and neutral stimuli.

Differential predictions were made regarding ERP amplitude to negative stimuli in anger styles, despite lack of guidance from the literature. It was hypothesized that higher anger-in scores would predict larger N200, P300, and N400 amplitude in response to negative words, as more resources may be needed for high anger-in individuals to suppress outward angry responses. In contrast, it was predicted that anger-out would be linked to reduced N200, P300, and N400 amplitudes to negative stimuli based on prior P300 research utilizing non-emotional stimuli with aggressive individuals. It was predicted that the two anger styles would diverge only when executive control was needed (reflected in N200, P300, and N400 amplitude) to override attention to negative valence in order to select the correct color response.

It was likely that differences in brain activation as a function of anger style would occur without behavioral differences in RT or error rates (e.g., longer RT and more errors for negative stimuli than for positive or neutral stimuli), since in nonclinical samples, including samples indexing traits such as anxiety, RT impairment from emotional content is attenuated in the emotion–word Stroop task (e.g., Franken et al., 2009; Thomas et al., 2007). Thus, in the present study the focus was on ERP indices of attentional bias to emotional stimuli.

2. Method

2.1. Participants

Participants were 102 paid undergraduates (54 female, 81% Caucasian, mean age = 19.02, *SD* = 1.74) recruited via group questionnaire sessions in which measures of anger, anxiety, and depression were administered. Participants completed the Anger Expression-In, Anger Expression-Out, and Trait Anger scales from the State-Trait Anger Expression Inventory 2 (STAXI-2; Spielberger, 1999). STAXI-2 Anger Expression-In and Anger Expression-Out are 8-item scales on which participants rate how they generally react or behave when angry or furious (1 = almost never, 2 = sometimes, 3 = often, 4 = almost always). Examples of Anger Expression-In items are "I boil inside but don't show it" and "I withdraw from people." Examples of Anger Expression-Out items are "I strike out at whatever infuriates me" and "I do things like slam doors." STAXI-2 Trait Anger is a 10-item scale that measures individual differences in the predisposition to express anger and react angrily to situations involving frustration or negative evaluation. In addition to the Trait Anger scale, participants were administered other measures of negative affect to assess depression and types of anxiety that may co-occur with anger styles: the Penn State Worry Questionnaire (PSWQ; Meyer et al., 1990) to assess anxious apprehension, or worry, and the Anxious Arousal (AA) and Anhedonic Depression (AD) scales of the Mood and Anxiety Symptom Questionnaire (MASQ; Watson et al., 1995) to assess anxious arousal, or somatic anxiety, and anhedonic depression. A subscale of 8 items from the MASQ-AD was used that identifies depressed mood and loss of interest distinct from other items reflecting low positive affect (Nitschke et al., 2001). Means and standard deviations for STAXI-2, PSWQ, MASQ-AA, and 8-item MASQ-AD scales are provided in Table 1, and correlations between scales are presented in Table 2.[1] Results indicate that, although higher anger-in and anger-out scores were both associated with higher trait anger scores, anger-in (but not anger-out) was positively linked to depression and types of anxiety, with anger-in possessing a significantly higher correlation with anxious apprehension than anger-out ($p < 0.01$).

[1] All participants in this sample were recruited for a larger study on the basis of high (above the 80th percentile) and low (below the 50th percentile) scores on PSWQ, MASQ-AA, and 8-item MASQ-AD scales gathered during group testing sessions (PSWQ: 72 low-scoring subjects, 30 high; MASQ-AA: 74 low, 28 high; 8-item MASQ-AD: 72 low, 30 high). The STAXI-2, PSWQ, and MASQ questionnaires were readministered to participants during an individual laboratory tour, and these scores were used in the present study. Subjects selected with these criteria represent most of the range of the scales (all but about 1 *SD*), so this is not a traditional extreme-groups strategy. Furthermore, some regression to the mean occurred from the time of the mass testing session to the lab tour session; Table 1 indicates that 24–32% of the sample moved into the 50th to the 80th percentile range on the PSWQ and MASQ scales, demonstrating a relatively normal distribution of scores on these measures.