



Anger and the behavioral approach system

Eddie Harmon-Jones*

*Department of Psychology, University of Wisconsin-Madison, 1202 West Johnson Street,
Madison, WI 53706, USA*

Received 11 April 2002; received in revised form 19 August 2002; accepted 9 October 2002

Abstract

Two studies were conducted to test the hypothesis that trait anger is related to trait behavioral approach sensitivity (BAS). In both studies, trait BAS, as assessed by Carver and White's (1994) scale, was positively related to trait anger, as assessed by the Buss and Perry (1992) aggression questionnaire. One of the two studies found that trait anger also related to trait behavioral inhibition sensitivity (BIS) at the simple correlation level. In both studies, statistically controlling for general negative affect, which correlates with both anger and BIS, revealed that BAS and not BIS related to anger. In these regression analyses, general negative affect also related to anger, suggesting that BAS and general negative affect independently contribute to anger. Additional results in Study 2 revealed that BAS was positively correlated with physical aggression, and regressing aggression onto BAS, BIS, and general negative affect revealed that physical aggression was positively related to BAS, negatively related to BIS, and positively related to negative affect. Together with other research on anger and left frontal cortical activity (e.g. Harmon-Jones & Sigelman, 2001), the present results strongly challenge theoretical models that assume that approach motivation is associated only with positive affect.

© 2002 Elsevier Ltd. All rights reserved.

Keywords: Behavioral approach sensitivity; Anger; Aggression; Approach motivation

Several motivation theorists have proposed that two systems underlie much behavior. One system, is posited to manage appetitive, incentive motivation and approach behavior. It has been referred to as a behavioral activation system (BAS; Fowles, 1980, 1988), behavioral approach system (BAS; Gray, 1982, 1987a, 1987b, 1990, 1994a, 1994b), and behavioral facilitation system (Depue & Collins, 1999; Depue & Iacono, 1989; Depue, Krauss, & Spont, 1987). It has also

* Tel.: +1-608-265-5504; fax: +1-608-262-4029.

E-mail address: eharmonj@facstaff.wisc.edu (E. Harmon-Jones).

been referred to as an approach or appetitive motivational system (Cacioppo & Berntson, 1994; Cacioppo, Gardner, & Berntson, 1999; Davidson, 1998; Lang, Bradley, & Cuthbert, 1990, 1997). The other proposed system manages aversive motivation and the behaviors of avoidance and withdrawal. This system has been referred to as the behavioral inhibition system (BIS; Gray, 1982, 1987a, 1987b, 1990, 1994b), aversive/defensive system (Lang et al., 1990, 1997), and withdrawal motivational system (Davidson, 1998).

In addition, these motive systems are posited to be involved in the generation of emotions that are relevant to approach and withdrawal behavior. And although the theories underlying the proposed motivational systems differ in several regards, most of the theories posit that the approach motivational system (e.g. BAS) is involved in the generation of positive affect (Depue & Iacono, 1989; Gray, 1994b; Lang et al., 1990, 1997), whereas the aversive motivational system (e.g. BIS) is involved in the generation of negative affect (Gray, 1982, 1994a, 1994b; Lang et al., 1990, 1997).

Much theory and research suggest that the BAS is associated with positive affect. Theoretically, Gray (1990, 1994b) and Watson (2000) have linked the BAS with positive affect. In support of these ideas, Carver and White (1994) found that individuals high in BAS responded with more happiness when confronted with a challenging task. They also found that trait positive affect was positively associated with BAS.

Other research has demonstrated that individuals high in BAS evidence greater left than right frontal cortical activity, as measured by the inverse of EEG alpha power, during baseline resting sessions (Harmon-Jones & Allen, 1997; Sutton & Davidson, 1997). These findings are consistent with the idea that the BAS is related to positive affect, as other research has demonstrated that greater relative left frontal activity is associated with greater positive affect and less depression (Henriques & Davidson, 1990, 1991; Tomarken, Davidson, Wheeler, & Doss, 1992). Also, greater relative left frontal activity has been associated with more positive affective reports to happy film clips (Davidson, Ekman, Saron, Senulis, & Friesen, 1990).

The idea that the approach motivation system (e.g. BAS) is responsible for the creation of only affects of positive hedonic tone is a view widely accepted in much contemporary theorizing (Cacioppo & Berntson; 1994, Cacioppo et al., 1999; Lang et al., 1990, 1997; Watson, 2000; Watson, Wiese, Vaidya, & Tellegen, 1999). Although the BAS may be involved in the generation of positive affective responses, it is also possible that the BAS may be responsible for negative affective responses when these responses are associated with behavioral approach. Indeed, the primary function of the BAS is approach motivation, and approach motivation can be associated with negative affect. As Carver (2001) has recently reviewed, the negative affect of sadness occurs when individuals fail to meet approach oriented goals. In contrast, the negative affect of anxiety occurs when individuals fail to meet avoidance oriented goals (see e.g. Finlay-Jones & Brown, 1981; Higgins, Shah, & Friedman, 1997).

Other research is consistent with the idea that the BAS is associated with approach-related but negative affect. In particular, research has revealed that relative left frontal cortical activity, a putative correlate of BAS, is associated with anger, which is often associated with approach motivation (see Harmon-Jones & Sigelman, 2001, for a review). That is, research has demonstrated that increased left frontal cortical activity and decreased right frontal cortical activity are associated with trait anger (Harmon-Jones & Allen, 1998) and state anger (Harmon-Jones & Sigelman, 2001; Harmon-Jones, Sigelman, Bohlig, & Harmon-Jones, in press). In addition, individuals

with proneness toward mania, who have been found to have high levels of BAS (Meyer, Johnson, & Carver, 1999), evidence increased left frontal and decreased right frontal activity in response to anger-provoking situations (Harmon-Jones, Abramson, Sigelman, Bohlig, Hogan, & Harmon-Jones, 2002). Also consistent with the idea of BAS being positively related to anger, Corr (2002) has suggested that in humans high levels of BAS should be associated with higher expectancies for rewards, which should cause higher levels of frustration upon termination or reduction of the magnitude of reward (see also Carver, 2001; Mikulincer, 1988; Wortman & Brehm, 1975).

While this recent research strongly suggests that the BAS is associated with the negative affect of anger, the conclusion is tenuous, as it is only through triangulation that the BAS is associated with anger. In other words, no direct link has been identified between the BAS and anger. To more convincingly demonstrate that the BAS is associated with anger, evidence needs to be provided that demonstrates that other measures of the BAS and anger are related. To address this issue, two studies were conducted in which the BAS and anger were measured using established, well-accepted, and face-valid measures. Individual differences in BAS were predicted to be associated with individual differences in anger, such that high levels of BAS would be associated with high levels of anger.

In addition to measuring BAS and anger, individual differences in general activated positive affect, general activated negative affect, and BIS were measured, to assess relationships of these constructs with anger and BAS. Based on past research (e.g. Carver & White, 1994), it was predicted that BAS would be associated with positive affect and that BIS would be associated with negative affect. It was also predicted that although anger is associated with BAS, it may also be associated with BIS, through BIS's connection with general negative affect. Because anger is associated with general negative affect (Berkowitz, 1999, 2000; Watson, 2000), it may also be associated with BIS because of the positive association of BIS and general negative affect. That is, the affect of anger has two subcomponents: a nonspecific component that reflects the contribution of general negative affect (Berkowitz, 1999; Watson, 2000) and a more specific component that reflects the unique qualities of anger (Watson, 2000). In other words, at the simple correlation level, anger may be associated with BIS, but when controlling for negative affect, anger will not be associated with BIS but will only be associated with BAS. To test these predictions, two studies were conducted.

1. Study 1

1.1. Method

1.1.1. Participants

The participants were 164 students at the University of Wisconsin-Madison who participated in exchange for extra credit in their introductory psychology course.

1.1.2. Procedure

Participants completed the questionnaires in groups of 10–20. They were seated in a classroom with at least one desk between each participant. After being greeted by an experimenter, participants were informed that the study concerned the relationships between various measures of personality characteristics. Then, they read a consent form and provided their informed consent

by signing the form. Next, they completed the questionnaires (listed later), which were presented in one of five random orders. Finally, they were thanked for their participation and excused.

1.1.3. Materials

Carver and White's (1994) BIS/BAS questionnaire was administered to assess individual differences in BIS sensitivity and BAS sensitivity. The BIS Scale contains seven items and sample items include: "I worry about making mistakes" and "I have very few fears compared to my friends (reverse scored)." The BAS Scale consists of three subscales: (1) reward responsiveness ("It would excite me to win a contest"), which contains items that "focus on positive responses to the occurrence or anticipation of reward"; (2) drive ("I go out of my way to get things I want"), which contains items that pertain "to the persistent pursuit of desired goals"; and (3) fun seeking ("I crave excitement and new sensations"), which has items "reflecting both a desire for new rewards and a willingness to approach a potentially rewarding event on the spur of the moment." (p. 322). The BIS/BAS questionnaire has acceptable reliability and validity (Carver & White, 1994) and it has been found to relate to other putative measures of BIS and BAS (Harmon-Jones & Allen, 1997; Sutton & Davidson, 1997). As in past research (Harmon-Jones & Allen, 1997; Sutton & Davidson, 1997), the three subscales were combined to form the index of BAS (the subscales were significantly inter-correlated, r 's > 0.28, P s < 0.001). Responses were measured using a four-point scale (1 = strongly disagree to 4 = strongly agree).

The anger subscale of the Buss and Perry (1992) Aggression Questionnaire was administered to assess trait anger. Only the anger subscale was administered to reduce the number of items participants had to complete. Sample items include "When frustrated, I let my irritation show" and "Some of my friends think I am a hothead." The anger scale has acceptable reliability and validity (Buss & Perry, 1992; Harris, 1997). Responses were measured using a five-point scale (1 = extremely uncharacteristic of me to 5 = extremely characteristic of me).

The Positive and Negative Affect Schedule (PANAS-X; Watson & Clark, 1991) assesses activated positive and negative affect (using items from Watson, Clark, & Tellegen, 1988), as well as 11 more specific affects (fear, hostility, guilt, sadness, joviality, self-assurance, attentiveness, shyness, fatigue, serenity, and surprise). In total, the PANAS-X has 60 items. Of particular importance for the present study is hostility, which is measured using the words angry, hostile, irritable, scornful, disgusted, and loathing. Instructions asked participants to indicate to what extent they feel the listed emotions "in general, that is, on the average." Extent was measured using a five-point scale (1 = very slightly or not at all to 5 = extremely).

1.2. Results and discussion

In support of the primary hypothesis, trait anger, as measured by Buss and Perry's (1992) anger scale, correlated positively with BAS, suggesting that greater levels of BAS are associated with greater levels of trait anger. In addition, trait anger correlated positively with BIS and general negative affect. This general pattern of correlations was replicated when the hostility subscale of the PANAS-X was used. Replicating past research (Carver & White, 1994), BAS was positively correlated with positive affect and BIS was positively correlated with negative affect. The simple correlations (and means and standard deviations for each scale) are displayed in Table 1.

Table 1
Means, standard deviations, and simple correlations—Study 1

| | M/SD | BAS | Drive | Fun | Rew | BIS | NA | PA | Anger |
|---------|-----------|---------|---------|---------|---------|---------|----------|-------|-------|
| BAS | 3.12/0.35 | | | | | | | | |
| Drive | 2.86/0.53 | 0.80*** | | | | | | | |
| Fun | 3.11/0.48 | 0.78*** | 0.42*** | | | | | | |
| Rew | 3.40/0.40 | 0.66*** | 0.28*** | 0.31*** | | | | | |
| BIS | 2.94/0.52 | 0.09 | −0.01 | −0.07 | .35*** | | | | |
| NA | 1.99/0.56 | −0.07 | −0.11 | −0.07 | −0.02 | 0.34*** | | | |
| PA | 3.46/0.56 | 0.47*** | 0.44*** | 0.26*** | 0.34*** | −0.08 | −0.26*** | | |
| Anger | 2.42/0.73 | 0.23** | 0.15* | 0.24** | 0.12 | 0.20* | 0.36*** | −0.03 | |
| Hostile | 1.87/0.61 | 0.13 | 0.19* | 0.10 | −0.02 | 0.19* | 0.70*** | −0.09 | 54*** |

M/SD = mean and standard deviation; BAS = behavioral approach sensitivity; Drive = BAS Drive; Fun = BAS Fun Seeking; Rew = BAS Reward Responsiveness; BIS = behavioral inhibition sensitivity; NA = activated negative affect; PA = activated positive affect; Anger = Buss and Perry (1992) trait anger scale; Hostile = PANAS trait hostility.

* $P < 0.05$.

** $P < 0.01$.

*** $P < 0.001$.

As hypothesized, trait anger related to BAS, BIS, and general negative affect. To explore whether these relationships of anger to BAS and BIS were due to the overlap of general negative affect with BIS, a standard regression analysis was performed in which BAS, BIS, and negative affect predicted anger. Results of this analysis revealed that only BAS and negative affect predicted anger (for both Buss and Perry anger and PANAS hostility). Results are displayed in Table 2. A standard regression analysis with BAS, BIS, negative affect, and positive affect as predictors and anger (hostility) as the criterion revealed that only BAS (anger $\beta = 0.27$, *partial* $r = 0.26$, $t = 3.26$, $P = 0.001$; hostility $\beta = 0.18$, *partial* $r = 0.27$, $t = 2.83$, $P = 0.005$) and negative affect (anger $\beta = 0.34$, *partial* $r = 0.33$, $t = 4.25$, $P = 0.001$; hostility $\beta = 0.73$, *partial* $r = 0.69$, $t = 11.94$, $P < 0.001$) related significantly with anger. BIS and positive affect were non-significant predictors ($P_s > 0.27$).

To assess whether the BIS affected the association of BAS and anger (and hostility), the statistical interaction of BIS and BAS was entered into the regression model (following recommendations of Aiken & West, 1991). Results revealed a non-significant effect for both anger and hostility. The statistical interaction of BIS and each BAS subscale was tested in six separate regression analyses (three BAS subscales and two anger criterions). Results revealed five

Table 2
Regression results from Study 1—predicting anger

| | β | <i>Partial r</i> | <i>t</i> | <i>P</i> |
|-----|------------|------------------|------------|-------------|
| BAS | 0.24/0.19 | 0.26/0.26 | 3.27/3.32 | 0.001/0.001 |
| BIS | 0.07/−0.07 | 0.08/−0.09 | 0.94/−1.14 | 0.35/0.26 |
| NA | 0.35/0.73 | 0.35/0.70 | 4.57/12.26 | 0.001/0.001 |

The numbers before the forward slash indicate the results for Buss and Perry anger. The numbers after the slash indicate the results for PANAS-X hostility.

non-significant interactions ($P_s > 0.16$), though the BIS \times Fun Seeking interaction approach significance ($\beta = 0.15$, *partial* $r = 0.15$, $t = 1.89$, $P = 0.06$).

Study 1 provided support for the primary hypothesis that individual differences in BAS would be related to individual differences in anger. In addition, results revealed that anger was associated with BIS and general negative affect. However, statistically controlling for general negative affect reduced the relationship of anger and BIS to non-significance, suggesting that anger and BIS are related because of the overlap of anger and general negative affect (Berkowitz, 1999, 2000; Watson, 2000). The positive association of approach motivation and anger is consistent with some contemporary approaches to emotion and motivation (Carver, 2001; Harmon-Jones & Allen, 1998; Harmon-Jones & Sigelman, 2001). However, because the finding is counter to predictions offered from other theories of emotion and motivation (Cacioppo & Berntson, 1994, Cacioppo et al., 1999; Davidson, 1998; Gray, 1994b; Lang et al., 1990, 1997), a second study was conducted to assess whether the relationship of anger and BAS would replicate. In addition, in Study 2, measures of individual differences in aggression were included to assess whether aggression would relate to BAS. If individual differences in physical aggression are due to differences in approach motivation, then physical aggression should relate to individual differences in BAS. Consistent with this hypothesis, past research has indicated that aggression is associated with increased left frontal cortical activity (Harmon-Jones & Sigelman, 2001), which has been found to be associated with the BAS (Harmon-Jones & Allen, 1997; Sutton & Davidson, 1997).

2. Study 2

2.1. Method

2.1.1. Participants

The participants were 41 students at the University of Wisconsin-Madison who participated in exchange for extra credit in their introductory psychology course.

2.1.2. Procedure and materials

The same procedure used in Study 1 was used in Study 2.

However, in this study, participants completed the full Buss and Perry (1992) Aggression Scale. It is composed of four factors: (1) physical aggression, which assesses the frequency of acting aggressively; (2) verbal aggression, which assesses the frequency of behaving verbally aggressive; (3) anger, which assesses the emotional component of aggression; and (4) hostility, which assesses the cognitive component of aggression that can be described as “feelings of ill will and injustice.” (Buss & Perry, 1992, p. 457).

2.2. Results and discussion

In support of the primary hypothesis, trait anger, as measured by Buss and Perry's (1992) anger scale, correlated positively with BAS, suggesting that greater levels of the BAS are associated with greater levels of trait anger. In addition, trait anger correlated positively with general negative affect but not BIS in this sample. In this study, BAS did not correlate with the hostility subscale

of the PANAS-X. Replicating past research (e.g. Carver & White, 1994), BAS was positively correlated with positive affect and BIS was positively correlated with negative affect. The simple correlations (and means and standard deviations for each scale) are displayed in Table 3.

As hypothesized, trait anger related to BAS. As in Study 1, a standard regression analysis was performed in which BAS, BIS, and negative affect predicted anger. Results of this analysis revealed that only BAS and negative affect predicted anger (for Buss and Perry anger but not PANAS hostility). Results are displayed in Table 4. A standard regression analysis with BAS, BIS, negative affect, and positive affect as predictors and anger as the criterion revealed that BAS ($\beta=0.57$, *partial r*=0.54, $t=3.84$, $P<0.001$), negative affect ($\beta=0.46$, *partial r*=0.52, $t=3.57$, $P=0.001$), and positive affect ($\beta=-0.37$, *partial r*=-0.37, $t=-2.38$, $P=0.02$) related significantly with anger. BIS was a non-significant predictor ($P<0.40$). A similar regression analysis with PANAS-hostility as the criterion revealed that only negative affect was a significant predictor

Table 3
Means, standard deviations, and simple correlations—Study 2

| | M/SD | BAS | Drive | Fun | Rew | BIS | NA | PA | Anger | Hostile | P-Agg | V-Agg |
|---------|-----------|---------|---------|---------|--------|--------|---------|--------|---------|---------|--------|-------|
| BAS | 3.07/0.45 | | | | | | | | | | | |
| Drive | 2.74/0.61 | 0.84*** | | | | | | | | | | |
| Fun | 3.020/.57 | 0.89*** | 0.61*** | | | | | | | | | |
| Rew | 3.44/0.43 | 0.76*** | 0.40** | 0.62*** | | | | | | | | |
| BIS | 3.14/0.43 | -0.08 | -0.03 | -0.17 | 0.03 | | | | | | | |
| NA | 1.97/0.47 | -0.13 | -0.03 | -0.16 | -0.15 | 0.17 | | | | | | |
| PA | 3.33/0.63 | 0.56*** | 0.38* | 0.52** | 0.52** | -0.20 | -0.32* | | | | | |
| Anger | 2.20/0.76 | 0.34* | 0.45** | 0.23 | 0.11 | 0.03 | 0.50** | -0.18 | | | | |
| Hostile | 1.79/0.56 | -0.17 | -0.05 | -0.19 | -0.20 | 0.05 | 0.79*** | -0.36* | 0.48** | | | |
| P-Agg | 1.92/0.66 | 0.37* | 0.42** | 0.32* | 0.14 | -0.34* | 0.41** | 0.16 | 0.64*** | 0.33* | | |
| V-Agg | 2.86/0.80 | 0.05 | 0.27 | -0.10 | -0.09 | 0.01 | 0.20 | -0.15 | 0.63*** | 0.31* | 0.48** | |
| B-Hos | 2.44/0.76 | -0.11 | 0.08 | -0.11 | -0.30 | 0.25 | 0.61*** | 0.35* | 0.57*** | 0.61*** | 0.42** | 0.31* |

M/SD=mean and standard deviation; BAS=behavioral approach sensitivity; Drive=BAS Drive; Fun=BAS Fun Seeking; Rew=BAS Reward Responsiveness; BIS=behavioral inhibition sensitivity; NA=activated negative affect; PA=activated positive affect; Anger=Buss and Perry (1992) trait anger scale; Hostile=PANAS trait hostility; P-Agg=physical aggression; V-Agg=verbal aggression; Hos-B=hostility on Buss and Perry (1992).

* $P<0.05$.

** $P<0.01$.

*** $P<0.001$.

Table 4
Regression results from Study 2—predicting anger

| | β | <i>Partial r</i> | t | P |
|-----|-------------|------------------|-------------|-------------|
| BAS | 0.37/-0.08 | 0.43/-0.12 | 2.85/-0.74 | 0.007/0.47 |
| BIS | -0.07/-0.09 | -0.08/-0.14 | -0.50/-0.87 | 0.62/0.39 |
| NA | 0.55/0.79 | 0.57/0.79 | 4.18/7.68 | 0.001/0.001 |

The numbers before the forward slash indicate the results for Buss and Perry anger. The numbers after the slash indicate the results for PANAS-X hostility.

Table 5
Regression results from Study 2—predicting physical aggression

| | β | Partial r | t | P |
|-----|---------|-------------|-------|-------|
| BAS | 0.37 | 0.46 | 3.13 | 0.003 |
| BIS | −0.44 | −0.53 | −3.75 | 0.001 |
| NA | 0.53 | 0.60 | 4.47 | 0.001 |

($\beta = 0.76$, $partial\ r = 0.77$, $t = 7.07$, $P > 0.001$). BAS, BIS, and positive affect were non-significant predictors of hostility ($P_s < 0.33$).

It is interesting to speculate as to why hostility as measured by the PANAS-X did not relate to BAS in the current study. As can be seen in Table 3, PANAS-X hostility correlated less strongly with physical aggression than did the Buss–Perry Anger Scale. In past research on anger and left frontal cortical activity, it has been found that Buss–Perry anger and physical aggression correlate more strongly with left frontal activity than Buss–Perry hostility (which measures suspicion, resentment, and sensitivity to mistreatment) correlates with left frontal activity (Harmon-Jones & Allen, 1998). These results suggest that PANAS-X hostility, which correlates highly with Buss–Perry hostility, does not assess approach motivation as well as Buss–Perry anger and physical aggression.

Because physical aggression was significantly correlated with BAS at the simple correlation level, a standard regression analysis was performed to assess how BAS, BIS, and general negative affect would predict physical aggression. As shown in Table 5, BAS was positively related to aggression, BIS was negatively related to aggression, and negative affect was positively related to aggression. These results are consistent with the hypothesis that individual differences in physical aggression are positively associated with individual differences in approach motivation.

To assess whether the BIS affected the association of BAS and anger (hostility was not tested because it was not related to BAS), the statistical interaction of BIS and BAS was entered into the regression model with BAS and BIS as predictors. Results revealed a non-significant interaction ($P < 0.18$). The statistical interaction of BIS and each BAS subscale was tested in three separate regression analyses. Results revealed three non-significant interactions ($P_s > 0.15$).

3. General discussion

The present research demonstrated that individual differences in the BAS are related to individual differences in anger. These results were demonstrated in straightforward simple correlational analyses in two studies. In Study 1, anger also correlated with BIS. Because anger is correlated with general negative affect (Berkowitz, 1999, 2000; Watson, 2000), and BIS is correlated with general negative affect (Carver & White, 1994), a regression analysis was performed to assess how BAS and BIS would relate to anger when general negative affect was statistically controlled. Results from this analysis revealed that BAS but not BIS correlated with anger. In Study 2, anger was correlated with BAS but not with BIS. A regression analysis also revealed that when BAS, BIS, and general negative affect were used to predict anger, only BAS and general negative affect

predicted anger. Thus, these results directly demonstrate that trait anger is related to trait BAS. Consistent with these results, Carver (submitted for publication) recently found that trait BAS predicted self-reported anger to anger-evoking situations. Finally, the present research suggests that BAS and general negative affect independently contribute to anger and aggression.

It is important to note that the correlation between trait anger and trait BAS occurred even when the self-report measures used to assess these constructs were very dissimilar. That is, there is no overlap of items between the BAS and anger scales. Moreover, it is impressive that anger related to BAS when reporting high levels of BAS is socially desirable and reporting high levels of anger is socially undesirable (in the culture in which the data were collected). That self-reported BAS and anger relate in opposite directions with socially desirable responding suggests that, were BAS and anger free of social desirability, their relationships may be even stronger.

Study 2 demonstrated that BAS was positively associated with physical aggression, whereas BIS was negatively associated with physical aggression. Importantly, BIS correlated negatively with physical aggression but not anger. These findings suggest that BIS inhibits physically aggressive behaviors but not anger.

Inconsistent with the present results that demonstrate a positive relationship between BAS and aggression, Gray (1987b) has posited that aggression is an escape response to unconditioned punishment or unconditioned frustration, and therefore should be related to the flight–fight system rather than the BAS (or the BIS). Future studies should compare the ability of measures of the BAS and the fight–flight system to predict anger and aggression in humans.

The present research is limited because the methods used were correlational and subject to limitations associated with correlational designs (e.g. third variables, direction of causality). Future research should extend the present research by manipulating the BAS and assessing whether increases in BAS increase state anger and aggression.

The present results strongly challenge theoretical models that assume that approach motivation is associated only with positive affect. The present results suggest that anger, a negative affect, is associated with approach motivation (BAS) at the individual differences level. These results are consistent with a growing body of evidence demonstrating that approach-related angry feelings are associated with increased left frontal cortical activity (Harmon-Jones & Sigelman, 2001; Harmon-Jones, Sigelman et al., in press), a brain region involved in the BAS (Harmon-Jones & Allen, 1997; Sutton & Davidson, 1997). Taken together, the research suggests the need for revision of contemporary theories of the relationship between approach motivation and positive affect.

Acknowledgements

I am grateful to Cindy Harmon-Jones for providing helpful comments on earlier versions of this manuscript.

References

- Aiken, L. S., & West, S. G. (1991). *Multiple regression: testing and interpreting interactions*. Newbury Park, CA: Sage.
- Berkowitz, L. (1999). Anger. In T. Dalgleish, & M. J. Power (Eds.), *Handbook of cognition and emotion* (pp. 411–428). Chichester, England: John Wiley and Sons.

- Berkowitz, L. (2000). *Causes and consequences of feelings*. Cambridge, United Kingdom: Cambridge University Press.
- Buss, A. H., & Perry, M. (1992). The aggression questionnaire. *Journal of Personality and Social Psychology*, *63*, 452–459.
- Cacioppo, J. T., & Berntson, G. G. (1994). Relationship between attitudes and evaluative space: a critical review, with emphasis on the separability of positive and negative substrates. *Psychological Bulletin*, *115*, 401–423.
- Cacioppo, J. T., Gardner, W. L., & Berntson, G. G. (1999). The affect system has parallel and integrative processing components: form follows function. *Journal of Personality and Social Psychology*, *76*, 839–855.
- Carver, C. S. (2001). Affect and the functional bases of behavior: on the dimensional structure of affective experience. *Personality and Social Psychology Review*, *5*, 345–356.
- Carver, C. S. Negative affects and the behavioral approach system (submitted for publication).
- Carver, C. S., & White, T. L. (1994). Behavioral inhibition, behavioral activation, and affective responses to impending reward and punishment: the BIS/BAS scales. *Journal of Personality and Social Psychology*, *67*, 319–333.
- Corr, P. J. (2002). J.A. Gray's reinforcement sensitivity theory and frustrative nonreward: a theoretical note on expectancies in reactions to rewarding stimuli. *Personality and Individual Differences*, *32*, 1247–1253.
- Davidson, R. J. (1998). Anterior electrophysiological asymmetries, emotion, and depression: conceptual and methodological conundrums. *Psychophysiology*, *35*, 607–614.
- Davidson, R. J., Ekman, P., Saron, C. D., Senulis, J. A., & Friesen, W. V. (1990). Approach-withdrawal and cerebral asymmetry: emotional expression and brain physiology I. *Journal of Personality and Social Psychology*, *58*, 330–341.
- Depue, R. A., & Collins, P. F. (1999). Neurobiology of the structure of personality: dopamine, facilitation of incentive motivation, and extraversion. *Behavioral and Brain Sciences*, *22*, 491–517.
- Depue, R. A., & Iacono, W. G. (1989). Neurobehavioral aspects of affective disorders. *Annual Review of Psychology*, *40*, 457–492.
- Depue, R. A., Krauss, S., & Spoont, M. R. (1987). A two-dimensional threshold model of seasonal bipolar affective disorder. In D. Magnusson, & A. Öhman (Eds.), *Psychopathology: an interactional perspective* (pp. 95–123). New York: Academic Press.
- Finlay-Jones, R., & Brown, G. W. (1981). Types of stressful life events and the onset of anxiety and depressive disorders. *Psychological Medicine*, *11*, 803–815.
- Fowles, D. C. (1980). The three arousal model: implications of Gray's two-factor learning theory for heart rate, electrodermal activity, and psychopathy. *Psychophysiology*, *17*, 87–104.
- Fowles, D. C. (1988). Psychophysiology and psychopathology: a motivational approach. *Psychophysiology*, *25*, 373–391.
- Gray, J. A. (1982). *The neuropsychology of anxiety: an enquiry into the functions of the septo-hippocampal system*. New York: Oxford University Press.
- Gray, J. A. (1987a). Perspectives on anxiety and impulsivity: a commentary. *Journal of Research in Personality*, *21*, 493–509.
- Gray, J. A. (1987b). *The psychology of fear and stress*. Cambridge: Cambridge University Press.
- Gray, J. A. (1990). Brain systems that mediate both emotion and cognition. *Cognition and Emotion*, *4*, 269–288.
- Gray, J. A. (1994a). Personality dimensions and emotion systems. In P. Ekman, & R. J. Davidson (Eds.), *The nature of emotion: fundamental questions* (pp. 329–331). New York: Oxford University Press.
- Gray, J. A. (1994b). Three fundamental emotion systems. In P. Ekman, & R. J. Davidson (Eds.), *The nature of emotion: fundamental questions* (pp. 243–247). New York: Oxford University Press.
- Harmon-Jones, E., Abramson, L. Y., Sigelman, J., Bohlig, A., Hogan, M. E., & Harmon-Jones, C. (2002). Proneness to hypomania/mania symptoms or depression symptoms and asymmetrical frontal cortical responses to an anger-evoking event. *Journal of Personality and Social Psychology*, *82*, 610–618.
- Harmon-Jones, E., & Allen, J. J. B. (1997). Behavioral activation sensitivity and resting frontal EEG asymmetry: covariation of putative indicators related to risk for mood disorders. *Journal of Abnormal Psychology*, *106*, 159–163.
- Harmon-Jones, E., & Allen, J. J. B. (1998). Anger and prefrontal brain activity: EEG asymmetry consistent with approach motivation despite negative affective valence. *Journal of Personality and Social Psychology*, *74*, 1310–1316.
- Harmon-Jones, E., & Sigelman, J. (2001). State anger and prefrontal brain activity: evidence that insult-related relative left prefrontal activity is associated with experienced anger and aggression. *Journal of Personality and Social Psychology*, *80*, 797–803.

- Harmon-Jones, E., Sigelman, J. D., Bohlig, A., & Harmon-Jones, C. Anger, coping, and frontal cortical activity: the effect of coping potential on anger-induced left frontal activity. *Cognition and Emotion* (in press).
- Harris, J. A. (1997). A further evaluation of the aggression questionnaire: issues of validity and reliability. *Behaviour Research & Therapy*, 35, 1047–1053.
- Henriques, J. B., & Davidson, R. J. (1990). Regional brain electrical asymmetries discriminate between previously depressed and healthy control subjects. *Journal of Abnormal Psychology*, 99, 22–31.
- Henriques, J. B., & Davidson, R. J. (1991). Left frontal hypoactivation in depression. *Journal of Abnormal Psychology*, 100, 535–545.
- Higgins, E. T., Shah, J., & Friedman, R. (1997). Emotional responses to goal attainment: strength of regulatory focus as a moderator. *Journal of Personality and Social Psychology*, 72, 515–525.
- Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1990). Emotion, attention, and the startle reflex. *Psychological Review*, 97, 377–395.
- Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). Motivated attention: affect, activation, and action. In P. J. Lang, R. F. Simons, & M. T. Balaban (Eds.), *Attention and orienting: sensory and motivational processes* (pp. 97–135). Mahwah, NJ: Lawrence Erlbaum.
- Meyer, B., Johnson, S. L., & Carver, C. S. (1999). Exploring behavioral activation and inhibition sensitivities among college students at risk for bipolar spectrum symptomatology. *Journal of Psychopathology and Behavioral Assessment*, 21, 275–292.
- Mikulincer, M. (1988). Reactance and helplessness following exposure to unsolvable problems: the effects of attributional style. *Journal of Personality and Social Psychology*, 54, 679–686.
- Sutton, S. K., & Davidson, R. J. (1997). Prefrontal brain asymmetry: a biological substrate of the behavioral approach and inhibition systems. *Psychological Science*, 8, 204–210.
- Tomarken, A. J., Davidson, R. J., Wheeler, R. E., & Doss, R. (1992). Individual differences in anterior brain asymmetry and fundamental dimensions of emotion. *Journal of Personality and Social Psychology*, 62, 676–687.
- Watson, D. (2000). *Mood and temperament*. New York: Guilford Press.
- Watson, D., & Clark, L. A. (1991). The PANAS-X: preliminary manual for the positive and negative affect schedule—expanded form (unpublished manuscript).
- Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: the PANAS scales. *Journal of Personality and Social Psychology*, 54, 1063–1070.
- Watson, D., Wiese, D., Vaidya, J., & Tellegen, A. (1999). The two general activation systems of affect: structural findings, evolutionary considerations, and psychobiological evidence. *Journal of Personality and Social Psychology*, 76, 820–838.
- Wortman, C. B., & Brehm, J. W. (1975). Responses to uncontrollable outcomes: an integration of reactance theory and the learned helplessness model. In L. Berkowitz (Ed.), *Advances in experimental social psychology*, Vol. 8 (pp. 278–336). New York: Academic Press.