

2014

# A Test of Spielberger's State-Trait Theory of Anger with Adolescents: Five Hypotheses

Colleen Quinn

*Virginia Commonwealth University*

David Rollock

*Purdue University*

Scott R. Vrana

*Virginia Commonwealth University, [svrana@vcu.edu](mailto:svrana@vcu.edu)*

Follow this and additional works at: [http://scholarscompass.vcu.edu/psyc\\_pubs](http://scholarscompass.vcu.edu/psyc_pubs)

 Part of the [Psychology Commons](#)

Copyright © 2013 American Psychological Association. This is the author's version of a work that was accepted for publication in *Emotion*, 2014, Vol. 14, No. 1, 74 – 84. The final publication is available at <http://dx.doi.org/10.1037/a0034031>. This article may not exactly replicate the final version published in the APA journal. It is not the copy of record.

---

Downloaded from

[http://scholarscompass.vcu.edu/psyc\\_pubs/13](http://scholarscompass.vcu.edu/psyc_pubs/13)

This Article is brought to you for free and open access by the Dept. of Psychology at VCU Scholars Compass. It has been accepted for inclusion in Psychology Publications by an authorized administrator of VCU Scholars Compass. For more information, please contact [libcompass@vcu.edu](mailto:libcompass@vcu.edu).

A Test of Spielberger's State-Trait Theory of Anger with Adolescents: Five Hypotheses

Colleen A. Quinn

Virginia Commonwealth University

David Rollock

Purdue University

and

Scott R. Vrana

Virginia Commonwealth University

Author Note

Colleen A. Quinn, Department of Psychology, Virginia Commonwealth University;  
David Rollock, Department of Psychological Sciences, Purdue University; Scott R. Vrana,  
Department of Psychology, Virginia Commonwealth University

Colleen A. Quinn is now in Baltimore, Maryland.

This research was supported by R01 HD30581 and F31 MH65102 from the National Institutes of Health. The data collection assistance of Miriam Delphin, Lisa Gordon, Natalie Milbrandt, Georgia Panayiotou, Andrea Waddell, and Charlotte Witvliet was invaluable in completing this study.

Correspondence concerning this article should be addressed to Scott Vrana, Department of Psychology, 806 West Franklin Street P.O. Box 842018, Richmond, Virginia 23284-2018. E-mail [srvrana@vcu.edu](mailto:srvrana@vcu.edu).

### **Abstract**

Spielberger's state-trait theory of anger was investigated in adolescents (n = 201, ages 10-18, 53% African American, 47% European American, 48% female) using Deffenbacher's five hypotheses formulated to test the theory in adults. Self-reported experience, heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) responses to anger provoking imagery scripts found strong support for the application of this theory to adolescents. Compared to the low trait anger (LTA) group, adolescents with high trait anger (HTA) produced increased HR, SBP and DBP, and greater self-report of anger to anger imagery (intensity hypothesis) but not greater self-report or cardiovascular reactivity to fear or joy imagery (discrimination hypothesis). The HTA group also reported greater frequency and duration of anger episodes and had longer recovery of SBP response to anger (elicitation hypothesis). The HTA group was more likely to report negative health, social, and academic outcomes (consequence hypothesis). Adolescents with high hostility reported more maladaptive coping with anger, with higher anger-in and anger-out than adolescents with low hostility (negative expression hypothesis). The data on all five hypotheses supported the notion that trait anger is firmly entrenched by the period of adolescence, with few developmental differences noted from the adult literature.

Key words: adolescents, trait anger, cardiovascular response, imagery

### A Test of Spielberger's State-Trait Theory of Anger with Adolescents: Five Hypotheses

Anger has been associated with detrimental outcomes for youth (Kerr & Schneider, 2008) and has been designated as an important research area by the National Institute of Mental Health (2001). Poorly managed anger in adolescents has been linked to increases in verbal and physical aggression (Peled & Moretti, 2007), peer rejection (Coie, Dodge, & Neckerman, 1989; Hubbard, 2001), school dropout (Bradshaw, Schaeffer, Petras, & Ialongo, 2010), juvenile delinquency (Maschi & Bradley, 2008), psychopathology (Daniel, Goldston, Erkanli, Franklin, & Mayfield, 2009; Kerr & Schneider, 2008), and later adult criminal behavior (Sigfusdottir, Gudjonsson, & Sigurdsson, 2010). Adolescent anger has also been linked with general health problems (Kerr & Schneider, 2008). Much research supports the link between anger problems and coronary heart disease risk in adults (Bleil, McCaffery, Muldoon, Sutton-Tyrrell, & Manuck, 2004; Williams, 2010). Elevated blood pressure in adolescence is an early biological precursor of essential hypertension and coronary heart disease (Ewart & Kolodner, 1994; Pankova, Alchinova, Afanaseva, & Karganov, 2010).

Studying the developmental trajectory of high anger levels through adolescence is important due to anger's role as a precursor to negative adult mental and physical health outcomes. It is also vital to study anger in adolescence due to the rapid and critical development of identity, social relationships, and emotion display rules occurring during this period. Emerging research has examined characteristics of adolescents with high trait anger. Meta-analysis of 288 studies on anger in adolescents revealed that high scores on trait anger measures were the largest predictor of state anger (Mahon, Yarcheski, & Yarcheski, & Hanks, 2010). Physiologically, children high in proactive aggression, an acquired coping style similar to trait anger, produced higher heart rate (HR) to an in-vivo provocation than controls (Hubbard et al.,

2002). Further, adolescents with high trait anger exhibit higher aggression (Wittmann & Santisteban, 2008), have lower self-esteem and perceived social support (Arslan, 2009), greater school alienation (Cecen, 2006), substance abuse, and attempted suicides (Daniel et al., 2009) compared with adolescents with low trait anger. Still, the research focusing on anger in adolescents has lagged behind research on anger research in adults (del Barrio, Aluja, Spielberger, 2004; Kerr & Schneider, 2008), and most of the existent research has been conducted on the negative consequences of state anger in adolescents rather than the more stable trait anger. The study of anger in children and adolescence has recently been described as a field that “as a whole generally lacks coherence, with separate lines of research appearing to operate independently” (Kerr & Schneider, 2008, p. 574). This may, in part, be caused by lack of a theory to bring the lines of research together.

Spielberger’s state-trait theory of anger (Spielberger Jacobs, Russell, & Crane, 1983) postulates that the state of feeling angry is a universal transitory condition consisting of subjective feelings of anger that vary in intensity and duration and produces physiological reactivity that increases along with the intensity of subjective anger feelings. Trait anger is postulated to be an enduring personality type that predisposes an individual to more frequent anger episodes than individuals who are not high in trait anger. Spielberger and his associates (1983) also posit that individuals with high trait anger tend to experience the same environmental anger triggers with a more intense, enduring, and aroused state anger than individuals low in trait anger. In this paper, “high trait anger” and “hostility” will be used interchangeably. Findings of significant relationships between hostility scales and trait anger scales in adolescents and adults provide support for construct validity (Liehr et al., 2000; Smith & Frohm, 1985).

Deffenbacher et al. (1996) empirically tested five key predictions derived from Spielberger’s state-trait theory of anger using adult samples: 1) The elicitation hypothesis

predicts that individuals high in trait anger will experience state anger more frequently and with a longer duration before they return to calm. 2) The intensity hypothesis predicts that individuals high in trait anger will experience their anger episodes (e.g. state anger) more strongly than individuals low in trait anger. 3) The discrimination hypothesis predicts that trait anger uniquely reflects increased proneness to state anger; therefore, it should produce different reactions to anger but similar reactions to other emotions (e.g. joy, fear). 4) The negative expression hypothesis predicts that compared to low trait anger individuals, high trait anger individuals will show maladaptive anger expression, specifically more anger suppression (anger-in) and anger explosion (anger-out). 5) The consequence hypothesis states that high trait anger individuals will experience more frequent and severe anger-related outcomes and negative consequences compared to low trait anger individuals. These hypotheses have gained support in adult samples, showing that trait anger is firmly established in one's personality in adulthood (Deffenbacher, 2003; Deffenbacher, Richards, Filetti, & Lynch, 2005). However, these hypotheses have yet to be fully tested in children or adolescents. The aim of the present study was to examine the developmental continuity of trait anger and determine if Deffenbacher et al.'s (1996) hypotheses are supported in adolescents as they have been in adults.

To test these hypotheses, questionnaires about anger and its consequences were administered to a sample of 201 adolescents aged 10-17 years. In addition, these adolescents participated in a well-validated imagery procedure (Lang, Kozak, Miller, Levin, & McLean, 1980; McNeil, Vrana, Melamed, Cuthbert, & Lang, 1993) that evaluated their response to anger and other emotions through cardiovascular and subjective responses. Research supports imagery as an ethically and empirically effective procedure to provoke anger that is manifested subjectively and physiologically (Beckham et al., 2002; Fredrickson et al., 2000). Imagery activates the same psychophysiological pattern as participation in the actual activity (Cuthbert,

Vrana, & Bradley, 1991). Research in anger and hostility shows that recalling an anger provocation produced equal or greater reactivity than the actual provocation (Lawler, Harralson, Armstead, & Schmied, 1993). Moreover, anger imagery produces consistently higher HR, SBP, and DBP than neutral imagery (Vrana, 1994; Vrana & Rollock, 2002). Because African Americans and European Americans have been found to express and cope with anger differently (Mabry & Kiecolt, 2005; Nelson, Leerkes, O'Brien, Calkins, & Marcovitch, 2012), efforts were made to recruit widely from both of these groups in order to sample a diversity of responses.

### **Hypotheses**

The purpose of this research was to examine differences in high versus low trait anger during adolescence in accordance with Deffenbacher et al.'s (1996) five hypotheses derived from Spielberger's state-trait theory of anger (Spielberger et al., 1983). Much support for this theory has been found in the adult literature, but sparse applicable data were found in the child or adolescent literature. Hypotheses for this study were based primarily on results from Deffenbacher et al. (1996) and the adult literature.

The *elicitation hypothesis* predicts that because trait anger and hostility are significant predictors of anger in adolescents (Mahon, Yarcheski, Yarcheski, & Hanks, 2010). Thus, adolescents high in trait hostility should report greater frequency and duration of anger than adolescents low in trait hostility. Moreover, as has been found in adults (Neumann, Waldstein, Sellers, Thayer, & Sorkin, 2004), adolescents with high trait anger will take longer for their systolic blood pressure to recover from anger imagery than adolescents low in trait anger.

The *intensity hypothesis* predicts that, compared to adolescents low in trait hostility, adolescents high in trait hostility will report a higher level of anger and will report greater state anger following imagined anger provocation. Also, among those who report anger to the imagery

provocation (Suls & Wan, 1993), high trait anger adolescents will exhibit increased heart rate and blood pressure to the anger provocation compared to low trait anger adolescents.

The *discrimination hypothesis* predicts that following the imagined anger provocation, adolescents with high trait anger will report greater anger, but not greater fear or joy, compared to adolescents with low trait anger. The high and low trait anger groups will differ in self-reported and physiological responses following imagined anger but not following imagined fear or joy. The *negative expression* hypothesis predicts that adolescents high in trait hostility will report more anger-in and anger-out than adolescents low in trait hostility. Based on Deffenbacher et al.'s (1996) findings, anger-out should predominate with anger-in being more strongly linked to trait anxiety.

Based on consistent research showing negative consequences for adults, adolescents, and children with high trait anger (Kerr & Schneider, 2008), the *consequence hypothesis* predicts that adolescents with high trait anger will report more negative outcomes than their low trait anger counterparts across a range of domains, including health, social, and academic outcomes.

## Method

### Participants

Two hundred and one adolescents (97 females and 104 males) from Indiana were recruited through presentations to churches and community groups, flyers distributed to libraries, churches, and community centers, and word of mouth. Adolescents were paid for their participation in this study. Special efforts were made to seek out equal numbers of African Americans ( $n = 106$ ) and European Americans ( $n = 95$ ). Ages of participants ranged from 10 to 18 ( $M = 13.3$ ). Roughly half ( $n = 108$ ) of the adolescents were recruited from a middle-class suburban/rural area in a mid-western United States university town (West Lafayette, Indiana). The other half ( $n = 93$ ) were recruited from an urban area in the mid-western United States



(Indianapolis, Indiana). The parents of the adolescents in the sample were more educated than the overall population: Twenty percent of the sample reported that the highest level of education completed by either parent was a high school education or less, roughly 45% of the sample reported education above a high school education to a four-year college diploma, and roughly 35% reported that the parent with the highest level of education had at least some post-baccalaureate education.

Participants were classified as high trait anger ( $n = 28$ ) if they scored at least one standard deviation ( $SD = .58$ ) above the item mean ( $M = 2.78$ ), or an average item score of  $\geq 3.36$  on the Multidimensional Anger Inventory General Anger scale (MAI: GA). In order to avoid an extreme low trait anger group (using one standard deviation below the mean), which may represent an unusually calm or unresponsive subset of individuals, the low trait anger comparison group consisted of participants who reported MAI: GA scores at or below the mean ( $\leq 2.78$ ,  $n = 99$ ). These low and high trait anger participants ( $n = 127$ ) were included in cardiovascular analyses and subjective ratings of the imagined scripts.

The MAI:GA is created by summing all items on the MAI. Several of the hypotheses in this study predict differences on MAI subscales (Frequency, Duration, Magnitude, Anger-In, Anger-Out) between the high trait anger group and the low trait anger group. Since the MAI scales share all items with the MAI: GA scale, systematic covariance would be built into the hypothesis tests if MAI: GA scores were used to classify participants and MAI scale scores are used as the dependent variable. Therefore, for all hypotheses looking at differences on MAI subscales, participants were classified using the MAI: Hostility (MAI: Ho) scale, which shares no items with any other MAI scale. Participants scoring one standard deviation ( $SD = 4.55$ ) above the mean ( $M = 17.42$ ) (average score of  $\geq 21.97$ ;  $n = 37$ ) on the MAI: Ho were classified as high hostility and participants scoring below the mean of 17.42 ( $n = 90$ ) were classified as low

hostility. A full breakdown of the trait anger versus hostility classifications is available from the authors. See Table 1 for ethnicity, gender, and age of participants of participants.

### **Imagery Scripts**

Vrana and Rollock (1995) conducted individual structured interviews with 30 adolescents aged 10-13 years and 30 adolescents aged 14-17 years to develop the imagery scripts used in this research. Each adolescent was asked to describe situations that would provoke feeling fear, anger, joy, and calm or no emotion. Once the adolescent fully described a situation, (s)he chose from a list of bodily sensations that (s)he would likely experience in the situation. From these data, two scripts were written for each emotion (anger, fear, joy, and calm or neutral emotion) consistent in style and length to those used in previous imagery studies with college students (Lang et al., 1980; McNeil et al., 1993). Each script included at least one physiological and one behavioral response, which past research had shown increases situation-appropriate physiological output during imagery (Lang et al., 1980). Each scenario was approximately 100 words in length and took on average 40-50 seconds to be read at a normal rate of speech.

All scripts identified their protagonists as either “Black” or “White”. Each adolescent was exposed to each of the two scripts for each emotion, and for each emotion one script included a Black protagonist and one script included a White protagonist. For instance, when anger was being provoked, if the participant imagined that a Black adolescent had tripped him/her, he/she imagined being accused of cheating by a White adolescent. Scenarios were recorded by an African American woman whose voice was rated by both African Americans and European Americans to be ethnically ambiguous, and were presented over headphones. All scripts are available on request from the authors.

## Questionnaires

**Multidimensional Anger Inventory (MAI).** The MAI (Siegel, 1986) is a 38-item paper-and-pencil test that uses a 5-point Likert scale for scoring. It correlates highly and has a similar factor-analytic structure compared with Spielberger's State-Trait Anger Inventory (Riley & Treiber, 1989). Although this scale originally was validated using a sample of 486 adults, it has been used successfully in many studies with children and adolescents from age seven through high school (Hemphill & Howell, 2000; Lee, Choi, Kim, Park, & Shin, 2009). Test-retest reliability was .75 for children as young as seven (Matthews, Stoney, Rakaczky, & Jamison, 1986). Alpha coefficients for the subscales range from .63 to .84 in college students (Siegel, 1986). In this sample Chronbach's alpha for the total (General Anger) score was .84, and the alpha coefficients for the subscales ranged from .46 to .75, except for Anger-out, with an alpha of .28.

**Background Information/Health Profile Questionnaire.** This questionnaire asked general demographic information including gender, age, current grade in school, and ethnicity, and yes/no questions about current and past smoking and exercise. Information gathered from participants on this form was used to address aspects of the consequence hypothesis such as hostility-related differences in health habits and whether a child was behind academically.

**Alien/Connect Scale.** This six-item questionnaire is based on the Social Isolation subscale of the Dean Alienation Scale (Dean, 1961) to assess perceptions about how closely participants feel connected to groups and people at school. Item wording was slightly revised to ensure reading comprehension by children. This was used to test relationship aspects of the consequence hypothesis.

## Imagery Physiology and Ratings Data Apparatus

Heart rate was obtained with a Coulbourn Optical Pulse Monitor clipped to the first finger of the participant's left hand. This monitor's signal triggered a digital input on the computer that recorded the interbeat interval with millisecond resolution. Blood pressure was measured on every heartbeat using an Ohmeda 2300 Non-Invasive Blood Pressure Monitor with a cuff attached to the middle finger of the non-dominant hand. Ratings of anger, joy, and fear were obtained using line ratings controlled by a joy-stick and converted to a 0-20 scale.

### **Procedure**

Each participant and parent were met by a female research assistant of the same ethnic background as the participant, had the study explained, and signed informed consent or assent. After the participant completed questionnaires, the same research assistant attached the physiological monitors and told the participant that he/she would be hearing an imagery scene over the headphones: "Listen to the scene and imagine it as clearly as you can. Continue to imagine the scene even after the scene stops. When you do this, imagine you are actually in the scene. Try to feel like you would if it were really happening." The adolescent was further instructed to continue thinking of the scene until he/she heard a tone, which was a signal to relax and stop imagining the scene. After a second tone the participant completed ratings about the imagery experience and then was instructed to "close your eyes again and wait for the next scene." After these instructions the participant was presented with instructions for progressive muscle relaxation techniques, with instructions to use these to relax after each imagined scene

Each participant started the study with an emotionally neutral practice trial. After the practice trial, one of each emotion type imagery script (neutral, anger, joy, and fear) was presented in a random order during the first four trials, and then the other script for each emotion was presented in random order in the next four trials. For all four script emotion types each

participant heard one script that centered on an interaction with a White peer and a different script that centered around an interaction with a Black peer.

Each imagery trial consisted of a 30-second REST period in which the participant was instructed to relax and wait to hear the beginning of the scenario, a 50-second READ period in which the adolescent heard the scenario over the headphones and imagined it while listening, a 30-second IMAGE period wherein the participant continued to imagine after the script had ended, a 30-second RECOVER period in which the participant cleared the image from his/her mind and relaxed, and an untimed rating period during which the participant made ratings on the intensity of anger, joy, and fear felt during the scene. After nine scenes (the neutral practice and the eight scenes described above), the adolescent was debriefed, paid, and thanked.

### **Physiological Data Reduction**

Heart rate (HR), systolic blood pressure (SBP), and diastolic blood pressure (DBP) were collected during the 30 seconds of REST, the last 30 seconds of READ, the 30 seconds of IMAGE, and the 30 seconds of RECOVER. To obtain reactivity to imagery, the mean physiological response during the 30 seconds of REST was subtracted from the mean response during the 30 seconds of IMAGE. There is strong evidence that elicitation of subjective anger has to be verified in order for results of physiological reaction to anger to be seen (Suls & Wan, 1993), and so physiological data were analyzed only for anger trials in which anger was elicited. Past research reported that the average score for level of anger felt (e.g. magnitude of state anger) to anger imagery in an adult population was 17 on this 0-20 scale (Vrana & Rollock, 2002). The average score for level of anger felt in this sample was 16.25. A score of  $\geq 15$  would represent the upper quartile of the range and capture the average sample adolescent's anger. Thus, for the purposes of this study, anger was defined as elicited when the participant endorsed an anger rating of  $\geq 15$  (on a 0-20 scale) after an anger script.

Using this definition, 17 of 28 participants in the high trait anger group (60.7%) and 61 of 99 participants in the low trait anger group (61.6%) endorsed anger to both anger scripts. In those cases, physiological reactions were averaged across data from the two scripts. Eleven participants in the high trait anger group and 19 in the low trait anger group reported feeling anger in one script but not the other. For these participants, physiological reactions were used only for the scenario in which anger was endorsed. Statistically equivalent numbers of participants endorsed anger either only to the same race script ( $n = 13$ ) or only to the different race script ( $n = 17$ ),  $\chi^2(2, N = 30) = .53$ , ns, and there was no difference in the number of low versus high trait anger adolescents who endorsed anger to one or two scripts,  $\chi^2(1, N = 108) = 2.49$ , ns. All 28 of the high trait anger adolescents endorsed anger to at least one provocation. However, 18 low trait anger adolescents did not endorse anger to either of the scripts, and due to equipment error state anger levels were lost for one low-trait anger adolescent; therefore, those 19 of 99 low trait anger participants were excluded from analyses of physiological variables.

To test the duration hypothesis with physiological reactions, the 30-second RECOVER period following anger imagery was examined. This 30-second segment was divided into two separate 15-second segments. Within each 15-second segment a participant was defined as having recovered from anger imagery if their data fell within their REST period mean  $\pm$  1/4 the sample's REST period standard deviation.

### **Results**

Most hypotheses were tested using the MAI General Anger (MAI: GA) scale. Because all MAI scales share items with the MAI: GA scale, hypotheses testing differences on MAI scales were tested with participants classified using the MAI Hostility (MAI: HO) scale. Means and standard deviations of all MAI scales used in analyses are presented in Table 1 separately for groups classified using the MAI:GA and MAI:HO. Preliminary between-groups ANOVA and

chi-square tests found no age, gender, or ethnic group differences between the high and low trait anger groups or the high and low hostility groups. Because there are five hypothesis tests involving MAI scales, an initial multivariate analysis of variance (MANOVA) was conducted with hostility group as the independent variable and five MAI scales (frequency, duration, magnitude, anger-in, anger-out) as dependent variables. This analysis found a significant effect of hostility group,  $F(5,120) = 10.87, p < .001$ ; subsequently, univariate ANOVAs were used to test the specific hypotheses involving these scales. The rest of the results are organized around Deffenbacher's (1996) five hypotheses.

### **Elicitation Hypothesis**

As predicted by the elicitation hypothesis, adolescents prone to high hostility reported higher frequency of anger episodes on the MAI: Frequency (FQ) than adolescents low in hostility,  $F(1,124) = 25.09, p < .001$ , partial  $\eta^2 = .168$ . A similar analysis performed on the MAI: Duration (DU) scale found that adolescents reporting high hostility reported greater duration of anger than adolescents low in hostility,  $F(1,124) = 7.67, p = .006$ , partial  $\eta^2 = .058$ . Within this sample, self-reported frequency and duration of anger were not related; the correlation between MAI: FQ and MAI: DU was  $r(127) = .12, ns$ .

The duration hypothesis also was tested by examining cardiovascular recovery of the high and low trait anger groups after the anger provocation. Participants were defined as having recovered from anger provocation if their heart rate or blood pressure fell within  $\frac{1}{4}$  of the sample's standard deviation from their individual baseline rate during the REST period, and chi-squares assessed the proportion of high versus low trait anger adolescents who recovered within 15 and 30 seconds post-provocation. There were no significant differences in the proportion of adolescents reporting high versus low trait anger who returned to baseline for DBP or HR. However, for SBP, 62% of adolescents low in trait anger returned to baseline within the first 15-

seconds of recovery compared to 39% of those high in trait anger,  $\chi^2(1, N = 93) = 3.97, p = .04, \phi = .207$ . Of the non-recovered participants, 62% of the adolescents low in trait anger returned to baseline in the second 15-second period, while only 28% of the adolescents high in trait anger did,  $\chi^2(2, N = 40) = 3.95, p = .048, \phi = .314$ . By the end of 30 seconds, 86% of the low trait anger group had recovered to their personal baseline level of SBP, whereas 56% of the high trait anger group had recovered,  $\chi^2(1, N = 93) = 8.74, p = .005, \phi = .307$ .

### **Intensity Hypothesis**

In accordance with the intensity hypothesis, adolescents with high hostility reported greater anger (as measured by the MAI: Magnitude scale) than adolescents low in hostility,  $F(1,124) = 33.47, p \leq .001, \text{partial } \eta^2 = .213$  (see Table 1). In addition, adolescents high in trait anger reported higher levels of anger to the anger imagery provocation than did adolescents low in trait anger,  $F(1,121) = 3.99, p < .05, \text{partial } \eta^2 = .032$  (see Table 2).

Differences in cardiovascular reactivity to anger provocation between adolescents high versus low in trait anger also followed hypothesized patterns. When anger was verified via joystick line ratings, a MANOVA with HR, SBP, and DBP as dependent variables found that adolescents high in trait anger exhibited greater cardiovascular reactivity than adolescents low in trait anger,  $F(3,75) = 2.99, p < .05, \text{partial } \eta^2 = .107$ . Univariate ANOVAs found greater cardiovascular reactivity among adolescents high in trait anger for HR,  $F(1, 94) = 6.10, p < .02, \text{partial } \eta^2 = .061$ ; SBP,  $F(1, 93) = 3.94, p < .05, \text{partial } \eta^2 = .041$ ; and DBP,  $F(1,95) = 3.87, p < .05, \text{partial } \eta^2 = .039$  (see Table 2).

### **Discrimination Hypothesis**

The discrimination hypothesis predicts that adolescents high in trait anger should produce stronger anger reactions in response to anger provocation compared to adolescents low in trait anger, and not differ in other emotional reactions to an anger provocation. As reported for the



intensity hypothesis (see Table 2), anger ratings following the anger provocation were higher for adolescents high in trait anger compared to those low in trait anger. Table 2 also shows that, as predicted, there was no difference between the high and the low trait anger group in fear reported to anger imagery,  $F(1, 121) = 0.16$ , and no difference between the high and the low trait anger group in joy reported to anger imagery,  $F(1, 121) = 0.60$ .

Also as predicted, there were no differences in level of joy reported in response to joyful imagery by the high trait anger group ( $M = 16.9$ ,  $SD = 5.0$ ) compared to the low anger group ( $M = 17.9$ ,  $SD = 4.1$ ),  $F(1, 120) = 1.24$ , nor in the level of fear reported in response to fear-eliciting imagery by the high trait anger group ( $M = 17.3$ ,  $SD = 3.8$ ) compared to the low trait anger group ( $M = 17.5$ ,  $SD = 4.2$ ),  $F(1, 120) = 0.03$ . As Figure 1 shows, while the high anger group reported significantly more anger to the anger imagery than did the low anger group, the low anger group reported slightly more joy to the joy imagery and slightly more fear to the fear imagery than did the high anger group.

Finally, the discrimination hypothesis predicts that cardiovascular reactions of the high and low trait anger groups would be different to anger (already shown in the intensity hypothesis), but would not differ to other emotions, such as fear and joy. Univariate ANOVAs found no trait anger group differences for HR, SBP, and DBP reactions (all  $p > .10$ ) to fear imagery. For joy imagery, there was no difference in HR reaction between high and low trait anger groups; however, the high trait anger group responded with marginally greater SBP *decreases* to joy ( $M = -3.85$  mm/Hg,  $SD = 18.57$ ) than the low trait anger group ( $M = 1.33$  mm/Hg,  $SD = 6.51$ ),  $F(1, 104) = 4.51$ ,  $p = .036$ , partial  $\eta^2 = .042$ , and greater DBP *decreases* ( $M = -1.93$  mm/Hg,  $SD = 6.91$ ) than the low trait anger group ( $M = .05$  mm/Hg,  $SD = 3.35$ ),  $F(1, 103) = 3.66$ ,  $p = .058$ , partial  $\eta^2 = .034$ .

### **Negative Expression Hypothesis**

to assess whether adolescents high versus low hostile differed in type of anger expression, a Hostility group (high hostile, low hostile) x Type of expression (MAI: Anger In, MAI: Anger Out) ANOVA was conducted. Adolescents high in hostility overall had greater negative expression than adolescents low in hostility,  $F(1,124) = 29.5, p < .001$ , partial  $\eta^2 = .192$ ; in addition, the pattern of expression differed between groups, Hostility group x Type of expression  $F(1,124) = 7.38, p < .008$ , partial  $\eta^2 = .056$ . As can be seen in Table 1, although adolescents high in hostility reported higher MAI: Anger In,  $F(1, 124) = 31.79, p < .001$ , partial  $\eta^2 = .204$ , and MAI: Anger Out,  $F(1, 124) = 6.05, p = .015$ , partial  $\eta^2 = .047$ , than adolescents low in hostility, the difference between groups was much greater for Anger In than for Anger Out.

### **Consequence Hypothesis**

This study explored the consequence hypothesis' predictions of more negative outcomes among adolescents high in trait anger in the domains of health, relationships, and academic achievement. In the domain of physical health, based on their answer to a series of yes/no questions on the Health Profile Questionnaire, adolescents high in trait anger were more than twice as likely than adolescents low in trait anger to report ever smoking cigarettes regularly (14.3% vs. 6.1%), having high blood pressure (3.6% vs. 1.0%), and being on a low-sodium diet (7.4% vs. 3.1%). Because of the low base rates for these variables, these differences were not significant (all  $\chi^2 < 2.5, p > .15$ ). Adolescents high in trait anger also were much more likely to report lack of exercise; 22.3% of adolescents high in trait anger reported that they did not exercise at least once/week, whereas only 5.1% of adolescents low in trait anger reported lack of exercise,  $\chi^2(1, N = 124) = 7.73, p = .005, phi = .250$ .

When looking at connection to the school environment, no differences were found between the high ( $M = 30.4, SD = 7.0$ ) and the low trait anger group ( $M = 32.2, SD = 6.7$ ),  $F(1,123) = 1.53, p = .22$ , on the six-item Alien/Connect Scale. However, an exploratory analysis

found that the high trait anger group was less likely ( $M = 4.4$ ,  $SD = 2.0$ ) to agree with the statement “I feel involved with the life of my school” than the low trait anger group ( $M = 5.2$ ,  $SD = 1.78$ ),  $F(1,123) = 3.96$ ,  $p = .049$ , partial  $\eta^2 = .031$ . Interestingly, participants low and high in hostility (based on MAI: Hostility scores) did differ on the overall Alien/Connect Scale, with participants high in hostility ( $M = 32.7$ ,  $SD = 6.2$ ) reporting more alienation than participants low in hostility ( $M = 28.6$ ,  $SD = 7.8$ ),  $F(1,120) = 9.36$ ,  $p = .003$ , partial  $\eta^2 = .072$ .

A chi square analysis was performed to see if adolescents high in trait anger were more likely to be behind academically. To do this, date of birth, current grade in school, and study participation date were used from the Background Information Form. If a participant reported that (s)he was older than the expected age for their grade based on their school district’s guidelines, then that participant was coded as being behind academically. Eleven percent ( $n=3$ ) of the adolescents high in trait anger were academically behind, while only three percent ( $n=3$ ) of the adolescents low in trait anger were academically behind grade level,  $\chi^2(1, N=124) = 2.95$ ,  $p = .08$ ,  $phi = .154$ .

## Discussion

Deffenbacher et al. (1996) derived a series of hypotheses about differences between high trait anger and low trait anger individuals from state-trait anger theory (Spielberger et al., 1983). This investigation found strong support for all five hypotheses in an adolescent sample, showing that the tendency for a personality trait of high anger is established at least by adolescence.

### Elicitation Hypothesis

As predicted by the elicitation hypothesis and found previously with adult women (Neumann et al., 2004), adolescents high in hostility reported higher frequency and duration of anger episodes, and adolescents high in trait anger did not return as quickly to baseline SBP levels following an anger provocation as adolescents low in trait anger did. Extended blood

pressure recovery has potential health implications for adolescents high in trait anger. Sustained blood pressure elevations produce even greater cardiovascular load and potential organ damage than large spikes lasting a short time (Borghi, Costa, Boschi, Mussi, & Ambrosioni, 1986; Gerin, Davidson, Christenfeld, Goyal, & Schwartz, 2006). Because the frequency and duration of anger episodes are not related (McGuire & Troisi, 1990), and the duration of cardiovascular recovery is independent of the magnitude of cardiovascular reaction to an anger-provoking situation (Fredrickson & Levenson, 1998), it is important to consider frequency, duration, and recovery separately when evaluating anger elicitation. Further, since duration of anger episode and its recovery have strong links with long-term health complications, these are the more functionally significant variables to consider when studying anger elicitation in adolescents and adults.

### **Intensity Hypothesis**

In line with the intensity hypothesis, adolescents high in hostility, compared to adolescents low in hostility, reported higher average magnitude of anger outbursts on the MAI Magnitude scale. In response to anger imagery, adolescents high in trait anger reported feeling angrier and also responded with greater HR, SBP, and DBP than adolescents low in trait anger. The magnitude of cardiac load is related to later hypertension (Pankova et al., 2010) and coronary heart disease (Miller, Smith, Turner, Guijarro, & Hallet, 1996; Williams, 2010), potentially putting adolescents high in trait anger at greater long-term health risk.

This investigation confirmed the importance of verifying that anger indeed was elicited in response to the provocation for results to be rendered meaningful. This methodological recommendation originally was put forth in 1993 by Suls and Wan; still, many subsequent studies have not included this crucial step in their protocols. Failure to verify anger elicitation has led to inconsistent and confusing results (Davis, Matthews, & McGrath, 2000; Engebretson & Matthews, 1992; Engebretson, Matthews, & Scheier, 1989).

### **Discrimination Hypothesis**

The discriminant validity of the trait anger construct was strongly supported in this adolescent population. Adolescents high in trait anger reported feeling greater anger in response to anger imagery than the low trait anger group, but were not different in reported fear or joy to anger imagery. Similarly, the high and low trait anger groups did not differ in reported emotional response to joy and fear imagery.

There also was discrimination between groups in their physiological responses. Adolescents high in trait anger responded with greater HR, SBP, and DBP to the anger provocation compared to the low trait anger group, but the groups did not differ in their cardiovascular response to fear imagery. In addition, the high trait anger group responded with *decreased* SBP and DBP to arousing joy imagery whereas the low trait anger group responded with *increased* SBP and DBP. Thus the difference between the high and low trait anger group is due not to the ability to generate physiological responses during imagery, but is due to a specific difference in response to anger compared to positive, joyful content. It may be that angry adolescents lack the ability to engage with positive affect and so do not have the resources to be resilient to or cope with angry feelings. This inability to “broaden and build” on positive emotion (Fredrickson, 2001) may inhibit the capacity to build enduring personal resources that function as reserves to draw on during future threats; more significantly, dysregulation of positive emotion is implicated in many forms of adolescent psychopathology (Gilbert, 2012). Further, broadening and building on positive emotions, as well as other types of emotion regulation such as cognitive re-appraisal (Vogele, Sorg, Studtmann & Weber, 2010) may speed recovery from the cardiovascular consequences of negative emotions, thereby “undoing” some of their negative effects (Tugade & Fredrickson, 2004).

### **Negative Expression Hypothesis**

In their research with adults Deffenbacher and associates (1996) found that anger-in, which involves suppressing angry feelings and preventing the outward expression of anger, was more strongly linked with trait anxiety, whereas anger-out, which involves external expression of anger, was more strongly linked with trait anger. Their results suggested that the negative expression found in hostile individuals is solely focused on anger-out. In contrast, the current study found that the high and low hostility groups differed more clearly on anger-in. Children learn at a relatively early age that unbridled anger-out expression is unacceptable (Shipman, Zeman, Nesin, & Fitzgerald, 2003). It may be that during adolescence, when adults are still in positions of authority over them, individuals high in hostility make a conscious effort to suppress outward expressions of anger, and thus their anger is more likely to be manifested as anger-in. This may place them doubly at risk, as high trait anger combined with an anger-in orientation can both increase blood pressure response to anger and decrease social competence (Rohrman, Bechtoldt, Hopp, Hodapp, & Zapf, 2011). As adolescents high in trait anger progress into adulthood, when coping style may become even more entrenched and behavior less constrained by adult supervision and control, anger-out may become the predominant mode of anger expression. This suggests that it is important to examine the developmental trajectory of anger-in and anger-out coping styles through adolescence into adulthood.

### **Consequence Hypothesis**

In line with the consequence hypothesis, adolescents high in trait anger were impaired across three domains: health, relationships, and school. Similar to the results with older adults (Anton & Miller, 2005), adolescents high in trait anger were less likely to exercise regularly. A potential explanation for this result is that anger and comorbid depression (Sigfusdottir, Farkas, & Silver, 2004) may reduce motivation and activity level. Teachers are more likely to describe angry students as easily frustrated and giving up on things easily (Fryxell & Smith, 2000). The

lack of motivation observed in individuals high in trait anger may reflect a decrease in motivation for exercise while the individual is in the negative emotional state (Leiker & Hailey, 1988). A second possible connection between exercise and anger is that adolescents would be less angry if they chose to exercise regularly. Exercise produces positive affect and cognitions that counteract general negative mood states (Martinsen & Morgan, 1997; North, McCullah, & Tran, 1990; Raglin, 1997), anger in particular (Burger & Owen, 1988). Thus, the relationship between high trait anger and lack of exercise may be bidirectional and reinforcing. Given the link between anger problems and coronary heart disease risk in adults (Williams, 2010), the relationship between anger, lack of exercise, and health problems, especially coronary heart disease, merits more developmental exploration.

Past research supports a wide range of links between high trait anger and impaired social relationships in children and adolescents (Kerr & Schneider, 2008). The current study found tentative support for this aspect of the consequence hypothesis. Adolescents high in trait anger reported more alienation from people and groups at their school than did adolescents who were not high on trait anger, although this difference failed to reach statistical significance. However, adolescents high in trait anger were significantly less likely to endorse feeling involved with the life of their school on the Alien-Connect scale, and adolescents high on the MAI: Hostility scale were significantly more alienated than non-hostile adolescents as measured by the full Alien-Connect scale. These results are consistent with Cecen's (2006) research that showed high school students with high trait anger reported more alienation from both peers and teachers. Such alienation may be particularly harmful during adolescence, as peer relationships become more important, and angry/aggressive children and adolescents are more likely to be rejected, which is associated with more aggression (Murray-Close et al., 2010).

The adolescents high in trait anger also tended to be behind their expected grade level, consistent with myriad findings of anger being related to school dropout, lower grades, and underachievement (Cairnes, Cairnes, & Neckerman, 1989; Little & Garber, 2000). As with social and health consequences, the academic consequences of anger may have bidirectional and mutually-reinforcing causes. For example, students with learning problems might experience academic frustration that leads to anger (Heavey, Adelman, Nelson, & Smith, 1989); in addition, teachers and peers may react to students with anger problems more negatively, attributing their underachievement to behavior problems or inadequate effort rather than lack of ability, and reject the child and respond with anger in return. (Georgiou, Christou, Stavrinides, & Panaoura, 2002; Murray-Close et al., 2010).

### **Summary and Conclusions**

This study found substantial support in adolescents for the five hypotheses about trait anger that Deffenbacher et al. (1996) advanced and then supported in adults. Compared to adolescents without high trait anger, those with high trait anger reported greater frequency, duration, and intensity of anger; exhibited greater heart rate and blood pressure response to and slower blood pressure recovery from imagined anger provocation; showed greater responses only to anger and not other emotions (and in fact were physiologically hypo-responsive to joy); reported more negative expression of anger (especially anger-in); and reported negative health, social, and academic consequences related to anger.

Given the importance of the adolescent period for the development of identity, social relationships, academic and occupational functioning, health habits, and physiological vulnerability to chronic disease, and that dysfunctional anger can play a detrimental role in all of these areas, it is important to study the developmental trajectory of trait anger and its effect on physical and emotional health. For example, although in general the results found here tracked



the results found with adults, Deffenbacher et al. (1996) found that adults high in trait anger emphasized the anger-out mode of expression, whereas adolescents emphasized anger-in. Thus it may be that outward expression of anger in adolescents is muted, at least in situations where there is adult social control, and therefore it is more difficult to identify psychologically and socially problematic levels of anger in adolescents than in adults. Another important finding is that adolescents high in trait anger appeared to have a deficit in expression of positive emotion. This may adversely affect their ability to recover from negative emotions (Tugade & Fredrickson, 2004), which may account for significant variance in detrimental physiological responding (Hogan & Linden, 2004), and be a better predictor of cardiovascular disease than general high trait anger (Bleil et al., 2004; Boddeker & Stemmler, 2000).

Although great care was used to recruit a sample of adolescents that varied not only in anger levels but also in terms of age, gender, socioeconomic status and ethnicity, cell sizes became too small to look at the effects of these important demographic variables, and sampling of ethnic groups was restricted to European Americans and African Americans. Research in adults shows that gender affects the way anger is internalized (Armstead & Clark, 2002) and the resultant physiological responses (Davis et al., 2000). Research also shows that ethnicity affects parents' beliefs about the consequences of negative emotional expression by their children—and consequently the ways such expression is socialized (Nelson et al., 2012). Ethnicity also plays a role in anger expression coping styles (Mabry & Kiecolt, 2005; Pittman, 2011) and results in physiological differences (Fredrickson et al., 2000) and differences in other negative outcomes (Johnson & Browman, 1987; Pittman, 2011). Given the importance of adolescence in shaping gender and ethnic identity, these moderators of anger outcome merit follow-up in adolescents.

### References

- Anton, S. D., & Miller, P. M. (2005). Do negative emotions predict alcohol consumption, saturated fat intake, and physical activity in older adults? *Behavior Modification, 29*, 677-688. doi:10.1177/0145445503261164
- Armstead, C. A. & Clark, R. (2002). Assessment of self-reported anger expression in pre-and early-adolescent African Americans: Psychometric considerations. *Journal of Adolescence, 25*, 365-371. doi:10.1006/jado.2002.0481
- Arslan, C. (2009). Anger, self-esteem, and perceived social support in adolescence. *Social Behavior and Personality, 37*, 555-564. doi:10.2224/sbp.2009.37.4.555
- Beckham, J. C., Vrana, S. R., Barefoot, J. C., Fledman, M. E., Fairbank, J., & Moore, S. D. (2002). Magnitude and duration of cardiovascular response to anger in Vietnam veterans with and without posttraumatic stress disorder. *Journal of Consulting and Clinical Psychology, 70*, 228-234. doi:10.1037//0022-006X.70.1.228
- Bleil, M. E., McCaffery, J. M., Muldoon, M. F., Sutton-Tyrrell, K., & Manuck, S. B. (2004). Anger-related personality traits and carotid artery atherosclerosis in untreated hypertensive men. *Psychosomatic Medicine, 66*, 633-639. doi:10.1097/01.psy.0000138128.68838.50
- Böddeker, I., & Stemmler, G. (2000). Who responds how and when to anger? The assessment of actual anger response styles and their relation to personality. *Cognition & Emotion, 14*, 737-762. doi:10.1080/02699930050156618
- Borghi, C., Costa, F., Boschi, S., Mussi, A., & Ambrosioni, E. (1986). Predictors of stable hypertension in young borderline subjects: A five year follow-up study. *Journal of Cardiovascular Pharmacology, 8*, S138-141. doi:10.1097/00005344-198608005-00030

- Bradshaw, C. P., Schaeffer, C. M., Petras, H., & Ialongo, N. (2010). Predicting negative life outcomes from early aggressive disruptive behavior trajectories: Gender differences in maladaptation across life domains. *Journal of Youth and Adolescence*, *39*, 953-966. doi:10.1007/s10964-009-9442-8
- Burger, B. G., & Owen, D. R. (1988). Stress reduction and mood enhancement in four modes: swimming, body conditioning, Hatha yoga, and Fencing. *Research Quarterly for Exercise and Sport*, *59*, 148-159. Retrieved <http://www.aahperd.org/rc/publications/rqes/>
- Cairnes, R., Cairnes, B., & Neckerman, H. (1989). Early school dropout: Configurations and determinants. *Child Development*, *60*, 1437-1452. doi:10.2307/1130933
- Cecen, A. R. (2006). School alienation: Gender, socio-economic status, and anger in high school adolescents. *Kuram ve Uygulamada Egitim Bilimleri*, *6*, 721-726. Retrieved from <http://www.scimagojr.com/journalsearch.php?q=19500157110&tip=sid&clean=0>
- Coie, J., Dodge, K. A., & Neckerman, H. (1989). Early school dropout: Configurations and determinants. *Child Development*, *60*, 1437-1452. Retrieved from [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1467-8624](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1467-8624)
- Cuthbert, B. N.; Vrana, S. R.; Bradley, M. M. (1991). Imagery: Function and physiology. In (Eds.) J. R. Jennings, P. K. Ackles, M. G. H. Coles. *Advances in psychophysiology: A research annual, Vol. 4*. London, England: Jessica Kingsley Publishers, 1991. pp. 1-42.
- Daniel, S. S., Goldston, D. B., Erkanli, A., Franklin, J. C., & Mayfield, A. M. (2009). Trait anger, anger expression, and suicide attempts among adolescents and young adults: A prospective study. *Journal of Clinical Child and Adolescent Psychology*, *38*, 661-671. doi:10.1080/15374410903103494

- Davis, M.C., Matthews, K. A., & McGrath, E. (2000). Hostile attitudes predict elevated vascular resistance during interpersonal stress in men and women. *Psychosomatic Medicine*, *62*, 17-25. Retrieved from <http://www.psychosomaticmedicine.org/>
- Dean, D. G. (1961). Alienation: Its meaning and measurement. *American Sociological Review*, *26*, 753-758. doi:10.2307/2090204
- Deffenbacher, J. L. (2003). Angry college student drivers: Characteristics and a test of state-trait theory. *Psicologia Conductual*, *11*, 163-176.
- Deffenbacher, J. L., Oetting, E. R., Thwaites, G. A., Lynch, R. S., Baker, D. A., Stark, R. S., .... Eiswerth-Cox, L. (1996). State-trait theory and the utility of the Trait Anger Scale. *Journal of Counseling Psychology*, *43*, 131-148. doi:10.1037/0022-0167.43.2.131
- Deffenbacher, J. L., Richards, T. L., Filetti, L. B., & Lynch, R. S. (2005). Angry drivers: A test of state-trait theory. *Violence and Victims*, *20*, 455-469. doi:10.1891/vivi.2005.20.4.455
- del Barrio, V., Aluja, A., & Spielberger, C. (2004). Anger assessment with the STAXI-CA: Psychometric properties of a new instrument for children and adolescents. *Personality and Individual Differences*, *37*, 227-244. doi:10.1016/j.paid.2003.08.014
- Engbretson, T. O., & Matthews K. A. (1992). Dimensions of hostility in men, women, and boys: Relationships to personality and cardiovascular responses to stress. *Psychosomatic Medicine*, *54*, 311-323. Retrieved from <http://www.psychosomaticmedicine.org/>
- Engbretson, T. O., Matthews K. A., & Scheier, M. F. (1989). Relations between anger expression and cardiovascular reactivity: Reconciling inconsistent findings through a matching hypothesis. *Journal of Personality and Social Psychology*, *57*, 513-521. doi:10.1037//0022-3514.57.3.513

- Ewart, C. K., & Kolodner, K. B. (1994). Negative affect, gender, and expressive style predict elevated ambulatory blood pressure in adolescents. *Journal of Personality and Social Psychology, 66*, 596-605. doi:10.1037//0022-3514.66.3.596
- Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The Broaden-and-Build theory of positive emotions. *American Psychologist, 56*, 218-226. doi:10.1037//0003-066X.56.3.218
- Fredrickson, B. L., Maynard, K. E., Helms, M. J., Haney, T. L., Siegler, I. .N. C., & Barefoot, J. C. (2000). Hostility predicted magnitude and duration of blood pressure response to anger. *Journal of Behavioral Medicine, 23*, 229-243. Retrieved from <http://www.springer.com/medicine/journal/10865>
- Fredrickson, B. L., & Levenson, R. W. (1998). Positive emotions speed recovery from the cardiovascular sequelae of negative emotions. *Cognition & Emotion, 12*, 191-220. Retrieved from <http://www.psypress.com/cognition-&-emotion-9780415646741>
- Fryxell, D., & Smith, D. C. (2000). Personal, social, and family characteristics of angry students. *Professional School Counseling, 4*, 86-94. Retrieved from <http://www.schoolcounselor.org/content.asp?contentid=235>
- Georgiou, S. N., Christou, C., Stavrinides, P., & Panaoura, G. (2002). Teacher attributions of student failure and teacher behavior toward the failing student. *Psychology in the Schools, 39*, 583-596. doi:10.1002/pits.10049
- Gerin, W., Davidson, K. W., Christenfeld, N. J. S., Goyal, T., & Schwartz, J. E. (2006). The role of angry rumination and distraction in blood pressure recovery from emotional arousal. *Psychosomatic Medicine, 68*, 64-72. doi:10.1097/01.psy.0000195747.12404.aa
- Gilbert, K. E. (2012). The neglected role of positive emotion in adolescent psychopathology. *Clinical Psychology Review, 32*, 467-481. doi:10.1016/j.cpr.2012.05.005

- Heavey, C. L., Adelman, H. S., Nelson, P., & Smith, D. C. (1989). Learning problems, anger, perceived control, and misbehavior. *Journal of Learning Disabilities, 22*, 46-50.  
doi:10.1177/002221948902200109
- Hemphill, J. F., & Howell, A., J. (2000). Adolescent offenders and stages of change. *Psychological Assessment, 12*, 371-381. doi:10.1037//1040-3590.12.4.371
- Hogan, B. E., & Linden, W. (2004). Anger response styles: At least don't ruminate about it! *Annals of Behavioral Medicine, 27*, 38-49. doi:10.1207/s15324796abm2701\_6
- Hubbard, J. A. (2001). Emotion expression processes in children's peer interaction: The role of peer rejection, aggression, and gender. *Child Development, 72*, 1426-1438.  
doi:10.1111/1467-8624.00357
- Hubbard, J. A., Smithmyer, C. M., Ramsden, S. R., Parker, E. H., Flanagan, K. D., Dearing, K. F., ... Simons, R. F. (2002). Observational, physiological, and self-report measures of children's anger: Relations to reactive versus proactive aggression. *Child Development, 73*, 1101-1118. doi:10.1111/1467-8624.00460
- Johnson, E. H., & Browman, B. (1987). The relationship of anger expression and health problems among black Americans in a national survey. *Journal of Behavioral Medicine, 10*, 103-116. doi:10.1007/BF00846419
- Kerr, M. A., & Schneider, B. H. (2008). Anger expression in children and adolescents: A review of the empirical literature. *Clinical Psychology Review, 28*, 559-577.  
doi:10.1016/j.cpr.2007.08.001
- Lang, P.J., Kozak, M. J., Miller, G. A., Levin, D. N., & McLean, A. (1980). Emotional imagery: Conceptual structure and pattern of somatovisceral response. *Psychophysiology, 17*, 179-192. Retrieved from [http://onlinelibrary.wiley.com/journal/10.1111/\(ISSN\)1469-8986](http://onlinelibrary.wiley.com/journal/10.1111/(ISSN)1469-8986)

- Lawler, K. A., Harralson, T. L., Armstead, C. A., & Schmied, L. A. (1993). Gender and cardiovascular responses: What is the role of hostility? *Journal of Psychosomatic Research, 37*, 603-613. doi:10.1016/0022-3999(93)90055-K
- Lee, J., Choi, H., Kim, M. J., Park, C. G., & Shin, D. (2009). Anger as a predictor of suicidal ideation in middle-school students in Korea: Gender difference in threshold point. *Adolescence, 44*, 433-446. Retrieved from [http://www.researchgate.net/journal/0001-8449\\_Adolescence](http://www.researchgate.net/journal/0001-8449_Adolescence)
- Leiker, M., & Hailey, B. J. (1988). A link between hostility and disease: Poor health habits? *Behavioral Medicine, 14*, 129-133. doi:10.1080/08964289.1988.9935136
- Liehr, P., Meininger, J. C., Mueller, W. H., Chan, W., Frazier, L., & Reyes, L. R. (2000). Psychometric testing of the adolescent version of the Cook-Medley Hostility Scale. *Issues in Comprehensive Pediatric Nursing, 23*, 103-116. Retrieved from <http://informahealthcare.com/loi/cpn>
- Little, S. A., & Garber, J. (2000). Interpersonal and achievement orientations and specific stressors predicting depressive and aggressive symptoms in children. *Cognitive Therapy and Research, 24*, 651-670. Retrieved from <http://journalseek.net/cgi-bin/journalseek/journalsearch.cgi?field=issn&query=0147-5916>
- Mabry, J. B., & Kiecolt, J. (2005). Anger in Black and White: Race, alienation, and anger. *Journal of Health and Social Behavior, 46*, 85-101. doi:10.1177/002214650504600107
- Mahon, N. E., Yarcheski, A., Yarcheski, T. J., & Hanks, M. M. (2010). A meta-analytic study of predictors of anger in adolescents. *Nursing Research, 59*, 178-184. doi:10.1097/NNR.0b013e3181dbba04
- Martinsen, E. W., & Morgan, W. P. (1997). Antidepressant effects of physical activity. In W. P. Morgan (Ed.), *Physical Activity and Mental Health*. Washington DC: Taylor & Francis.

- Maschi, T., & Bradley, C. (2008). Exploring the moderating influence of delinquent peers on the link between trauma, anger, and violence among male youth: implications for social work practice. *Child and Adolescent Social Work Journal*, 25, 125-138. doi:10.1007/s10560-008-0116-2
- Matthews, K. A., Stoney, C. M., Rakaczky, C. J., & Jamison, W. (1986). Family characteristics and school achievements of Type A children. *Health Psychology*, 5, 453-468. doi:10.1037//0278-6133.5.5.453
- McGuire, M. T. & Troisi, A. (1990). Anger: An evolutionary view. In R. Plutchik and H. Kellerman (Eds.) *Emotion, psychopathology, and psychotherapy. Emotion: Theory, research and experience, vol 5.* (pp 43-57). San Diego: Academic Press.
- McNeil, D. W., Vrana, S. R., Melamed, B. G., Cuthbert, B. N., & Lang, P. J. (1993). Emotional imagery in simple and social phobia: fear versus anxiety. *Journal of Abnormal Psychology*, 102, 212-225. doi:10.1037//0021-843X.102.2.212
- Miller, T. Q., Smith, T. W., Turner, C. W., Guijarro, M. L., & Hallet, A. J. (1996). A meta-analytic review of research on hostility and physical health. *Psychological Bulletin*, 119, 322-348. doi:10.1037//0033-2909.119.2.322
- Murray-Close, D., Hoza, B., Hinshaw, S. P., Eugene, A. L., Swanson, J., Jensen, P. S.,....Wells, K. (2010). Developmental processes in peer problems of children with attention-deficit/hyperactivity disorder in The MTA: Developmental cascades and vicious cycles. *Development and Psychopathology*, 22, 785-802. Retrieved from <http://journals.cambridge.org/action/displayJournal?jid=DPP>
- National Institute of Mental Health (2001). Child and adolescent research at NIMH [on-line] Retrieved from <http://www.nimh.nih.gov/publicat/violenceresfact.cfm>.



- Nelson, J. A., Leerkes, E. M., O'Brien, M., Calkins, S. D., & Marcovitch, S. (2012). African American and European American mothers' beliefs About negative emotions and emotion socialization practices. *Parenting: Science and Practice, 12*, 22-41. doi: 10.1080/15295192.2012.638871
- Neumann, S. A., Waldstein, S. R., Sellers, J. J., Thayer, J. F., & Sorkin, J. D. (2004). Hostility and distraction have differential influences on cardiovascular recovery from anger recall in women. *Health Psychology, 23*, 631-640. doi:10.1037/0278-6133.23.6.631
- North, T. C., McCullah, P., & Tran, Z. V. (1990). Effects of exercise on depression. *Exercise and Sport Science Reviews, 18*, 379-415. doi:10.1249/00003677-199001000-00016
- Pankova, N. B., Alchinova, I.B., Afanaseva, E. V., & Karganov, M. Y. (2010). Functional characteristics of the cardiovascular system in adolescents with high normal blood pressure. *Human Physiology, 36*, 319-324. doi:10.1134/S0362119710030102
- Peled, M., & Moretti, M. M. (2007). Rumination on anger and sadness in adolescence: Fueling of fury and deepening of despair. *Journal of Clinical Child and Adolescent Psychology, 36*, 66-75. doi:10.1080/15374410709336569
- Pittman, C. T. (2011). Getting mad but ending up sad: The mental health consequences for African Americans using anger to cope with racism. *Journal of Black Studies, 42*, 6-24. doi: 0.77/002934740737
- Raglin, J. S. (1997). Anxiolytic effects of physical activity. In W. P. Morgan (Ed.) *Physical Activity and Mental Health*. Washington DC: Taylor & Francis.
- Riley, W. T. & Treiber, F. A. (1989). The validity of multidimensional self-report anger and hostility measures. *Journal of Clinical Psychology, 45*(3), 397-404. doi:10.1002/1097-4679(198905)45:3<397::AID-JCLP2270450308>3.0.CO;2-4

- Rohrman, S., Bechtoldt, M. N., Hopp, H., Hodapp, V., & Zapf, D. (2011). Psychophysiological effects of emotional display rules and the moderating role of trait anger in a simulated call center. *Anxiety, Stress, & Coping, 24*, 421-438. doi:10.1080/10615806.2010.530262
- Shipman, K.L., Zeman, J., Negin, A.E., & Fitzgerald, M. (2003). Children's strategies for displaying anger and sadness: What works with whom? *Merrill-Palmer Quarterly, 49*, 100–122. doi: [10.1353/mpq.2003.0006](https://doi.org/10.1353/mpq.2003.0006)
- Siegel, J. M. (1986). The Multidimensional Anger Inventory. *Journal of Personality and Social Psychology, 51*, 191-200. doi:10.1037//0022-3514.51.1.191
- Sigfusdottir, I. D., Farkas, G., & Silver, E. (2004). The role of depressed mood and anger in the relationship between family conflict and delinquent behavior. *Journal of Youth and Adolescence, 33*, 509-522. doi: 0047-2891/04/1200-0509/0
- Sigfusdottir, I. D., Gudjonsson, G. H., & Sigurdsson, J. F. (2010). Bullying and delinquency: the mediating role of anger. *Personality and Individual Differences, 48*, 391-396. doi:10.1016/j.paid.2009.10.034
- Smith, T.W., & Frohm, K. D. (1985). What's so unhealthy about hostility? Construct validity and psychosocial correlates of the Cook and Medley Ho scale. *Health Psychology, 4*, 503-520. doi:10.1037/0278-6133.4.6.503
- Spielberger, C. D., Jacobs, G., Russell, S., & Crane, R. (1983). Assessment of Anger: the State-Trait Anger Scale. In J. N. Butcher & C. D. Spielberger (Eds.), *Advances in Personality Assessment (Vol 2)*. Hillsdale, NJ: Erlbaum.
- Suls, J., & Wan, C. K. (1993). The relationship between trait hostility and cardiovascular reactivity: A quantitative review and analysis. *Psychophysiology, 30*, 615-626. doi:10.1111/j.1469-8986.1993.tb02087.x

- Tugade, M. M., & Fredrickson, B. L. (2004). Resilient individuals use positive emotions to bounce back from negative emotional experiences. *Journal of Personality and Social Psychology, 86*, 320-333. doi:10.1037/0022-3514.86.2.320
- Vogele, C., Sorg, S., Studtmann, M., & Weber, H. (2010). Cardiac autonomic regulation and anger coping in adolescents. *International Journal of Psychophysiology, 85*, 465-471. doi:10.1016/j.biopsycho.2010.09.010
- Vrana, S. R., & Rollock, D. (2002). The role of ethnicity, gender, emotional content, and contextual differences in physiological, expressive, and self-reported emotional responses to imagery. *Cognition & Emotion, 16*, 165-192. doi:10.1080/02699930143000185
- Vrana, S. R., & Rollock, D. (1995). The social context of emotion in African American adolescents. Presented at the meeting of the Society for Research in Child Development, Indianapolis, Indiana.
- Vrana, S. R. (1994). Startle reflex response during sensory modality specific disgust, anger, and neutral imagery. *Journal of Psychophysiology, 8*, 211-218. Retrieved from <http://www.hogrefe.com/periodicals/journal-of-psychophysiology/>
- Williams, J. E. (2010). Anger, hostility and cardiovascular disease. In M. Potegal, G. Stemmler, C. Spielberger (Eds.), *International handbook of anger: Constituent and concomitant biological, psychological and social processes* (pp. 435-447). NY: Springer Science.
- Wittmann, M., & Santisteban, C. (2008). How impulsiveness, trait anger, and extracurricular activities might affect aggression in school children. *Personality and Individual Differences, 45*(7), 618-623. doi:10.1016/j.paid.2008.07.001

Table 1

*Demographics and MAI scores of High and Low Trait Anger and High and Low Hostility**Groups*

	High Trait Anger N=28	Low Trait Anger N = 99	High Hostility N = 37	Low Hostility N = 90
Female (n)	14	40	16	44
Male (n)	14	59	21	46
African American (n)	14	44	16	42
European American (n)	14	55	21	48
Average Age (years)	13.6	13.1	13.6	13.1
Age Range (years)	10-17	10-17	10-17	10-17
MAI: General Anger (GA)	3.72 (0.28)	2.33 (0.31)	3.29 (0.5)	2.43 (0.46)
MAI: Hostility (HO) Total	21.64 (3.28)	14.93 (4.03)	23.81 (1.72)	13.56 (2.76)
MAI: Frequency (FQ) Total	19.43 (3.32)	9.29 (2.76)	14.72 (4.62)	10.54 (3.92)
MAI: Duration (DU) Total	5.89 (1.50)	5.2 (1.36)	5.92 (1.36)	5.14 (1.42)
MAI: Magnitude (MG) Total	15.39 (1.81)	9.57 (2.34)	13.35 (2.62)	10.21 (2.79)
MAI: Anger In (AI) Total	21.60 (3.13)	15.23 (3.47)	20.01 (3.91)	15.90 (3.59)
MAI: Anger Out (AO) Total	16.75 (3.21)	12.75 (2.68)	14.83 (3.12)	13.31 (3.46)

Note: All MAI means are followed by the standard deviation in parentheses. There are no significant gender, racial or age differences between groups; MAI scale differences between low and high trait anger groups, and low and high hostility groups, are all significant (all  $p < .03$ ).

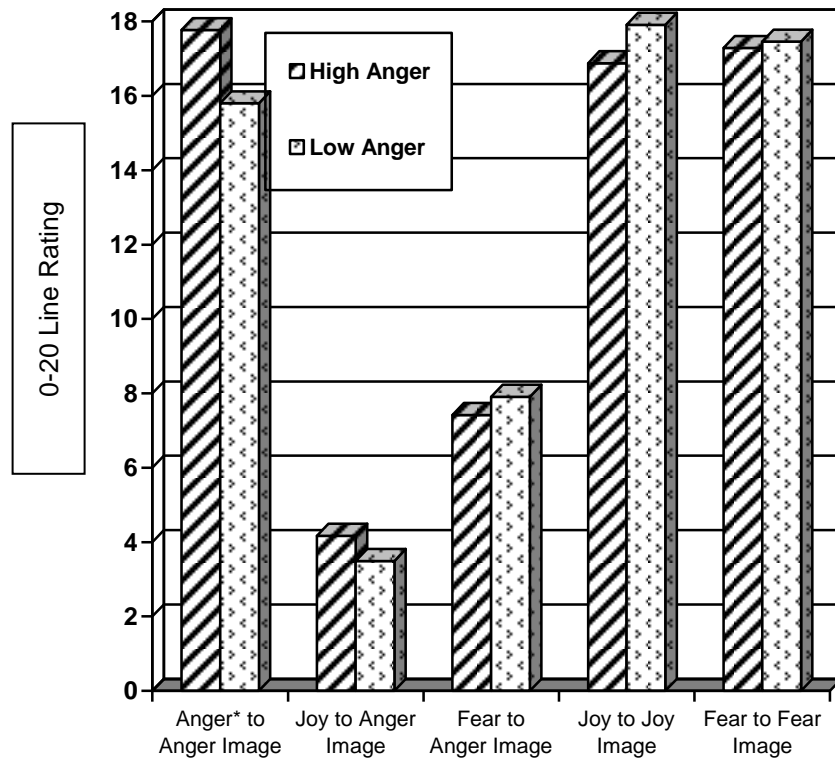
Average item scores are used in reporting MAI: GA and total scale scores are used for reporting each of the MAI subscales.

Table 2:

*Means and Standard Deviations for Differences in Anger Imagery Response Between High and Low Anger Groups*

	High Trait Anger		Low Trait Anger		<i>p</i>
	Mean	S.D.	Mean	S.D.	
Anger Rating*	17.8	3.9	15.8	4.8	.05
$\Delta$ HR (beats/min)	1.2	4.2	-1.8	4.7	.02
$\Delta$ SBP (mm/Hg)	4.0	7.8	0.8	5.1	.05
$\Delta$ DBP (mm/HG)	2.2	3.8	0.6	2.9	.05
Fear rating*	7.4	6.2	7.9	5.4	ns
Joy rating*	4.2	3.8	3.5	4.2	ns

Note: \* = denotes the average anger, fear, or joy rating across the two anger scripts on a 0 (no emotion) to 20 (extreme emotion) scale. The *p* column indicates the *p*-value of the ANOVA testing for differences between the high trait anger group and the low trait anger group. ns indicates the group difference is not significant.



*Figure 1:* Differences in emotion levels reported following anger provocation for high and low trait anger groups