ATTENTION TO ANGER-RELEVANT AND IRRELEVANT STIMULI FOLLOWING NATURALISTIC INSULT

Christopher I. Eckhardt* and Dale J. Cohen
Department of Psychology, University of North Carolina at Wilmington.
Wilmington, NC 28403-3297, U.S.A.

(Received 8 December 1996)

Summary—Attentional biases toward mood-congruent, task-irrelevant stimuli have previously been demonstrated in anxious and depressed subjects using the emotional Stroop procedure. We used a variation of this method to investigate basic information processing mechanisms underlying anger arousal. Eighty-eight undergraduates classified as high or low trait anger according to the Trait Anger Scale were randomly assigned to insult or no-insult conditions. Subjects' response latencies to name the colors of computer-presented anger words, positive emotion words, and neutral words were then assessed. An interaction between anger classification, word, and insult was found. Specifically, anger words interfered with the performance of high trait anger-insulted subjects, but not with performance of low trait anger-insulted subjects. There was no effect of word type for all non-insulted subjects. This finding is consistent with Persons and Miranda's mood-state hypothesis. © 1997 Elsevier Science Ltd

INTRODUCTION

A substantial number of articles investigating the information processing styles of emotionally disordered individuals have accumulated in the past 15 years (for a review see MacLeod & Mathews, 1991; Williams, Mathews & MacLeod, 1996). A frequently cited starting point for this area of research is Bower's (1981) seminal article on mood and memory. While not specifically addressing the area of experimental psychopathology in his review, Bower stated that associative memory links exist between each distinct emotion and other information, concepts, ideas, etc. stored in long-term memory. Activation of one emotion 'node' in this associative network has the effect of activating associated or related nodes throughout the memory structures to which it is connected. Additionally, Bower (1981) explicitly hypothesized that (a) an "emotion will enhance the salience of mood-congruent material for selective attention and learning" (p. 142) and (b) "an emotion should cause [mood] congruent words to 'pop out' at the perceiver" (p. 142) since these stimuli will be attended to in greater detail because of the activation of the relevant emotion node. This tendency to allocate attentional resources toward emotionally relevant stimuli is known as a mood congruent bias. As noted by Blaney (1986), "mood-congruence findings ... are numerous and have been obtained across varied tasks, indices of memory access, stimuli, and subject samples" (Blaney, 1986, p. 233).

Various modifications of the Stroop (1935) color naming procedure have been used to study Bower's hypotheses regarding selective attention, emotion, and perceptual processes. In the 'emotional' Stroop task, subjects who differ on an affective state or trait are asked to name the colors of both affectively and nonaffectively valenced words. Color naming response latency is the dependent variable. Bower's hypothesis predicts that subjects who score high on an affective state or trait will engage in task irrelevant processing when presented with affectively-valenced words. This interchange will produce longer response latencies for color-naming. Data accumulated during the past decade have indicated that, relative to control subjects, emotionally disordered subjects demonstrate longer color naming latencies to emotion/threat related words. This effect has been found in samples of spider phobics (Lavy & van den Hout, 1993; Watts, McKenna, Sharrock & Trezise, 1986), generalized anxiety disorder patients (Mathews & MacLeod, 1985; Mogg, Mathews & Weinman, 1989), panic disorder patients (Ehlers, Margraf, Davies & Roth, 1988; McNally, Riemann & Kim, 1990), rape victims (Foos, Geske, Murdock, Kozak & McCarthy, 1991), combat

*To whom all correspondence should be addressed. Now at: Department of Psychology, Southern Methodist University, Dallas, TX 75275, U.S.A.
veterans with post-traumatic stress disorder (Kaspi, McNally & Amir, 1995), obsessive compulsive disorder patients (Foa, Ilai, McCarthy, Shoyer & Murdock, 1993), depressed undergraduates (Gotlib & McCann, 1984), depressed outpatients (Segal, Gemar, Truchon, Guirguis & Horowitz, 1995), and depressed inpatients (Gotlib & Cane, 1987) (for a complete review see Williams et al., 1996).

A recent extension of the mood-congruency phenomenon has been articulated by Persons and Miranda (1992). They noted that research investigating cognitive factors in depression is often incongruent with cognitive theory. Specifically, cognitive differences between depressed and non-depressed individuals seem to disappear following the remittance of the depressive episode. However, when a negative mood state is induced in currently nondepressed individuals with a history of depression, the cognitive distortions become apparent (Miranda & Persons, 1988; Miranda, Persons & Byers, 1990). Persons and Miranda’s (1992) ‘mood-state hypothesis’ posits that activation of negative mood increases the likelihood of the activation and accessibility of mood-relevant cognitive processes. For example, patients in the midst of a depressive episode (high levels of state depression) may be more likely to access depressogenic cognitive distortions relative to when they are non-depressed. Therefore, while previous research indicated that individuals scoring high on an affective trait evidence the mood congruency effect, the mood state hypothesis suggests that manipulation of the individual’s emotional state at the time of assessment may be needed to activate latent cognitive processes.

The data have been inconsistent concerning the effects of inducing specific moods on subsequent information processing. While some researchers have found that trait levels of anxiety interact with increases in state anxiety to produce mood congruency effects (Broadbent & Broadbent, 1988; MacLeod & Mathews, 1988; Richards, French, Johnson, Naparstek & Williams, 1992), others have found the effect only in high trait anxiety subjects exposed to a prolonged (rather than laboratory-induced) stressor (Mogg, Bradley & Hallowell, 1994), and in both high and low trait anxiety subjects exposed to a high stress condition (Mogg, Mathews, Bird & Macgregor-Morris, 1990). In contrast to these data, Mathews and Sebastian (1993) demonstrated that traditional emotional Stroop effects can be nullified if a relevant mood is induced. Williams et al. (1996) have noted that these inconsistent results are perhaps due to the type of subjects under investigation (clinical vs non-clinical), differing methods of anxiety induction, and different modes of assessing mood congruent allocation of attention (e.g. emotional Stroop vs dot probe tasks). The lack of clarity in this area certainly suggests the need for continued research to further specify the parameters under which mood induction affects emotional Stroop performance.

Thus far, little attention has been directed toward basic information processing mechanisms involved with the emotion of anger. The lack of anger related research may stem from the difficulty of selecting relevant subject samples. As anger problems are not formally recognized in official diagnostic nomenclature, there exist no accepted criteria for identifying individuals with ‘anger disorders’ (Eckhardt & Deffenbacher, 1995; Novaco, 1985). While several official diagnostic categories include symptoms of anger or irritability (e.g. antisocial personality disorder, borderline personality disorder, post-traumatic stress disorder), anger is not a necessary criterion. The lack of an official anger diagnostic category, however, does not mean that significant and measurable individual differences in anger do not exist or that they are better described by existing classifications. Given the recent attention afforded to anger-related public health concerns (e.g. interpersonal aggression and cardiovascular diseases), it is clear that a more systematic study of the emotion of anger is needed (DiGiuseppe, Tafrate & Eckhardt, 1994; Tavris, 1989).

From a clinical cognitive perspective, inappropriate levels of anger have been theoretically (Beck, 1976; Berkowitz, 1993; Eckhardt & Deffenbacher, 1995; Ellis, 1962, 1977; Huesmann, 1988) and empirically (see below) associated with numerous cognitive distortions. Researchers have conducted correlational research using self-report measures of anger and questionnaires assessing Ellis’ (1962) irrational beliefs construct with a diverse array of subjects, including college undergraduates in the U.S. (Hazaleus & Deffenbacher, 1985; Hogg & Deffenbacher, 1986; Mizes, Morgan & Buder, 1990; Zwemer & Deffenbacher, 1984) and abroad (e.g., Kassinove & Eckhardt, 1994), violent prisoners (Ford, 1990), clinical outpatients (Deffenbacher, 1992; Deffenbacher & Stark, 1992), and maritally violent men (Lohr, Hamberger & Bonge, 1988). These studies generally conclude that there exists a moderate, but significant, overlap between one’s self-reported level of anger and irrational ideation.

Although these studies have advanced our understanding of the cognitive distortions associated
Attention allocation and anger

with anger, the attention and perceptual processes involved in anger arousal have not been investigated. We used a modified version of the emotional Stroop task to assess the attentional processes of undergraduates scoring high and low on the Trait Anger Scale (Spielberger, 1988). To investigate whether the interference effects were due to differences at the trait or state level, we randomly assigned subjects into a naturalistic insult condition or a no insult condition previously implemented by Nisbett (1993; Cohen, Nisbett, Bowdle & Schwarz, 1993). As discussed earlier, priming manipulations (such as an anger inducing insult) are designed to activate associative networks involved in processing affect-related information (Anderson & Bower, 1973; Broadbent & Broadbent, 1988; Persons & Miranda, 1992). This activation may produce differential response outcomes relative to subjects who have not been primed. We hypothesized that (a) subjects high in trait anger who were primed would show longer color-naming latencies for anger-related words relative to both high trait anger subjects who were not primed and all low trait anger subjects; and (b) insulted subjects, regardless of whether they were high or low in the trait of anger, would demonstrate longer color-naming latencies.

METHOD

Participants

Eighty-eight subjects participated. Subject selection began with a large-scale questionnaire distribution to undergraduates enrolled in Introductory Psychology during the Spring semester, 1995, at a medium-sized public university in the Southeast. Of the 167 subjects who completed the questionnaire packet, those scoring in the upper and lower third of the Trait Anger Scale (TAS) of the State Trait Anger Expression Inventory (STAXI; Spielberger, 1988) were selected as high anger and low trait anger subjects for the second phase of the study (high anger = raw score of 21 or higher; low trait anger = raw score of 17 or lower). National college student norms were used to identify cut scores (Spielberger, 1988). The STAXI is a well-validated measure of the experience and expression of anger that possesses excellent psychometric properties (Fuqua, Leonard, Masters, Smith, Campbell & Fischer, 1991; Spielberger, 1988; Spielberger & Sydeman, 1994). The 10-item TAS has been frequently used to define client analog samples by Deffenbacher and colleagues (for a review see Deffenbacher, 1992) and has consistently been shown to possess excellent construct and criterion validity.

Of the 111 high and low trait anger subjects selected for follow-up, 88 subjects (34 males, 54 females) were located, scheduled, and completed all requirements of the study. The remaining 23 subjects were not assessed because they could not be located. High and low trait anger subjects were randomly assigned into anger-insult or control (no insult) groups. Thus, four groups of subjects participated: (a) High Trait Anger, Insult; (b) High Trait Anger, No Insult; (c) Low Trait Anger, Insult; and (d) Low Trait Anger, No Insult. Demographic information and TAS scores for subjects in each of the four groups are presented in Table 1. To illustrate that the high trait anger samples were indeed relevant analogs, note that these subjects' TAS means exceed norms presented by Spielberger (1988) for a large sample of male and female prison inmates (male prisoners M = 21.66, SD = 6.71; female prisoners M = 19.79; SD = 6.44). The four groups were not significantly different with regard to age, race, or gender. No gender differences were found on the TAS. All subjects had normal or corrected 20/20 vision.

![Table 1. Characteristics of the four subject groups](image)

<table>
<thead>
<tr>
<th>Measure</th>
<th>High Anger Insulted</th>
<th>High Anger Not Insulted</th>
<th>Low Anger Insulted</th>
<th>Low Anger Not Insulted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>19.4*</td>
<td>19.3*</td>
<td>19.5*</td>
<td>19.4*</td>
</tr>
<tr>
<td>% Female</td>
<td>47.4*</td>
<td>58.3*</td>
<td>63.2*</td>
<td>73.1*</td>
</tr>
<tr>
<td>% White</td>
<td>100*</td>
<td>79.2*</td>
<td>94.7*</td>
<td>100*</td>
</tr>
<tr>
<td>Trait anger</td>
<td>27.58* (6.25)</td>
<td>26.08* (4.91)</td>
<td>13.68* (1.77)</td>
<td>13.42* (1.81)</td>
</tr>
</tbody>
</table>

Note. STAXI = State Trait Anger Expression Inventory. SD in parentheses. For variables with a significant omnibus F, post hoc Fisher's LSD tests were calculated to determine group differences. *Within a variable row, those groups sharing the same letter did not differ significantly (p > 0.05).
Apparatus and materials

Stimulus words. One hundred-twenty colored stimulus words of three different varieties were presented to subjects: (a) Anger Words, (b) Positive Emotion Words, and (c) Neutral Words. Emotion words were utilized as stimuli in the present study since they serve as important semantic cues for specific emotions (for a discussion of subjective labeling of anger arousal, see Eckhardt & Deffenbacher, 1995; Kassinove & Sukhodolsky, 1995). Thus, it would be expected that these words may activate associated emotion-cognition complexes. Forty Anger words were selected using empirical and rational criteria. We began with a list of 80 rationally-derived words that were reflective of the constructs of anger, hostility and aggression. From this initial list, we utilized Clore, Ortony, and Foss' (Clore, Ortony & Foss, 1987) empirically derived taxonomy of the affective lexicon and matched 40 words from our original list that were found to represent ‘true’ affective conditions (see Clore et al., 1987, pp. 752–754 for a definition of this term). The average word length of Anger words was 6.9 characters. The same procedure was used to identify 40 Positive Emotion words, which had an average word length of 8.0 characters. The third set of 40 words were affectively Neutral words. These words were selected using a random number generator and an unabridged dictionary. The first non-emotion word after a randomly selected number of dictionary pages was selected.* Average word length was 7.0 characters.

Presentation of stimulus words. All stimuli were randomly presented on a 15” VGA color monitor with a 60 Hz refresh rate controlled by an 80486 micro computer using the DOS operating system. The resolution of the monitor was 640 x 480. The stimuli were centered on the monitor in IBM default text at twice the standard size (the visual angle subtended about 2 degrees). The words were presented in one of five colors: red, purple, blue, green, and yellow (IBM palette numbers 4, 5, 1, 2, and 14 respectively). The screen background was always black.

In the present study, we used a modified version of the emotional Stroop task to assess anger-related attentional biases. This modification was made to assess whether attentional biases can be found using a paradigm theoretically similar but not identical to the emotional Stroop task. Recall that in the original Stroop (1935) task, the semantic content of the color word interfered with the response of naming the ink color of the presented word. This interference is termed response competition. In the emotional Stroop task, the subject is required to name the ink color of an emotionally valenced word. Because the semantic content of the word and the required response are unrelated, there is no possibility for response competition. The interference often found in the emotional Stroop task is hypothesized to be the result of a variety of extraneous cognitive processes initiated by the semantic content of the word (MacLeod, 1991). These processes are hypothesized to interfere with the subject’s color identification decision. It is untenable to propose that these extraneous cognitive processes only interfere with the response required by the emotional Stroop task; one would expect that extraneous, task-irrelevant cognitive processes would interfere with the completion of any task requiring shared resources. Therefore, we tested subjects using a modified version of the emotional Stroop task. In this version, subjects are given a target color before each trial and are then presented with an emotionally valenced word in colored ink. Subjects indicate whether the target color is the same as the color of the presented word’s ink. We hypothesize that high anger subjects may automatically attend to the content of the anger words, which would initiate extraneous cognitive processes that interfere with the decision of whether the target color matches the emotion word color. Although this task superficially differs from the standard emotional Stroop task, both tasks’ susceptibility to inhibition by extraneous cognitive processes are theoretically identical.

A trial consisted of a fixation cross presented for 500 ms, followed by the name of the target color printed in white letters (e.g., ‘blue’). The target color name remained on the screen for 800 ms, followed by a 200 ms blank screen, followed by the stimulus word (e.g. ‘annoy’). The subject’s task was to judge whether the stimulus word was presented in the same color as the target color name. The stimulus word remained on the screen until the subject pressed either the ‘d’ or ‘k’ key on the computer keyboard to indicate their response.† The key indicating a positive response (i.e. target

*We should note that Neutral words were not associated with a single category.
†MacLeod (1991) notes that while interference effects can be lowered in tasks requiring a manual response, the effect cannot be explained by response mode alone.
color and word color were the same) was counterbalanced between subjects within groups. Negative trials (i.e. target color and word color were different) were randomly presented with a probability of 0.50. Subjects' reaction time (RT) was recorded by the computer.

Procedure

The nature of the anger induction for those subjects in the Anger-Insult conditions was adapted from a script provided by R. Nisbett (Cohen et al., 1993). High and low trait anger subjects were contacted by phone to schedule their assessment times. Upon arrival to the Psychology department, subjects were greeted by the experimenter and escorted down a hallway. Midway down the hall, the experimenter instructed the subject to complete a consent form at a desk situated at the end of the hallway, and the experimenter left the area. Eight feet prior to arriving at the desk, the subject's path was impeded by an accomplice of the experimenter who worked at a file cabinet with the file drawer pulled out as far as possible. The accomplice was a 21 year old male of average height and build. Subjects typically excused themselves to walk by the accomplice. The accomplice would then move forward and gently push the file drawer in to allow the subject to pass behind. When the subject attempted to pass by the accomplice a second time to return to the laboratory, the accomplice stared into the eyes of the subject, slammed the file drawer into the cabinet, and said 'Asshole!' as he brushed past the subject and entered a room at the end of the hallway with a self-locking door. Fifteen seconds after the insult was delivered, the experimenter came down the hallway and instructed the subject to enter the 6' x 6' laboratory room.

It should be noted that of 38 subjects insulted in the present study, no subject attempted to follow the accomplice or otherwise retaliate following the insult. Results from Nisbett's laboratory are quite similar (see Nisbett, 1993). As Cohen et al. (1993) has reported on the validity of this procedure as an anger induction manipulation (especially for college-aged students from the south), and since a direct assessment of anger following this apparently 'natural' insult may have suggested the study's purpose to the subject, post-insult anger was not assessed.

Once the experimenter and subject were in the laboratory room, the emotional Stroop task was explained using both verbal and written instructions. The experiment began when the subject indicated understanding of the task. Each subject was individually assessed for a single 15 minute session. The sessions consisted of 12 practice trials and 120 experimental trials. The experimenter left the laboratory room during the experimental trials. Upon completion of the Stroop task, the experimenter entered the room, announced that the experiment was over, and inquired about the perceived purpose of the study. Upon learning of the deception, subjects were immediately reunited with the accomplice, who entered the laboratory room and shook hands and interacted with the subject. No subject reported feeling upset at the deception. The experimenter proceeded to review the study's hypotheses, the necessity for employing the deception, the random nature of the anger-insult assignment, and the feelings and concerns of the subjects. All subjects were asked to sign a statement indicating that they would not reveal the nature of the experiment to anyone. The 88 subjects received course credit and $10 for their participation.

RESULTS

Separate 3 (anger, positive, or neutral content words) by 2 (high trait anger vs low trait anger) by 2 (insult vs no insult) by 2 (male vs female) analyses of variance (ANOVAs) were run on positive trials (target color and word color are the same) and negative trials (target color and word color are different). Negative trials were analyzed separately since subjects' reaction times to negative trials are often contaminated by irrelevant 'second guessing' strategies (Sternberg, 1970). These strategies often increase reaction time and mask most effects. Furthermore, since reaction time data are very susceptible to positive outliers, all trials in which the subjects' response exceeded two seconds (over three SD's away from the mean) were deleted (Bowerman & O'Connell, 1990). Finally, since reaction time data are only valid if the subject does the task correctly, only correct responses were included in the analysis (Weltford, 1980). Six subjects were excluded in the analysis because they had error rates over 15% (three low-anger no insult subjects, two high-anger no insult subjects,
Table 2. Mean color naming latencies (in msec) to positive trials by anger status, word type, and insult condition

<table>
<thead>
<tr>
<th></th>
<th>Insulted subjects</th>
<th>Non-insulted subjects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Positive</td>
<td>Neutral</td>
</tr>
<tr>
<td>High anger</td>
<td>19</td>
<td>600</td>
<td>663</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(307)</td>
<td>(323)</td>
</tr>
<tr>
<td>Low anger</td>
<td>18</td>
<td>615</td>
<td>641</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(265)</td>
<td>(284)</td>
</tr>
</tbody>
</table>

Note. SD in parentheses.

Positive trials

Reaction time means and standard deviations are presented in Table 2. There was a significant main effect of word, $F(2,146) = 5.81, p = 0.004$ ($\eta = 0.27$). Fisher's LSD (alpha = 0.05) indicated that subjects took significantly longer to identify the color of anger words ($M = 715, SD = 326$) than either neutral ($M = 693, SD = 315$) or positive words ($M = 688, SD = 304$). There was a significant main effect of insult, $F(1,73) = 6.58, p = 0.01$ ($\eta = 0.29$), such that those who were insulted ($M = 660, SD = 304$) took less time to respond than those who were not insulted ($M = 731, SD = 321$). There was also a significant interaction between gender and insult, $F(1,73) = 6.34, p = 0.01$ ($\eta = 0.20$), such that female subjects' RTs were unaffected by the insult (insult: $M = 698, SD = 319$; no insult: $M = 702, SD = 306$), while male subjects' RTs were faster in the insulted condition ($M = 606, SD = 273$) than the no insult condition ($M = 802, SD = 343$).

Importantly, there was a significant 3-way interaction between word type, anger classification, and insult, $F(2,146) = 3.49, p = 0.03$ ($\eta = 0.28$). Fisher's LSD (alpha = 0.05) indicated that the response latencies to anger words were not significantly different from those to neutral words for all low trait anger subjects and high trait anger non-insulted subjects. However, high trait anger insulted subjects had significantly longer response latencies to anger words than neutral words. For all subject groups, response latencies to positive words were not significantly different from those to neutral words. With the important exception of the longer response latencies to anger words from high trait anger insulted subjects, the response latencies were facilitated by the insult (i.e. RTs were shorter for insulted subjects than those for non-insulted subjects).

There were no other significant effects (all $F$s < 2.18).

Negative trials

There was a significant main effect of insult, $F(1,73) = 6.58, p = 0.01$ ($\eta = 0.32$), such that those who were insulted ($M = 719, SD = 303$) took less time to respond than those who were not insulted ($M = 804, SD = 326$). There was also a trend towards an interaction between gender and insult, $F(1,73) = 3.81, p = 0.054$ ($\eta = 0.22$), such that female subjects' RTs were less affected by the insult (insult: $M = 754, SD = 313$; no insult: $M = 789, SD = 326$) than male subjects' RTs (insult: $M = 670, SD = 282$; no insult: $M = 849, SD = 322$). Finally, there was a 3-way interaction between gender, word type, and anger classification, $F(2,143) = 3.45, p = 0.03$ ($\eta = 0.21$). Fisher's LSD (alpha = 0.05) indicated that female high-anger subjects' RTs to anger words were significantly greater than their RTs to neutral words but no different than positive words (see Table 3). There were no significant effects of word type for all low-anger subjects and male high-anger subjects.

Table 3. Mean color naming latencies (in msec) to negative trials by anger status, word type, and gender

<table>
<thead>
<tr>
<th></th>
<th>Male subjects</th>
<th>Female subjects</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>Positive</td>
<td>Neutral</td>
</tr>
<tr>
<td>High anger</td>
<td>17</td>
<td>794</td>
<td>778</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(337)</td>
<td>(328)</td>
</tr>
<tr>
<td>Low anger</td>
<td>12</td>
<td>714</td>
<td>716</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(274)</td>
<td>(287)</td>
</tr>
</tbody>
</table>

Note. SD in parentheses.
There were no other significant effects (all Fs < 2.34).

**DISCUSSION**

Let us return to Bower's (1981) hypothesis of selective attention to mood congruent material, and Persons and Miranda's (1992) hypothesis of mood state-dependent cognitive accessibility. Based on these models, we hypothesized that high trait anger subjects experiencing an episode of state anger would be affected differently by the anger related semantic content of the colored word than those subjects classified as low trait anger. This prediction was supported by the data.* In the primed condition, high trait anger subjects had longer color decision latencies for anger words relative to both positive and neutral words. Regardless of priming, low trait anger subjects did not show this pattern of response inhibition.

Contrary to our predictions anger induction priming facilitated all decision times. These data are in contrast to emotional Stroop findings by Richards et al. (1992) and Mogg et al. (1990), who reported increases in decision latencies following anxiety induction, but consistent with findings of Mathews and Sebastian (1993), who reported decreased color naming latencies when snake avoidant subjects color-named in the presence of a snake or spider. While Williams et al. (1996) explained the latter finding in terms of the ability for nonclinical subjects to 'override' the emotion-relevant aspects of the stressful situation, allowing them to focus more intently on task demands, we hypothesize that our subjects' responding may have been a result of the 'energizing' function of anger (Novaco, 1985). As adrenal hormones are released during anger arousal, one may be more vigilant, prepared for threat, and attack-ready (as opposed to the escape/avoidance readiness present during anxiety). Anger-related individual differences may thus be unobservable in the absence of this physiological arousal. For example, Suarez and Williams (1989) found that subjects classified as high or low in hostility on the basis of the Cook-Medley Hostility Inventory did not differ on various physiological measures at rest. When angered during a frustration task, however, high hostility subjects had significantly higher systolic and diastolic blood pressure and a higher heart rate. Among the subjects assessed in the present study, dispositional tendencies may have interacted with the cognitive, affective, and physiological changes that accompanied anger elicitation to produce faster reaction times. While all groups' color naming latencies were reduced during the priming condition, high trait anger individuals—those who experience more frequent episodes of state anger—nevertheless attended to task-irrelevant anger words longer after anger induction than anger induced subjects low in trait anger. Thus, in the context of the generalized response facilitation for insulted subjects, high trait anger insulted subjects demonstrated the expected finding of longer decision latencies for anger related stimuli.

When primed, high trait anger subjects had longer color decision latencies for anger words relative to both positive and neutral words. This effect could not have been the result of stimulus factors alone (e.g. average word length of lexical stimuli) since (a) high trait anger subjects did not demonstrate the effect when they were not primed, and (b) low trait anger subjects did not demonstrate the effect in either priming condition. Persons and Miranda's (1992) variation of Bower's (1981) theory would explain these data by hypothesizing that high and low trait anger subjects differentially activated attentional resources to anger-relevant stimuli. High trait anger subjects, when primed, are more likely to selectively attend to anger stimuli because of complex and diffuse interconnections between anger activation and information processing operations. Importantly, when high trait anger subjects are not primed, these interconnections are hypothesized to remain latent. From a theoretical standpoint, our data support these predictions.

Because we did not assess subjects' emotional states after the insult, we cannot definitively conclude that anger was indeed induced. Therefore, our results may appear equivocal. However, low trait anger insulted subjects performed similar to that of low and high trait anger noninsulted

*All conclusions are based upon data from positive trials. Subjects' RT to negative trials has been shown to be contaminated by second guessing strategies (Sternberg, 1970). The time associated with these strategies often masks the effects of the manipulation.

†A hypothesis of reaction time latencies based solely on word length would predict faster responses to the anger words by *all groups* given that the anger words had fewer characters on average.
subjects. Therefore, any emotion induced in low trait anger insulted subjects had no effect on their reaction times. The effect of word type on high trait anger insulted subjects' reaction times indicates that the emotion induced by the insult, which Cohen et al. (1993) have reliably found to be anger, triggered a tendency for high trait anger subjects to allocate attentional resources to the anger words. The question therefore remains as to what specific emotion was induced by the insult for the high trait anger subjects. Although this is a theoretically important issue, it is nonetheless of little practical importance. The data show that when high trait anger subjects are insulted they engage in task-irrelevant processing of anger related stimuli. It is the situation in which the task-irrelevant processing occurs that is of practical importance. Future experiments should explore the emotion associated with this important finding.

Although gender did not interact with word type, we are intrigued by the unexpected finding that insulted males were more likely than insulted females to show faster decision latencies. Researchers have indicated that men and women are angered by different classes of events (Frodi, 1977, 1978). However, Harris (1993) demonstrated that while different classes of stimuli triggered anger for males and females, obscenities that came from males produced similar levels of anger in males and females. Thus, Harris' data indicate that the insult used in the present study should have elicited similar levels of anger in male and female targets. It is important to distinguish between questions regarding the dimensions of anger experience (i.e. what cognitive, physiological, and behavioral dimensions are activated during anger arousal?) and questions concerning the causes of anger experience (i.e. in the presence of what stimuli is anger elicited?). While ample evidence exists demonstrating that males and females are prompted to feel angry by different stimuli, a wealth of data indicate that, in general, males and females experience similar levels of anger (Eckhardt, Kassinove, Tsutsarev & Sukhodolsky, 1995; Goldman & Haaga, 1995; Hazaleus & Deffenbacher, 1985; Hogg & Deffenbacher, 1986; Mizes et al., 1990; Spielberger, 1988; Zwemer & Deffenbacher, 1984). Future researchers can shed light on the relation between anger eliciting events and anger experience by employing in vivo anger induction techniques with male and female research participants while carefully assessing how anger is experienced by the two genders.

As the present investigation represents the first attempt to delineate basic processing mechanisms involved in anger arousal, emerging theory and data from the childhood aggression literature may relate to our findings. Huesmann's (1988) information processing model of aggression has likened the connections between aggression and social information processing to a 'script' which the individual accesses to: (a) select and perceive events, (b) guide responses to these events, and (c) predict the likely outcomes following response enactment. Anger elicitation fosters attention to salient script-relevant cues, often at the expense of other contextual cues that may redirect script retrieval (Huesmann & Eron, 1989). The aggressive script is likely to be reinforced since others tend to reciprocate with anger and aggression. Similarly, Dodge (e.g. Dodge & Coie, 1987; Dodge, Pettit, Bates & Valente, 1993) has demonstrated that aggressive children characterized by intense anger evidence a hostile attribution bias, whereby ambiguous events or actions by others are automatically perceived as being hostilely motivated and worthy of an aggressive response. Similar findings have been found for antisocial adolescents (e.g. Slaby & Guerra, 1988).

The present data, while not directly confirming the existence of a hostile attribution bias in angry adults, are suggestive of attentional attraction toward anger-related stimuli. It is important to understand the utility of such a bias. Research investigating the reciprocal nature of marital violence using marital interaction paradigms (Burman, Margolin & John, 1993; Cordova, Jacobson, Gottman, Rushe & Cox, 1993; Jacobson, Gottman, Waltz, Rushe, Babcock & Holtzworth-Munroe, 1994) has indicated that maritaly violent men engage in a variety of negative communication patterns (e.g., anger, belligerence, aggression) which tend to be reciprocated by their partners. These men are also more likely to attribute the cause of marital conflict situations to the hostile intentions of their wives (Holtzworth-Munroe & Hutchinson, 1993). If husband negative behavior is assumed to follow attribution of negative wife intent, these biases are then verified and reinforced by the subsequent negative responses of their wives (Cordova et al., 1993). This cognitive bias favoring anger-relevant contextual information may explain why the anger-primed, high trait anger subjects in the present study engaged in task-irrelevant information processing; these processes are perhaps the first part of the anger activation sequence. Future studies would be wise to examine whether preliminary attentional biases, such as those demonstrated in the present analog sample of insulted
high trait anger subjects, are also present in conjunction with hostile attributional biases in a sample of maritally violent men.

An important limitation to this study deserves mention. While the two high trait anger samples in the present study had mean TAS scores that were (a) in the 90th percentile according to Spielberger's (1988) college student norms and (b) were approximately one standard deviation above the mean of a sample of prisoners, they are nevertheless an analog sample. As was mentioned at the outset of this paper, little progress has been made in clinical research on angry patients. Recently, the first author has delineated a series of diagnostic criteria to describe angry patients and has constructed interview and self-report measures to facilitate identification of angry subjects for clinical research purposes (Eckhardt, 1993, 1995; Eckhardt & Deffenbacher, 1995). Until criteria such as these are considered a valid way to identify clinically angry individuals, anger research must continue to use available assessment and screening techniques such as the TAS. It is worth restating that Deffenbacher and colleagues (for a review see Deffenbacher, 1992) have also used TAS-defined high trait anger college student samples in their series of anger treatment-outcome studies and have found that high trait anger subjects demonstrate a remarkably high level of symptom distress and anger-related functional impairment.

In conclusion, the quantity and quality of clinical research on anger has lagged behind the substantial advancements that have occurred in clinical research on anxiety and depression. One way of reducing this research gap is to apply paradigms used in the latter research to study the variables involved in the experience of anger. In our experiment, we have demonstrated that high trait anger subjects who are insulted tend to process irrelevant anger information, while both high trait anger subjects who were not insulted and low trait anger subjects in all conditions did not evidence such processing biases. We attribute this effect to the tendency for high trait anger individuals who are primed to overapply angry scripts and selectively attend to potential anger-relevant stimuli in ambiguous situations (i.e. perceiving a hostile threat when none is present). Although both Bower's (1981) and Persons and Miranda's (1992) theories predicted these results, they cannot be validated by one particular method. Innovative applications of traditional cognitive tasks, such as the method used in the present study as well as visual search tasks and word/non-word priming manipulations, are needed to further investigate the many important questions that remain regarding the role of information processing in the experience and expression of anger.

Acknowledgements—This research was supported by a Cahill Faculty Research and Development Grant awarded to the first author. Portions of this research were presented at the November 1996 convention of the Association for Advancement of Behavior Therapy. Special thanks to: Richard Nisbett for providing details on his anger induction paradigm, Anita Herring for assisting in data collection, Shawn Prevette for delivering the insults, and Julian Keith and Ellen Dennehy for helpful comments on earlier versions of this manuscript.

REFERENCES


