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From Antecedent Conditions to Violent Actions: A General Affective Aggression Model

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The General Affective Aggression Model (GAAM) posits that variables that increase aggression do so by increasing aggressive affect, aggressive cognition, or arousal. The effects of trait hostility, pain, and cognitive cues on state hostility (Experiment 1), on lexical decisions for aggressive and control words (Experiment 2), on escape motives (Experiment 3), and on aggressive behavior (Experiment 4) are presented. Consistent with GAAM, trait hostility increased both flight and fight motives, presumably due to affective reactions. Pain also increased hostile affect but increased aggression only when aggressive thoughts were made highly accessible (i.e., after viewing gun pictures). Theoretical implications are discussed.

Although armchair and academic philosophers have debated the psychological processes underlying aggression for many years, one could argue that the 1939 monograph *Frustration and Aggression* (Dollard, Doob, Miller, Mower, & Sears, 1939) launched the social-psychological inquiry into this behavioral domain. The theoretical progression in aggression research reflects the paradigmatic milestones of social psychology. First, Dollard, et al.'s (1939; Miller, 1941; Sears, 1941) frustration-aggression hypothesis provides a synthesis of psychoanalytic concepts, elements of Hullian theory, and concepts from behaviorism. Aggression research in the 1960s was influenced heavily by classical and instrumental learning paradigms and definitions (e.g., Berkowitz, 1971; Buss, 1961, 1966) and Bandura's (1973) and others' work on observational learning (e.g., Eron, Walder, & Lefkowitz, 1971). More modern theoretical perspectives have incorporated social-cognitive and psychophysiological concepts. For instance, most aggression scholars have acknowledged some degree of active thought by incorporating intention to do harm into their working definition of affective aggression (e.g., Baron & Richardson, 1994; Berkowitz, 1993; Geen,

1990). Also, Berkowitz's cognitive neoassociationist model of aggression (CNA) and Huesmann and colleagues' script model of media violence effects (e.g., Huesmann, 1998; Huesmann & Eron, 1984) rely heavily on cognitive principles. Finally, a psychophysiological perspective is provided by Zillmann and colleagues (Zillmann, 1983, 1988) with their inquiry into the influence of arousal and cognitive processes in formation of emotion and aggressive behavior.

THE GENERAL AFFECTIVE AGGRESSION MODEL

These and other social psychologists have not only provided insight into the factors that increase the likelihood of human aggression but also have elucidated the mechanisms involved in this behavior. Recently, C. A. Anderson and colleagues (C. A. Anderson, 1997; C. A. Anderson, Anderson, & Deuser, 1996; C. A. Anderson & Bushman, 1998; C. A. Anderson, Deuser, & DeNeve, 1995) have combined these various conceptualizations into a single broad framework. Specifically, they have proposed that the variables that produce affectively based aggressive behavior do so by activating aggression-related cognitions, by inducing an anger-related affective state, and/or by increasing arousal (see Figure 1).

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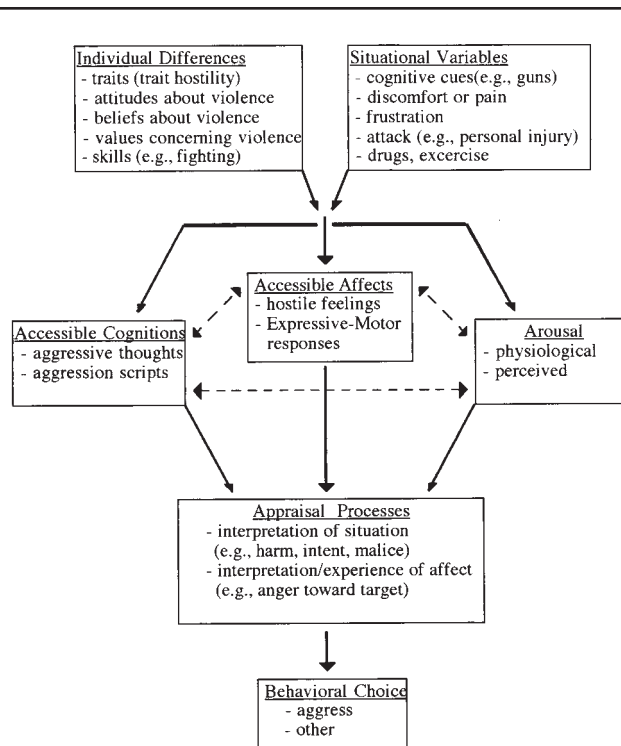


Figure 1 C. A. Anderson's (1997) General Affective Aggression Model.

To date, empirical support for C. A. Anderson's (1997) General Affective Aggression Model (GAAM) has been piecemeal. For instance, C. A. Anderson et al. (1995, 1996) demonstrated a link between extreme temperatures and aggressive affect. Uncomfortable temperatures produce increases in state hostility but have little direct influence on accessibility of aggression-related cognitions. Similarly, the preponderance of the evidence also suggests that cognitive cues (e.g., photo primes of weapons, violent movie content) directly activate aggression-related thoughts (C. A. Anderson, 1997; C. A. Anderson et al., 1996; C. A. Anderson, Benjamin, & Bartholow, 1998; Bushman, 1998; Bushman & Geen, 1990) but have little impact on the affective route to aggression. The one empirical exception to this claim is Bushman's (1995) finding that violent media can increase hostile feelings for some people under some conditions. But even this finding fits the GAAM formulation in that input variables may also produce indirect effects via the interconnections between the affective, cognitive, and arousal processes, displayed in Figure 1 as dashed lines. Links between input variables and arousal also have been tested. C. A. Anderson et al. (1995) found that temperature and exercise produce changes in both perceived arousal and several physiological measures.

Thus, studies have provided empirical support for the relationships between the input variables that are known to increase aggressive behavior and the next immediate

stage in GAAM, involving affect, cognition, and arousal. However, few studies have examined how individual differences moderate relationships between commonly studied situational factors and aggression-related processes, and there have not been any studies that have investigated the influence of various input variables on the immediate and subsequent stages simultaneously.

MEDIATION AND THE PSYCHOLOGICAL HEISENBERG PRINCIPLE

Baron and Kenny (1986) outlined statistical procedures for testing the influence of intermediate theoretical stages. In terms of C. A. Anderson's (1997) GAAM, the accessibility of aggressive thoughts can be seen as mediating the effect of aggressive cognitive cues on aggressive behavior if the following criteria are met: (a) the cognitive cue manipulation influences accessibility of aggressive thoughts; (b) a significant, positive, zero-order relationship is found between accessibility of aggressive thoughts and aggressive behavior; and c) a significant effect of the cognitive cue manipulation on aggressive behavior becomes substantially reduced when accessibility of aggressive thoughts is first partialled out of the statistical model.

However, these tests of mediation require that the act of measurement of upstream variables (e.g., accessibility of aggressive thoughts) not interfere with or influence downstream variables (e.g., aggressive behavior). Unfortunately, this assumption of mediation testing is frequently violated in the social psychological and cognitive literatures. In many of our pilot studies, for example, we found that cognitive priming effects are disrupted when more than a few minutes pass between the prime manipulation and the assessment of aggressive thought accessibility. Similarly, assessing the accessibility of aggressive thoughts can affect later behaviors in several ways, such as by tipping off the participants about the purpose of the aggressive behavior task. This methodological problem is similar to the Heisenberg uncertainty principle in physics, which states (in its general form) that increasing the accuracy of measurement of one observable quantity increases the uncertainty with which other quantities may be known, because measurement of one variable influences the value of other related variables. The psychological uncertainty principle is much the same in that measurement of one variable may well change the psychological processes at work, thereby changing the values of downstream variables.

Whether the psychological uncertainty principle is operative in a given context can be assessed by experimentally varying the order in which hypothesized mediating variables are assessed and then testing for order effects. Significant order effects confirm that the psychological uncertainty principle is at work. In such cases,

mediation models can be tested only by conducting multiple experiments, each of which assesses only one of the key variables.

THE PRESENT INVESTIGATION

The research presented in this article was intended to meet several objectives. First, we sought to examine the influence of trait hostility, pain, and aggression-related cues on aggressive behavior from the GAAM perspective. Second, we sought to elucidate the routes through which these input variables influence aggressive behavior. Third, we sought to examine interactions between cognitive and affective processes and between situational factors and individual differences. Previous theory has provided hypotheses for this research.

Cognitive Primes and Aggressive Behavior

Berkowitz and LePage (1967) first provided evidence suggesting a purely cognitive link between aggressive thoughts engendered by presence of a weapon and subsequent aggressive behavior. Following a mild provocation, participants who gave evaluations (in the form of electric shocks) in the presence of a revolver and shotgun administered more electric shocks to another person than did those who gave the evaluations in the presence of neutral objects or no objects.

Although attempts to replicate Berkowitz and LePage's (1967) weapons-effect study have not always been successful, a meta-analytic review of such effects suggested that the weapons effect is reliable when experimental participants are not suspicious or apprehensive (Carlson, Marcus-Newhall, & Miller, 1990). More important in terms of theory, this meta-analysis also revealed that experimental manipulations of aggression-related cognitive cues (e.g., pictures of guns) in general promote higher levels of aggression.

These findings are supportive of Berkowitz's (1993) CNA model of aggression. Berkowitz postulates that general negative affective states tend to produce a series of cognitive, affective, and expressive-motor associations. As a result of this spreading activation, participants experience a more differentiated affective state (e.g., anger or fear) and are motivated to either attack or flee from the source of the negative affect. Thus, given previous research and theory, cognitive cues should activate the cognitive route to aggression and increase the motivation to aggress.

Pain as a Cause of Aggressive Behavior

The effect of pain on aggression is less clear-cut. Research on lower animals indicates that aversive stimulation (e.g., electric shock) elicits aggressive behavior toward cellmates (Hutchinson, 1973; Renfrew, 1997).

However, there is relatively little empirical evidence supporting this pure pain-aggression effect in humans. In one pain-related study (Berkowitz, Cochran, & Embree, 1981), participants who were required to keep their arms immersed in cold water (6°C) gave fewer rewards as an evaluation of a partner's performance than did similar participants whose arms were immersed in water having a more comfortable temperature (18°C). Analysis of the number of punishments given to the partner proved nonsignificant. Berkowitz and Thome (1987) also studied the influence of pain on aggression, but in this study, the (intentional) confounding of pain expectancies with the manipulation of pain made the results difficult to interpret (although we agree with the interpretation given by those authors).

K. B. Anderson, Anderson, Dill, and Deuser (1998) and Lindsay (1996) investigated the process through which pain-aggression effects presumably occur. In these studies, pain was manipulated by having participants keep their nondominant arms in a position horizontal to the rest of their body during multiple 2.5 minute periods, separated by 30 seconds of rest (with their arms down on the desk in which they were seated). K. B. Anderson et al. (1998) found that, relative to participants whose arms were in the resting position throughout the experiment, those in pain reported more feelings of hostility. No pain-related differences were found in accessibility of aggressive thoughts in either study.

The dearth of evidence on the pain-aggression relationship in humans may be attributable to investigators' ethical qualms about performing experiments on this topic or to the failure of researchers to uncover significant effects. This speculation gives rise to three alternative hypotheses. First, given findings from the animal domain, the results of K. B. Anderson et al. (1998), and the theoretical links in GAAM, one might expect that the experience of pain produces a feeling of hostility and an increased inclination to either aggress or flee the situation. A second hypothesis (the null hypothesis or publication bias hypothesis) is that pain produces neither increased state hostility nor increases in the flight-fight response. This alternative seems unlikely considering evidence indicating pain effects on state hostility. The third alternative is that the processes governing the pain-aggression relationship differ for humans and lower animals. In humans, physical discomfort effects on aggression may be mediated by their interpretation of the event. If a provocation that elicits pain cannot be attributable to the potential target of aggression, then the aggressive response may be suppressed. Indeed, GAAM, as well as the theories on which it was based, all suggest that higher order or deliberative processing of intention information can play a part in the motivation to aggress. Thus, factors influencing this interpretation

stage (e.g., cognitive cues) may moderate the effect of pain on aggression.

Overview of Experiments 1 Through 4

Because pervasive order effects have prevented simultaneous examination of moderating and mediating effects of the various stages in GAAM, we examined the effects of trait irritability, cognitive prime, and pain on the intermediate and final stages in a series of four studies. The only difference between experiments was the dependent variable under investigation. The outcome variables of Experiments 1 through 4, respectively, were state hostility, accessibility of aggression-related thoughts, escape motivation, and aggressive behavior. The four experiments were conducted simultaneously, with each participant being randomly assigned to one of the four experiments.

EXPERIMENT 1: AFFECTIVE ROUTE

The goal of this experiment was to determine how cognitive cues, pain, and trait hostility interact to produce the experience of hostility. Given past research and the links in GAAM, we expected that both trait hostility and pain would produce increases in state hostility. Cognitive cues, because they have been demonstrated to operate mainly through the cognitive route to aggression, should show little influence on measures of affect such as our measure of state hostility.

METHOD

Participants

Seventy-five introductory psychology students were recruited for the experiment based on their scores on the Caprara et al. (1985) trait hostility scale. Data from one woman were discarded due to failure to comply with the instructions, and data from another four participants (1 man and 3 women) were discarded because they suspected the true purpose of the experiment. The final sample consisted of 37 men and 33 women. Participation in the experiment was compensated with course credit.

Design and Independent Variables

This experiment employed a 2 (pain vs. no pain) \times 2 (aggressive prime vs. nonaggressive prime) factorial design with a continuous variable (trait hostility) serving as another independent variable. The dependent variable was state hostility. Participants were randomly assigned to one of four experimental conditions such that roughly equal numbers of men and women from the upper tertile and lower tertile of the trait hostility distribution were represented in each of the four conditions.

Pain manipulation. Participants in the pain condition were instructed that, when asked to place their arm into Position 1, they were to raise their nondominant arms horizontally into the air. Arm Position 1 lasted for 3 minutes on the first Position 1 command and for 2.5 minutes on all subsequent Position 1 periods. Between these periods, they rested their arm in Position 2 (i.e., on the desk) for 30 seconds. Those participants in the no-pain condition were told to keep their nondominant arm on the desk during Positions 1 and 2. This procedure is similar to that used by K. B. Anderson et al. (1998).

Prime manipulation. Participants in the aggressive prime condition were asked to rate the familiarity, design, and appeal of 18 weapon photographs. Participants in the nonaggressive prime condition made similar ratings for pictures of nature scenes. The photos were from C. A. Anderson et al. (1996).

Trait hostility. Scores on Caprara et al. (1985) 30-item trait irritability scale were included as a continuous variable. Participants were preselected from the top and bottom tertiles of the distribution of this scale based on a mass pretesting questionnaire completed earlier in the semester. (Practical considerations precluded use of students falling within the middle tertile of the trait irritability distribution.) Care was taken to ensure that participants scoring above the 70th percentile and below the 30th percentile on this individual difference measure were distributed equally to experimental conditions.

The Caprara et al. (1985) trait irritability scale is an expanded version of Buss and Durkee's (1957) irritability subscale and assesses the "readiness to explode at the slightest provocation, including quick temper, grouchiness, exasperation, and rudeness" (Caprara et al., 1985, p. 667). Twenty of the scale items directly reflect irritability, such as "I easily fly off the handle with those who don't listen or understand" or "I often feel like a powder keg ready to explode." Ten additional scale items, originally included as fillers, reflect a lack of irritability, such as "I never get mad enough to throw things." Participants in the studies presented here responded to each of the 30 items using a 7-point Likert-type rating format anchored at 1 (*disagree strongly*) and 7 (*agree strongly*).

Caprara and colleagues (1985) have documented the internal consistency, test-retest reliability, and split-half reliability for the 20-item version of the measure (i.e., 20 positive items). Moreover, across multiple administrations (C. A. Anderson, 1997; Lindsay, 1996), we have found that the 30-item version of the measure also possesses good psychometric qualities (coefficient alphas have ranged from .84 to .90). Furthermore, the 20-item irritable subscale and the 10 nonirritable subscale load on the same general latent factor as the subscales of the Buss-Perry Aggression Questionnaire, a latent factor

labeled "trait hostility" by Dill, Anderson, Anderson, and Deuser (1997).

Dependent Variable: State Hostility

The affective route to aggression was assessed using a computer-administered version of the state hostility scale (C. A. Anderson et al., 1995, 1996). This scale requires participants to read and rate how much they currently feel like various hostility-related adjectives (e.g., *outraged, burned-up, discontented, cooperative*). In this computerized version, ratings were anchored at 1 (*not at all*), 2 (*a little*), 3 (*moderately*), 4 (*quite a bit*), and 5 (*extremely*) to indicate the degree to which the adjective describes their current mood. Of the 35 adjectives in this scale, 11 require reverse scoring (e.g., *cooperative, friendly*).

Materials and Apparatus

The state hostility scale was presented using SUPERLAB software and Macintosh LCIII computers. This software both presented the instructions and questionnaire items and recorded the participants' numeric responses.

Eighteen photographs of handguns and rifles were used as aggressive primes in this experiment. The pictures were obtained from popular hunting, survivalist, and gun enthusiast magazines (e.g., *Guns and Ammo, American Rifleman, Soldier of Fortune*, etc.). Likewise, the photographs used in the nonaggressive prime condition also were gathered from popular magazines. These pictures depicted nature scenes.

Each participant completed all tasks in an individual cubicle containing a classroom desk, a computer monitor, keyboard and mouse, and a microphone/headphone headset used to communicate with the experimenter. Participants' compliance with the discomfort instructions was monitored through a one-way mirror in the cubicle's door.

Procedure

Participants scoring in the upper and lower 30% of the distribution for trait hostility scores for their sex were recruited by telephone for the experiment. For each experimental session, two same-sex participants were asked to arrive at a waiting area outside the laboratory.¹ On arrival, they were greeted by the experimenter and asked to read and complete the consent information.

The experimenter then led each participant to one of the two cubicles. Procedures were explained to the participants individually. When both participants acknowledged understanding the experimental procedures, the experimenter returned to the control room and began the experiment.

All experimental sessions began with a 3-minute pain induction period (no-pain participants just sat in silence). The arm position changes continued throughout the experiment. Following the first Position 2 rest period, all participants began rating the familiarity, design, and appeal of the advertisement photographs. They then completed the state hostility scale.

At the completion of the experiment, the experimenter directed the participants into separate rooms and asked them to complete a structured postexperiment (suspicion) questionnaire. Two questionnaire items were especially important. The first inquired about the amount of discomfort experienced as a result of the arm position changes (if any), and the second question was an open-ended item asking, "What do you think the purpose of this experiment was?" Once this questionnaire was finished, the experimenter read over their responses to these items, probed for additional information if necessary, and delivered the debriefing. Finally, participants were thanked and dismissed.

RESULTS AND DISCUSSION

Pain Manipulation Check

One question on the postexperiment questionnaire required participants to use a scale ranging from 1 (*not at all uncomfortable*) to 5 (*painful*) to rate the amount of discomfort they experienced as a result of the arm position task. Those participants in the pain condition reported feeling more discomfort ($M = 3.31$, $SD = 1.16$) than those in the no-pain condition ($M = 1.65$, $SD = 0.92$), $t(67) = 6.62$, $p < .0001$.

Reliability of Trait and State Hostility

Both scales were internally consistent (coefficient alphas = .88 and .96 for trait and state hostility, respectively). For each scale, each participant's scores were averaged across items.

State Hostility

The data were analyzed using a 2×2 (Cognitive Prime \times Pain) analysis of variance. The trait hostility variable was included in the ANOVA model as a properly centered continuous variable. Cohen (1983) and Maxwell and Delaney (1993) have argued against dichotomizing such data during analysis because such procedures result in decreased power and possibly an increased Type I error rate.

As predicted, a main effect was found for trait hostility, $F(1, 62) = 17.91$, $p < .0001$, $MSE = 0.44$, such that trait hostility (measured some weeks before the experimental session) was positively related to self-reported feelings of state hostility during the experiment. The results also yielded the predicted main effect for pain, $F(1, 62) =$

5.12, $p < .05$. Participants in the pain condition reported more hostile feelings than did those in the no-pain condition (adjusted $M = 2.33$, $SD = 0.61$ vs. adjusted $M = 1.97$, $SD = 0.83$, respectively).² The cognitive prime main effect and the interactions were nonsignificant (all p 's $> .15$). These results were substantially unchanged when data from the four suspicious participants were included in the analyses.

We dissected our findings even further to examine the conditions under which trait hostility is related to state hostility and to help resolve the apparent inconsistency between these results and those of Bushman (1995). After averaging across pain conditions and regressing state hostility on trait hostility, we found positive relationships between these variables in both the gun photo condition, $b = .40$, $t(30) = 2.61$, $p < .01$, and nature scene conditions, $b = .20$, $t(33) = 1.57$, $p = .06$. Bushman, however, found no trait aggressiveness–aggressive affect relationship in his nonviolent film condition ($b = -.077$, *ns*). There may be several explanations for this dissimilarity. First, we suspect that Caprara et al.'s (1985) trait irritability scale may be more affect-related than the Buss and Durkee (1957) assault subscale scores used by Bushman (1995). Second, as mentioned earlier, Bushman's findings may reflect an indirect effect of aggression-related cues on aggression-related affect. This effect would be easier to detect with an experiment employing a sample size similar to Bushman's than with our less-powered experiment. Finally, although Bushman went to great lengths to equate his violent and nonviolent videos on factors other than aggressive cues, the act of watching aggressive or nonaggressive actions may elicit different reactions than does simply evaluating a series of photographs. Clearly, future research should attempt to resolve this inconsistency.

Some caution is warranted in interpreting state hostility as synonymous with anger. Although many of the items in the state hostility scale are anger-related (e.g., *mad*, *burned-up*), others are more related to a general sense of discomfort and annoyance (e.g., *discontented*, *disgusted*, *disagreeable*). Indeed, state hostility in this case may represent a more general agitated state consistent with Berkowitz's (1993) notion of negative affect. Berkowitz and others (e.g., Weiner, 1985) have speculated that the experience of more precisely defined emotional states (e.g., anger) requires some form of attributional processing or higher order deliberation. Although the participants in this study may have been capable of performing such higher-order differentiation of their affective state, we did not attempt to measure this.

In sum, as predicted, Experiment 1 found that trait hostility and pain both increase state hostility. Furthermore, and as predicted, the picture prime manipulation had little effect on state hostility.

EXPERIMENT 2: COGNITIVE ROUTE

In Experiment 2, we sought to determine the effects of trait hostility, cognitive primes, and pain on accessibility of aggressive thoughts. Prior research and theory suggest that all three of the independent variables may influence accessibility of aggressive thought. Trait hostile individuals often appear to be chronically primed to think aggressively. Our picture prime manipulation is, of course, designed to directly influence accessibility of aggressive thoughts. Pain also may increase aggressive thoughts indirectly by increasing feelings of state hostility. Of course, a number of interactions among these variables may also be important. Despite these complexities, we expected the most consistent effects to be increases in accessibility of aggressive thoughts by high-trait-hostile individuals and in the gun picture prime conditions.

METHOD

The design, materials/apparatus, and procedure for this experiment were identical to those used in Experiment 1, except for the dependent variable. Accessibility of aggressive thoughts was assessed immediately following the rating of gun or nature pictures.

Participants

Eighty-one introductory psychology students were recruited for this experiment in a manner similar to that described for Experiment 1. Data from 6 participants (2 men and 4 women) were discarded because of suspicion. An additional 12 participants (7 men and 5 women) were dropped from the experiment due to the unacceptably high rates of outliers among their reaction times (see preliminary analysis for procedure). Thus, the final sample consisted of 63 participants (31 men and 32 women).

Measure of Cognitive Accessibility

Accessibility of aggressive thoughts was assessed using a lexical decision task. Participants were presented with strings of letters and asked to indicate as fast as possible whether the strings constituted an actual word by pressing a "yes" key or a "no" key. There were 96 letter strings presented, 24 of which were aggressive words (e.g., *butcher*), 23 were frequency-matched control words, 24 words were escape-related (e.g., *depart*), and the remaining 25 were nonword strings.

RESULTS AND DISCUSSION

Manipulation Check

Responses on postexperiment questionnaires indicated that participants in the pain condition experi-

enced more discomfort as a result of the arm position task than did those in the no-pain condition ($M = 3.11$, $SD = 1.10$ vs. $M = 1.61$, $SD = 0.86$, respectively), $t(73) = 6.61$, $p < .0001$.

Preliminary Analyses

Coefficient alphas for the reaction times for the three word types attest to the reliability ($\alpha s = .86$, $.86$, and $.84$ for aggression, escape, and control words, respectively). Tukey's (1977) box plot procedure was used to identify outliers among all reaction times from the lexical decision task. Reaction times greater than 1289 milliseconds or less than 116 milliseconds were deemed outliers and were converted to missing values. To ensure that the data to be analyzed came from people who thoughtfully performed this lexical decision task, participants having more than 10 missing reaction times (due to outliers) or 10 incorrect lexical decisions for any word type were dropped from analyses of the cognitive measure. Comparison between average reaction times for escape-related words and control words suggested no difference between the two, $F(1, 63) = 0.13$, *ns*. We therefore averaged these two word types to use as a baseline for aggressive accessibility. Thus, accessibility of aggressive thoughts was calculated by subtracting reaction time for the aggression-related words from this baseline average, as has been done in other research of this type (e.g., C. A. Anderson, 1997). Higher scores for this measure therefore indicate greater accessibility of aggressive thoughts.

Accessibility of Aggressive Thoughts

A 2×2 ANOVA was performed with trait hostility as a continuous variable. There was a marginally significant main effect for cognitive prime, $F(1, 55) = 3.52$, $p < .07$, $MSE = 1361.38$. As expected, accessibility of aggressive thoughts was higher in the gun prime condition (adjusted $M = 44.41$, $SD = 32.69$) than in the nature scene condition (adjusted $M = 25.54$, $SD = 43.88$). Tests of the main effects for trait hostility and pain and of the two-way interactions were not significant (all $ps > .10$).

The data also yielded a significant Trait Hostility \times Prime \times Pain interaction, $F(1, 55) = 5.59$, $p < .05$. These results are presented in Figure 2. This figure reveals considerable consistency but also one large discrepancy. Specifically, the gun prime means were higher than the corresponding nature scene means in all cases except for low-hostile participants in the pain conditions. Similarly, trait hostility was positively related to accessibility of aggressive thoughts in all cases except in the nature scene/pain condition, the slope for which was found to not differ from 0, $b = -19.18$, $t(14) = -1.48$, *ns*. Only in the gun photo/pain condition was the relationship between trait hostility–accessibility of aggressive thoughts signifi-

cant, $b = 18.95$, $t(15) = 18.95$, $p < .01$. Inclusion of suspicious participants' data had no impact on these cognitive accessibility results.

Although the pattern of results in the pain condition was not as expected, careful consideration of that pattern and of the situation in which these participants found themselves yields one intriguing interpretation involving attempts at mood control (e.g., Wegner & Wenzlaff, 1996). When in pain, participants who found themselves thinking unacceptably negative or aggressive thoughts may have attempted to distract themselves by focusing on more pleasant thoughts. This would be especially likely of all high-trait-hostility participants regardless of prime condition and of low-trait-hostility participants in the gun prime condition. If this attempt succeeds, then we should expect to see unusually low aggression accessibility scores for these participants, relative to those in the low-trait-hostile people in the pain/nature scene condition or relative to those in the comparable no-pain conditions. This accounts for three of the four data points displayed in the pain panel of Figure 2. If the mood control attempt fails when there are too many sources of unacceptably high aggressive thoughts, then the fourth data point—the high-aggression-accessibility scores of high-trait-hostile people in the pain/gun prime condition—also makes sense. Although this account is consistent with Leventhal and associates' work on attention to painful stimulation and feelings of distress (Ahles, Blanchard, & Leventhal, 1983; Leventhal, Brown, Shacham, & Engquist, 1979), the spontaneous use of such attentional strategies is speculative and remains to be tested empirically.

In any case, Experiment 2 reveals that trait hostility and gun primes are both positively linked to increased aggressive thoughts, at least under some conditions. Whether these same conditions produce increases in aggressive behavior is explored in Experiment 4. First, another affective variable remains to be explored, namely, motivation to escape.

EXPERIMENT 3: MOTIVATION TO ESCAPE

Cannon (1929) first provided evidence that different physiological processes may be involved in the urge to flee potentially harmful situations than in the urge to aggress against a harm-doer. More recently, Berkowitz (1993) has postulated that the desire to escape and the desire to fight have specific emotional correlates (fear and anger, respectively) that emerge simultaneous to behavioral intention. Yet, little research has examined this alternative to aggressive behavior.

We suspect that both the motives to escape and to fight have a general affective foundation. Given this aversive state, accessible cognitions and beliefs regarding

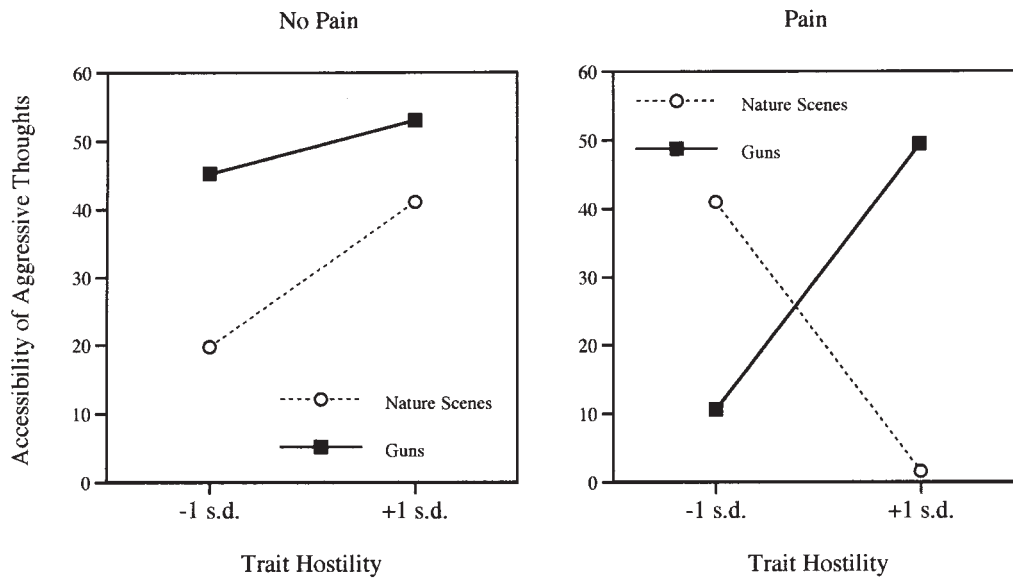


Figure 2 The effects of cognitive prime, pain, and trait hostility on accessibility of aggressive thoughts.

one's skills and those of the opponent influence the direction of behavior. Thus, we hypothesize that those variables influencing the affective route (Experiment 1: trait hostility, pain) will produce a desire to escape. The cognitive primes used in these experiments were not expected to have much impact on escape motives.

METHOD

The design, materials, apparatus, and procedure were identical to those described in the previous experiments, except that the dependent variable of interest was participants' desire to escape from the situation.

Participants

Eighty-three introductory psychology students were recruited as in Experiments 1 and 2. Data from two participants (1 man, 1 woman) were discarded when their responses on the postexperimental questionnaire revealed suspicion. Only the data from the remaining 42 men and 40 women were analyzed.

Measuring Escape Motives

As was the case with state hostility in Experiment 1, the desire to flee the situation was measured using a computer-presented series of unipolar self-ratings. Participants were asked to use the same 5-point scale described in Experiment 1 to indicate the degree to which they wanted to perform certain actions listed as verbs (e.g., *evade*, *leave*, *withdraw*). Their responses on the 22 escape-related actions constituted the escape motivation measure. This task was performed after participants rated the pictures of nature scenes and guns.

RESULTS AND DISCUSSION

Manipulation Check

Once again, the pain induction technique worked, as indicated by participants' ratings on the postexperiment questionnaire. Those in the pain condition reported feeling more discomfort than their no-pain counterparts ($M = 3.2$, $SD = 0.92$ vs. $M = 1.57$, $SD = 0.86$), $t(78) = 7.85$, $p < .0001$.

Preliminary Analyses and Data Consolidation

The responses to the 22 escape-related items were found to be reliable ($\alpha = .92$). Each participant's ratings for the escape-related items were averaged across the 22 items.

Escape Motivation

The 2 (prime) \times 2 (pain) ANOVA with trait hostility as a continuous variable yielded a significant main effect for trait hostility, $F(1, 74) = 12.72$, $p < .001$, $MSE = 0.58$.³ The slopes for trait hostility indicate that, in general, as trait hostility increased so did the participant's desire to flee the situation. A marginally significant Trait Hostility \times Pain interaction also was obtained, $F(1, 74) = 2.88$, $p < .10$. For participants in the no-pain condition, a positive relationship between motivation to escape and trait hostility was evident, $b = .48$, $t(29) = 3.85$, $p < .001$. The trait hostility–escape motivation relationship was less pronounced for those in pain, $b = .14$, $t(49) = 1.26$, *ns*. Tests for the main effects of prime and pain and for the Trait Hostility \times Prime, Prime \times Pain, and Trait Hostility \times Prime \times Pain interactions were all nonsignificant (all $ps >$

.15). As was the case in the previous two experiments, these findings remained unchanged when suspicious participants' data were included in the analyses.

Overall, the results of Experiment 3 revealed that high trait hostility tends to produce higher levels of agreement with escape-related actions. Surprisingly, the pain manipulation had little overall effect on escape motives. Participants' knowledge of ethical constraints placed on psychology experiments may account for this finding. Gardner (1978) suggested that the human participants guidelines instituted in the mid-1970s (e.g., informed consent procedures, opportunity to withdraw from experiments without penalty, review of experiments by human participant committees) may have led to several failures to replicate older findings on cognitive effects of stressful conditions. Specifically, he postulated that participants' knowledge of such procedures may increase their sense of control and/or sense of commitment toward experiments, especially in stressful conditions. Although plausible—even likely given Gardner's data and conclusions—this explanation merits additional empirical validation.

EXPERIMENT 4: AGGRESSION

In this experiment, we had two main objectives. First, as a continuation of the series of experiments presented previously, we wanted to determine if those variables influencing the cognitive and affective routes to aggression also influence the end-stage, aggressive behavior. That is, how do trait hostility, pain, and cognitive cues interact in the formulation of aggressive behavior?

Our second main objective was methodological. The competitive reaction-time task, a seemingly nonreactive measure of aggressive behavior that has been used for more than 20 years, was created when researchers in this domain adhered to a behavioristic definition of aggression (i.e., delivery of noxious stimuli to another) (Buss, 1961; Taylor, 1967). This task requires participants to compete against another person on a series of reaction-time trials. The loser of a reaction-time trial is administered a punishment (e.g., electric shock or burst of white noise), the intensity and duration of which is supposedly set by the participant's competitor prior to the trial. The intensity and duration of punishment that participants set is considered aggressive behavior. However, more recent definitions of aggression, which include the intention to harm the victim (Baron & Richardson, 1994; Berkowitz, 1993; Geen, 1990), may not be satisfied with participants' intensity and duration settings. Specifically, these punishment settings may be sensitive to other motives in addition to the intention to harm (e.g., motive to control their opponent's behavior or to recip-

rocate their opponent's settings—as in a tit-for-tat strategy), thus undermining the competitive reaction-time task's ability to detect true aggression.

A new independent variable—behavior paradigm—was added to this experiment in addition to those used in the previous three experiments. Half of the experimental participants used the original Taylor (1967) reaction-time paradigm, and the other half used a new retaliation reaction-time paradigm designed to minimize effects of nonaggressive motives. If this new paradigm is more sensitive to the influences of pain, prime, and trait hostility, then we would expect interaction effects between paradigm and these other independent variables on aggression settings. However, if no such interactions are observed, the findings would be consistent with the results of a meta-analytic review by Carlson, Marcus-Newhall, and Miller (1989), which suggested that lab-based aggression measures, including the Taylor paradigm, produce very similar results and are thus measuring the same kind of aggression.

GAAM-Based Predictions

As for predictions concerning the effects of our primary independent variables—cognitive prime, trait hostility, and pain—on aggressive behavior, GAAM suggests that aggression-related affect, such as state hostility, either chronic (e.g., from trait hostility) or temporary (e.g., from pain), should increase the likelihood of aggressive behavior. However, GAAM also specifies that appraisals of the situation and attributions about the opponent's intentions also play important roles in determining behavior. Thus, variables hypothesized to influence the appraisal process by influencing aggression-related thoughts (i.e., aggressive primes) should also influence the expression of aggressive behavior.

Experiments 1 and 2 revealed trait hostility to be positively related to current feelings of state hostility and (in most conditions) to accessibility of aggressive thoughts. The prime manipulation had little impact on state hostility but tended to increase the accessibility of aggressive thoughts in most conditions. Pain consistently increased state hostility but had some paradoxical effects on aggressive cognitions. This mix of effects on presumed mediating variables of state hostility and accessibility of aggressive cognitions makes specific predictions for aggressive behavior in Experiment 4 impossible. Nonetheless, it seems reasonable to expect (a) trait hostility to be fairly consistently and positively related to aggression, (b) gun photo primes to increase aggression (relative to nature photos) in at least some conditions, and (c) no clear overall effects of pain on aggression.

METHOD

Participants

Eighty-one introductory psychology students were recruited in the same manner as described in Experiments 1 through 3. Data from 7 participants (3 men, 4 women) were discarded due to suspicion.⁴ The remaining sample was composed of 35 men and 39 women. Their participation was compensated with course credit.

Materials and Apparatus

This experiment was also conducted within individual cubicles containing a Macintosh LCIII computer. The competitive reaction-time task was conducted using a program written in HYPERCARD. The noise blasts were computer-generated bursts of white noise intensified using a Laconic GTS-201 amplifier.

Design and Procedure

The design and procedure were identical to that used in Experiments 1 through 3, with two notable exceptions. First, in addition to the prime and pain manipulations, each session was randomly assigned to either the Taylor (1967) reaction-time paradigm or the retaliation paradigm. In both procedures, participants are led to believe that they are competing against another person on a series of simple auditory reaction-time trials.

In the Taylor Competitive Reaction Time (TCRT) procedure (Taylor, 1967), participants are told that both competitors will make noise intensity and noise duration settings (punishments) before each of the 25 reaction-time trials, punishments that will be delivered immediately to the loser of that trial.

Participants performing the Retaliation Competitive Reaction Time procedure (RCRT) are told that there are two 25-trial phases to the reaction-time task and that they have been assigned to be the receiver during the first phase. Thus, during Phase 1 of the reaction-time task, they receive noise blasts for trials that they lose but do not set punishments for their opponent. During Phase 2 of the reaction-time task, they become the noise inducer and therefore set the level of noise to be administered to their opponent on trials that the opponent loses.

The second difference from Experiments 1 through 3 involves the time sequence for the pain manipulation. Prior to beginning the competitive reaction-time task, participants had to put on a different set of headphones (for the auditory reaction-time signal and for punishment noise blasts), which made communication between experimenter and participant impossible. This necessitated discontinuation of the arm position task while performing the competitive reaction-time task. However, the reaction-time tasks were begun immedi-

ately after the last Position 1 pain period ended so that increases in state hostility or aggressive thoughts brought about by the pain manipulation would still be active. Participants performing the retaliation version of the competition task were given an additional Position 1 period (in the air) during a 2.5-minute period break between Phase 1 and 2 of their reaction-time task.

Measuring Aggressive Behavior

Aggressive behavior was measured using intensity and duration settings from the competitive reaction-time task. The intensity of noise in our task can range from 0 (0 dB) to 10 (105 dB), selected by participants from an 11-point scale (0-10). In reality, the participants were not competing against one another but rather the feedback was preprogrammed so that they lost the first trial and 12 of the remaining 24 trials. The noise punishment levels supposedly administered by the opponent were also computer controlled. We used an ambiguous pattern of opponent-generated punishments, in which noise intensity and noise duration varied considerably but was uncorrelated with trial number (see C. A. Anderson & Anderson, 1998, for a more complete description of this procedure).

RESULTS AND DISCUSSION

Manipulation Check

Participants' discomfort ratings from the postexperimental questionnaire indicated that those in the pain condition experienced more discomfort ($M = 3.19$, $SD = 1.04$) than did their no-pain counterparts ($M = 1.58$, $SD = 0.79$), $t(72) = 7.55$, $p < .0001$.

Computation of Aggression Scores

The duration settings (hold times) were found to be positively skewed. We reduced this skew by subjecting the duration settings to a log transformation. For each participant, we multiplied the transformed duration setting by the intensity setting for each trial separately. These aggression scores represent the amount of aggressive energy directed at the opponent. There were 25 such scores, one for each of the 25 trials. Participants' overall aggression scores represented their average across all 25 trials.

Overall Aggression Level

Main findings. The aggression scores were analyzed with a 2 (prime) \times 2 (pain) \times 2 (Competitive Reaction Time [CRT] paradigm) ANOVA with trait hostility as a continuous independent variable. This yielded a significant main effect for trait hostility, $F(1, 58) = 4.57$, $p < .05$, $MSE = 100.01$. As predicted on the basis of GAAM and the results of Experiments 1 and 2, as trait

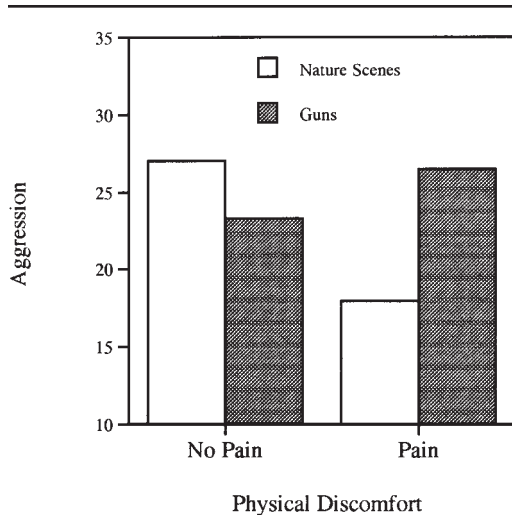


Figure 3 The effects of cognitive prime and pain on physical aggression.

hostility increased so did participants' noise blast settings ($b = 2.71$).

We also found a significant Cognitive Prime \times Pain interaction, $F(1, 58) = 5.78, p < .05$, and a marginally significant Cognitive Prime \times Trait Hostility interaction, $F(1, 58) = 3.81, p < .06$. As can be seen in Figure 3, exposure to the gun photos increased overall aggressive behavior for participants in the pain condition, $t(58) = 2.59, p < .05$. However, the photo prime manipulation did not reliably influence overall aggression in the no-pain condition, $t(58) = -1.13, ns$. This is also consistent with GAAM and our earlier experiments.

The Prime \times Trait Hostility interaction is illustrated in Figure 4. There was a nonsignificant positive relation between trait hostility and aggression for those who had rated pictures of nature scenes, $b = 0.50, t(33) = 0.31, ns$. However, a reliable positive relation occurred for those who had rated pictures of guns, $b = 4.40, t(37) = 3.11, p < .01$. No other main effects or interactions were found (all $ps > .10$).

Interesting null findings. Two sets of null findings warrant comment here. First, the lack of consistent pain effects on overall aggression mirrors the inconsistent effects of pain on state hostility and aggressive thoughts found in Experiments 1 and 2. Therefore, this null effect on aggression in Experiment 4 also supports GAAM. We realize that claiming support for a model based on null findings is risky business, and we do not wish to overemphasize this, but in the present context it can be thought of as a kind of discriminant validity. That is, given that Experiments 1 and 2 yielded directionally inconsistent effects of pain on state hostility and aggressive thoughts, finding large and consistent pain effects on aggression in Experiment 4 would have been a bit hard to explain via GAAM or related theories.

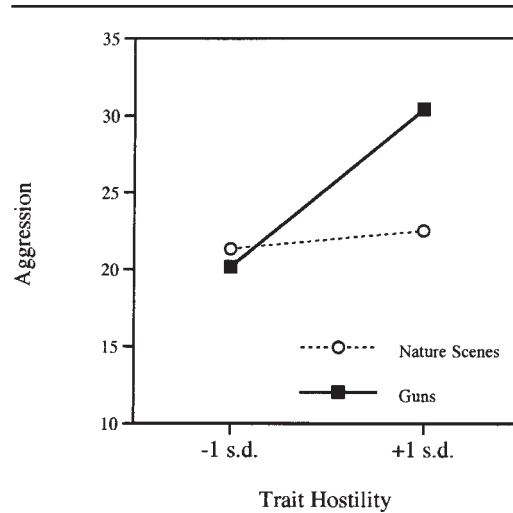


Figure 4 The effects of cognitive prime and trait hostility on physical aggression.

The second set of null effects worth comment concern the lack of any reliable effects of the CRT paradigm manipulation on overall aggression. This finding is consistent with the claim that both paradigms are essentially measuring the same thing and that they are equally sensitive to effects of the independent variables used in the present experiments. Thus, the original Taylor (1967) paradigm does not seem to be handicapped by a tendency of participants to use systematic strategies (such as tit-for-tat) to control their opponents' future punishment settings. In other words, even if such strategies are being used to some extent, the effects of other theoretically interesting independent variables, such as trait hostility, are still revealed by the paradigm.

Aggression Across Trials

We also examined shifts in punishment levels across trials by use of linear and quadratic contrasts. Although a number of patterns across trials would be interesting, the only prediction we had was that under at least some conditions, high-trait-hostile participants would show a greater tendency to increase aggression across trials than would low-trait-hostile participants. This would show up as a main effect of trait hostility on the linear contrast scores or as some interaction involving trait hostility.

There were no reliable effects from the quadratic contrast analyses, so they will not be discussed further. However, there were several significant effects from the linear contrast analyses.

The linear contrast analyses revealed main effects for paradigm, $F(1, 58) = 36.02, p < .0001, MSE = 219.32$, and trait hostility, $F(1, 58) = 7.59, p < .01$. The paradigm main effect on the linear contrast revealed that the two competitive reaction-time paradigms yielded different linear trends, as can be seen in the raw score plots shown in Fig-

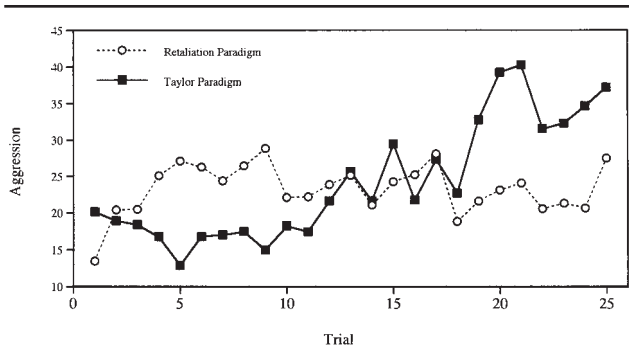


Figure 5 Plot of aggression trends across trials for the Taylor (1967) reaction-time paradigm and the retaliatory paradigm.

ure 5. Basically, participants in the Taylor (1967) paradigm set increasingly higher punishment levels for their opponents across trials, $b = 0.94$, $t(23) = 7.88$, $p < .0001$, but those in the retaliation paradigm did not, $b = 0.04$, $t(23) = 0.49$, *ns*.

The trait hostility main effect on the linear contrast revealed that on the whole, higher trait hostility scores were associated with a greater tendency to increase punishment across trials, a finding that is congruent with our prediction ($b = 4.86$). However, this main effect was qualified by a significant Trait Hostility \times Paradigm interaction, $F(1, 58) = 4.57$, $p < .05$. This interaction revealed that trait hostility was positively associated with the tendency to increase punishment levels across trials when the Taylor (1967) paradigm was used, $b = 6.84$, $t(37) = 2.74$, $p < .01$, but there was almost no relation in the retaliation paradigm, $b = 1.64$, $t(33) = 0.90$, *ns*.

There was also a significant Prime \times Pain interaction on the linear contrast, $F(1, 58) = 5.40$, $p < .05$, and the pattern of this interaction is much like that for general aggression (see Figure 4). For the pain condition, participants who had rated gun photos showed a greater tendency to increase punishment across trials than did those who had rated nature scenes; for the no-pain condition, the opposite pattern occurred. We can think of no plausible explanation for this finding and so prefer to leave it unexplained until replicated in future work.

Finally, we examined whether a tit-for-tat, reciprocity, or control strategy was employed by participants in the TCRT paradigm. For instance, we compared the aggression levels following loss trials versus win trials and found no differences in average aggression settings, no relationship between computer-administered noise blast settings received on the previous trial and participants' settings, and no interactions for computer-administered noise blast settings on previous trial and other independent variables. The Trait Hostility \times Paradigm interaction on the linear trend, combined with the null findings resulting from the examination of alterna-

tive strategies in the original Taylor paradigm, suggest that the original Taylor paradigm is more sensitive to certain types of individual difference effects than is the retaliation version of the competitive reaction-time paradigm.

GENERAL DISCUSSION

The Psychological Uncertainty Principle Revisited

If the psychological version of the Heisenberg uncertainty principle was not at work in this type of aggression research, testing mediation models would be considerably simpler. However, order effects in this line of work demonstrate that one cannot simply measure various mediating variables and the criterion variable (aggression) in the same study and conduct standard mediation analyses.

Indeed, as mentioned earlier in this article, participants in the present four experiments were randomly assigned to experiment as well as to condition within each experiment. What was not mentioned earlier was that all four dependent variables (state hostility, accessibility of aggressive thoughts, escape motivation, and aggressive behavior) were measured in each study, with the remaining (unreported) measures being administered after the primary dependent variable in various counterbalanced orders. In preliminary analyses, we treated the whole set of four experiments as one large experiment and examined order effects. As expected, we found several significant order effects, confirming that measuring one dependent variable changed the subsequently measured variables. In other words, standard mediation procedures are simply not appropriate in this domain. Thus, we adopted the alternative (and older) procedure of examining hypothesized mediating variables and the criterion variable in separate studies.

GAAM Predictions for Aggressive Behavior

The results of the four experiments presented here provide considerable support for the proposed mediating influence of cognitive and affective processes in the generation of aggressive behavior. Basically, the three predictions concerning aggressive behavior, outlined prior to Experiment 4 and based on GAAM and the results of the earlier experiments, were all supported.

First, trait hostility was fairly consistently and positively related to aggression. The only exception was that the slope relating trait hostility to overall aggression was essentially zero for participants in the no pain/nature scene photo condition. Second, gun photo primes increased overall aggression (relative to nature scene photos) in the pain condition. Third, there were no clear overall effects of pain on aggression, just the Prime \times Pain interaction. As noted earlier, this is consistent with

the earlier contradictory effects of pain on state hostility and aggressive thoughts.

Other Key Findings

Perhaps the strongest additional finding from these experiments is that trait hostility influences multiple aggression-related mechanisms. People who score high on trait hostility express higher levels of state hostility (Experiment 1), are more likely to have aggressive thoughts when exposed to aggression-related situational cues (Experiment 2), and express a greater desire to escape even relatively neutral situations (Experiment 3) than do low-trait-hostile people.

The present data are consistent with findings from many related studies. For instance, Dill et al. (1997) found that relationships among Caprara et al.'s (1985) irritability scale and other aggression-related scales all load on one underlying factor—general aggressive personality. They also found that people who score high on trait hostility are susceptible to two kinds of social information biases—they expect others to solve problems with more aggression and they perceive more aggressiveness in others' behaviors than do low-trait-hostile people. Similarly, considerable research by Dodge and colleagues (e.g., Crick & Dodge, 1994; Dodge & Newman, 1981; Dodge & Tomlin, 1987) shows that general aggressiveness among children is related to an interpretational style in which minor provocations are inferred to be intentional aggressive acts. Epps and Kendall (1995) have demonstrated a similar attribution bias among aggressive adults. Thus, trait hostility may not only influence the routes to aggression but also reduce the mediating effects of the appraisal stage, resulting in the disinhibition of aggressive responses.

Furthermore, our data indicate that factors facilitating the accessibility of aggressive thoughts (i.e., cognitive cues) can moderate the causal influence of affective agents (i.e., pain, trait hostility) in producing aggressive behavior. We believe that cognitive cues activate other aggression-related thoughts, thereby priming people to interpret general negative affect as anger and to perceive ambiguous provocations as indicative of hostile intent (Dill et al., 1997). The fact that pain increased aggression only for participants who had previously rated gun photos supports this interpretation.

In addition, our Prime \times Trait Hostility interaction effect on overall aggression in Experiment 4 (displayed in Figure 4) is nearly identical to results reported by Bushman (1995), despite the use of very different prime manipulations and different measures of trait aggressiveness. Bushman used the Buss-Perry physical aggression subscale as the measure of trait aggressiveness, whereas we used the Caprara et al. (1985) irritability scale. Bushman used violent and nonviolent movie clips

as the cognitive prime manipulation, whereas we used photos of guns or nature scenes. In both experiments, the aggressive behavior measure was from a competitive reaction-time task. Just as in our Figure 4, Bushman found that his aggressive prime (i.e., the violent movie clip) increased aggressive behavior for high-trait-aggression participants but had no impact on low-trait-aggression participants.

Finally, the pain results warrant comment. Unlike many studies of the pain-aggression relationship among lower animals (Renfrew, 1997), our data suggest that no simple relationship between pain and aggression exists among humans. The paucity of other pain-aggression effects in the literature also supports this suggestion. One explanation is that unlike lower animals, people sometimes engage higher reasoning skills before choosing a behavioral response. Some participants in this experiment may have (correctly) attributed their discomfort to the experimenter and therefore tried to not let their discomfort affect their punishment settings for their competitors. Indeed, Figure 3 suggests that participants in the pain/nature scene condition may have overcompensated for presumed pain effects on their aggressive inclinations.

Future Directions

One general theme underlying many of our findings is that situational factors (e.g., physical discomfort, cognitive cues) are often qualified by individual differences—a position well founded in social psychology but lacking in aggression research. Consideration of the Person \times Situation interaction is especially necessary in aggression research because our theoretical models often form the basis for applied interventions, in this case, attempts to reduce aggressive behavior in at-risk individuals (i.e., those high on trait hostility).

Clearly, one set of studies cannot completely test the implications of GAAM or any other broad model of human aggression. The present studies illustrate the utility of examining effects of specific aggression-related independent variables from a mediation model perspective, even when the psychological uncertainty principle makes direct mediation statistical methods inappropriate to use. Thus, we believe that to fully understand how any particular factor increases aggression, a series of studies examining underlying processes (and mediating variables) will be needed. For instance, to understand how attitudes toward violence influence aggression, studies are needed that assess the attitude effects on aggression-related affect (e.g., state hostility) and cognition (e.g., accessibility of aggressive thoughts) as well as on aggressive behavior itself.

Further work on GAAM is especially needed at the later stages of the model. For instance, additional

research needs to be conducted on factors affecting appraisal processes and how judgments of culpability are related to aggressive behavior. In sum, however, we are beginning to get a handle on one of the questions with which we began this article, concerning the processes underlying the generation of aggressive behavior. Future work will contribute more to the understanding of why people try to hurt others.

NOTES

1. In those cases where only one participant showed up for an experiment, a confederate was used to play the other participant.
2. The distribution of scores for state hostility was found to be positively skewed. Performing a similar ANOVA with rank-transformed data had little impact on these results.
3. The distribution of scores for escape motivation was found to be positively skewed. Performing a similar ANOVA with rank-transformed data had little impact on these results.
4. For Experiment 4, participants were considered suspicious if their open-ended postexperiment questionnaire responses indicated awareness of the hypothesis or if they suspected that they were not actually competing against another person.

REFERENCES

- Ahles, T. A., Blanchard, E. B., & Leventhal, H. (1983). Cognitive control of pain: Attention to the sensory aspects of the cold pressor stimulus. *Cognitive Therapy and Research, 7*, 159-178.
- Anderson, C. A. (1997). Effects of violent movies and trait hostility on hostile feelings and aggressive thoughts. *Aggressive Behavior, 23*, 161-178.
- Anderson, C. A., & Anderson, K. B. (1998). Temperature and aggression: Paradox, controversy, and a (fairly) clear picture. In R. Geen & E. Donnerstein (Eds.), *Human aggression: Theories, research and implications for social policy* (pp. 247-298). San Diego, CA: Academic Press.
- Anderson, C. A., Anderson, K. B., & Deuser, W. E. (1996). Examining an affective aggression framework: Weapon and temperature effects on aggressive thoughts, affect, and attitudes. *Personality and Social Psychology Bulletin, 22*, 366-376.
- Anderson, C. A., Benjamin, A. J., Jr., & Bartholow, B. D. (1998). Does the gun pull the trigger? Automatic priming effects of weapon pictures and weapon names. *Psychological Science, 9*, 308-314.
- Anderson, C. A., & Bushman, B. J. (1998). *An integrated social-cognitive model of human aggression*. Manuscript submitted for publication.
- Anderson, C. A., Deuser, W. E., & DeNeve, K. M. (1995). Hot temperatures, hostile affect, hostile cognition and arousal: Tests of a general theory of affective aggression. *Personality and Social Psychology Bulletin, 21*, 434-448.
- Anderson, K. B., Anderson, C. A., Dill, K. E., & Deuser, W. E. (1998). The interactive relations between trait hostility, pain, and aggressive thoughts. *Aggressive Behavior, 24*, 161-171.
- Bandura, A. (1973). *Aggression: A social learning analysis*. Englewood Cliffs, NJ: Prentice Hall.
- Baron, R. A., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology, 51*, 1173-1182.
- Baron, R. A., & Richardson, D. R. (1994). *Human aggression* (2nd ed.). New York: Plenum.
- Berkowitz, L. (1971). The contagion of violence: An S-R mediational analysis of some effects of observed aggression. In W. J. Arnold & M. M. Page (Eds.), *Nebraska symposium on motivation*. Lincoln: University of Nebraska Press.
- Berkowitz, L. (1993). *Aggression: Its causes, consequences, and control*. New York: McGraw-Hill.
- Berkowitz, L., Cochran, S., & Embree, M. (1981). Physical pain and the goal of aversively stimulated aggression. *Journal of Personality and Social Psychology, 40*, 687-700.
- Berkowitz, L., & LePage, A. (1967). Weapons as aggression-eliciting stimuli. *Journal of Personality and Social Psychology, 7*, 202-207.
- Berkowitz, L., & Thome, P. R. (1987). Pain expectation, negative affect, and angry aggression. *Motivation and Emotion, 11*, 183-193.
- Bushman, B. J. (1995). Moderating role of trait aggressiveness in the effects of violent media on aggression. *Journal of Personality and Social Psychology, 69*, 950-960.
- Bushman, B. J. (1998). Priming effects of media violence on the accessibility of aggressive constructs in memory. *Personality and Social Psychology Bulletin, 24*, 537-545.
- Bushman, B. J., & Geen, R. G. (1990). Role of cognitive-emotional mediators and individual differences in the effects of media violence on aggression. *Journal of Personality and Social Psychology, 58*, 156-163.
- Buss, A. H. (1961). *The psychology of aggression*. New York: John Wiley.
- Buss, A. H. (1966). Instrumentality of aggression, feedback, and frustration as determinants of physical aggression. *Journal of Personality and Social Psychology, 3*, 153-162.
- Buss, A. H., & Durkee, A. (1957). An inventory for assessing different kinds of hostility. *Journal of Consulting Psychology, 21*, 343-349.
- Buss, A. H., & Perry, M. (1992). The aggression questionnaire. *Journal of Personality and Social Psychology, 63*, 452-459.
- Cannon, W. B. (1929). *Bodily changes in pain, hunger, fear, and rage*. New York: Appleton-Century.
- Caprara, G. V., Cinanni, V., D'Imperio, G., Passerini, S., Renzi, P., & Travablia, G. (1985). Indicators of impulsive aggression: Present status of research on irritability and emotional susceptibility scales. *Personality and Individual Differences, 6*, 665-674.
- Carlson, M., Marcus-Newhall, A., & Miller, N. (1989). Evidence for a general construct of aggression. *Personality and Social Psychology Bulletin, 15*, 377-389.
- Carlson, M., Marcus-Newhall, A., & Miller, N. (1990). Effects of situational aggression cues: A quantitative review. *Journal of Personality and Social Psychology, 58*, 622-633.
- Cohen, J. (1983). The cost of dichotomization. *Applied Psychological Measurement, 7*, 249-253.
- Crick, N. R., & Dodge, K. A. (1994). A review and reformulation of social information-processing mechanisms in children's social adjustment. *Psychological Bulletin, 115*, 74-101.
- Dill, K. E., Anderson, C. A., Anderson, K. B., & Deuser, W. E. (1997). Effects of aggressive personality on social expectations and social perceptions. *Journal of Research in Personality, 31*, 272-292.
- Dodge, K. A., & Newman, J. P. (1981). Biased decision making processes in aggressive boys. *Journal of Abnormal Psychology, 90*, 375-379.
- Dodge, K. A., & Tomlin, A. M. (1987). Utilization of self-schemas as a mechanism of interpretational bias in aggressive children. *Social Cognition, 5*, 280-300.
- Dollard, J., Doob, L. W., Miller, N. E., Mowrer, O. H., & Sears, R. R. (1939). *Frustration and aggression*. New Haven, CT: Yale University Press.
- Epps, J., & Kendall, P. C. (1995). Hostile attribution bias in adults. *Cognitive Therapy and Research, 19*, 159-178.
- Eron, L. D., Walder, L. O., & Lefkowitz, M. M. (1971). *Learning of aggression in children*. Boston: Little, Brown.
- Gardner, G. T. (1978). Effects of federal human subjects regulations on data obtained in environmental stressor research. *Journal of Personality and Social Psychology, 36*, 628-634.
- Geen, R. G. (1990). *Human aggression*. Pacific Grove, CA: Brooks/Cole.
- Huesmann, L. R. (1998). The role of social information processing and cognitive schema in the acquisition and maintenance of habitual aggressive behavior. In R. Geen & E. Donnerstein (Eds.), *Human aggression: Theories, research and implications for policy* (pp. 73-109). San Diego, CA: Academic Press.
- Huesmann, L. R., & Eron, L. D. (1984). Cognitive processes and the persistence of aggressive behavior. *Aggressive Behavior, 10*, 243-251.
- Hutchinson, R. R. (1973). The environmental causes of aggression. In J. K. Cole & D. D. Jensen (Eds.), *Nebraska symposium on motivation* (Vol. 20, pp. 155-181). Lincoln: University of Nebraska Press.

- Leventhal, H., Brown, D., Shacham, S., & Engquist, G. (1979). Effects of preparatory information about sensations, threats of pain, and attention on cold pressor distress. *Journal of Personality and Social Psychology, 37*, 688-714.
- Lindsay, J. J. (1996). *Situationally induced hostile attribution bias*. Unpublished master's thesis, University of Missouri-Columbia.
- Maxwell, S. E., & Delaney, H. D. (1993). Bivariate median splits and spurious statistical significance. *Psychological Bulletin, 113*, 181-190.
- Miller, N. E. (1941). The frustration-aggression hypothesis. *Psychological Review, 48*, 337-342.
- Renfrew, J. W. (1997). *Aggression and its causes: A biopsychosocial approach*. New York: Oxford University Press.
- Sears, R. R. (1941). Non-aggressive reactions to frustration. *Psychological Review*, pp. 343-346.
- Taylor, S. P. (1967). Aggressive behavior and physiological arousal as a function of provocation and the tendency to inhibit aggression. *Journal of Personality, 35*, 297-310.
- Tukey, J. W. (1977). *Exploratory data analysis*. Menlo Park, CA: Addison-Wesley.
- Wegner, D. M., & Wenzlaff, R. M. (1996). Mental control. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 466-492). New York: Guilford.
- Weiner, B. (1985). An attributional theory of achievement motivation and emotion. *Psychological Review, 92*, 548-573.
- Zillmann, D. (1983). Arousal and aggression. In R. Geen & E. Donnerstein (Eds.), *Aggression: Theoretical and empirical reviews, Vol. 1: Theoretical and methodological issues* (pp. 75-101). New York: Academic Press.
- Zillmann, D. (1988). Cognition-excitation interdependencies in aggressive behavior. *Aggressive Behavior, 14*, 51-64.

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