AGGRESSIVE BEHAVIOR
Volume 24, pages 161–171 (1998)

The Interactive Relations Between Trait Hostility, Pain, and Aggressive Thoughts

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A recent model of affective aggression [Anderson et al., 1996] proposes that individual differences and situational factors can affect aggressive behavior through cognitive, affective, and arousal pathways. An experiment tested the relations of trait hostility and physical pain to aggressive thoughts (the cognitive path) and state hostility (the affective path). The experiment found an interaction between pain and trait hostility on aggressive thoughts. Trait hostile participants who experienced pain rated ambiguous words (e.g., alley) as more similar to aggressive words (e.g., hit) than did the other groups. State hostility was positively related to trait hostility and was increased by the experience of pain. These results demonstrate the heuristic utility of the Anderson et al. model. Aggr. Behav. 24:161–171, 1998. © 1998 Wiley-Liss, Inc.

Key words: aggression; violence; pain; trait hostility; anger; hostility

INTRODUCTION

Many factors contribute to the instigation of human aggression. Some of the more intriguing situational factors include climate [e.g., Anderson and Anderson, 1996; Montesquieu, 1748/1989], culture [Anderson and Anderson, 1996; Nisbett, 1993], current temperature [e.g., Anderson, 1989; Dexter, 1899], pain [e.g., Berkowitz et al., 1981], the viewing of aggressive models [e.g., Bandura, 1973], frustration [e.g., Berkowitz, 1989; Dill and Anderson, 1995; Miller, 1941], exposure to violent media [e.g., Bushman, 1995; Huesmann and Eron, 1984, 1986], and physiological arousal [Zillmann, 1983]. Other work has uncovered a host of important personological factors, such as trait hostility or irritability [e.g., Buss and Durkee, 1957; Caprara et al., 1985], sex [e.g., Bettencourt and Miller, 1996; Macoby and Jacklin, 1974], emotional reactivity [Caprara et al., 1994], and antisocial personality [e.g., Hare and McPherson, 1984].

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Received 16 December 1996; Accepted 20 June 1997

The depth and diversity of research on factors linked to aggressive behavior stands in marked contrast with the paucity of work on mediating processes. The question of how a particular factor (independent variable) leads to the eventual production of aggressive behavior (dependent variable) is sometimes discussed at a theoretical level, but it seldom receives adequate empirical attention. For example, many tests of the temperature-aggression hypothesis—the notion that hot temperatures increase aggressive behavior—involve archival data and field studies that show this link but do not (and usually cannot) test mediational mechanisms [e.g., Anderson and Anderson, 1996]. One such field study by Reifman et al. [1991] showed that the number of batters hit by pitchers in professional baseball games increased in hot temperatures. Although this study elegantly shows the strength of the temperature-aggression relation, it does not suggest *why* or *how* heat makes pitchers (or the average person) more aggressive.

Current theoretical work in the aggression/violence domain has produced a converging set of psychological conceptualizations that seem amenable to more detailed empirical investigations of mediating processes. The social learning theories of Bandura [1973] and Mischel [1973], Berkowitz's cognitive neoassociation model [1990, 1993a], Huesmann and Eron's application of script theory [1984], and Dodge's work with aggressive children [e.g., Dodge and Crick, 1990] all suggest possible routes through which causal factors can increase (or decrease) aggressive behavior.

In our recent work we formulated a General Affective Aggression Model (GAAM) that outlines how various situational and personological factors influence impulsive (or affective) aggression [Anderson et al., 1996; Anderson et al., 1995]. To the authors' knowledge, GAAM is the only model of aggression that explicitly incorporates situational variables, attitudes, and traits in a multistage model. GAAM delineates three routes through which various individual differences and situational factors can lead to aggressive behavior. Borrowing from Berkowitz's cognitive neoassociation model [1990, 1993a] and Geen's [1990] model of affective aggression, Anderson et al. [1996] state that various input variables (e.g., trait hostility, pain) can increase aggressive behavior through cognitive or affective routes. That is, aggressive cognitions or affect can become more accessible following exposure to an input variable. Some input variables (e.g., drugs or exercise) can influence aggressive behavior through a third route involving arousal. The routes are not independent; an input variable may operate through more than one route, and traversing one route may cause another route to be affected.

Situational Factors

The members of our lab have undertaken several experiments to test which route(s) various situational variables traverse. Some have found that uncomfortable temperatures increase hostile affect [e.g., Anderson et al., 1995; Anderson and Anderson, in press]. One of our experiments [Anderson et al., 1996] tested whether temperature primarily affects aggression by increasing hostile thoughts (in a modified Stroop task), hostile affect, or both. This same experiment also investigated cognitive and affective effects of viewing photographs of guns [e.g., Berkowitz and Le Page, 1967]. We found that uncomfortable temperatures increased hostile feelings and did not influence aggressive thoughts. Viewing gun photos had a very different effect; hostile thoughts were increased and hostile affect was not. We concluded that temperature primarily

influences aggressive behavior via the affective route and viewing gun photos primarily traverses the cognitive route.

A situational variable that has been shown to have powerful effects on aggression is physical pain [Berkowitz, 1993a, 1993b]. A multitude of experiments by Azrin, Hutchinson, and Ulrich and their colleagues [e.g., Azrin et al., 1965; Hutchinson, 1983; Ulrich, 1966] have shown that pain elicits aggression in animals. Although some researchers have argued that pain-elicited attacks are mostly defensive [e.g., Blanchard et al., 1978], others have shown that pained animals will also display "appetitive" aggression in that they will expend effort (e.g., pull a chain) to gain access to a target of their aggression [Azrin et al., 1965]. Humans have also been shown to display such appetitive aggression under conditions of physical pain. For example, Berkowitz et al. [1981] found that women who experienced pain (by holding their hands in very cold water) delivered more noise blasts to a female target when they believed that the noise blasts would be harmful to her than when they believed that the blasts could help her by motivating her to perform better.

It is therefore clear that pain elicits aggressive behavior in both animals and humans, but how? Does pain increase both aggressive thoughts and hostile affect? The present investigation tests the route(s) through which pain influences aggression.

Personological Factors

It is likely that some personological factors related to hostility may influence aggression through both the cognitive and affective routes. Due to the stability of aggressive personalities across the life span [Olweus, 1979], individuals with aggressive personalities are likely to develop richly complex hostile schemata and belief systems that link aggressive thoughts (and perhaps hostile affect) to a variety of social situations, contexts, and concepts. Aggressive personalities may lead people to be chronically aggressively primed; hostile schemata and hostile affect may always be accessible for these people.[1]

Aggressive Cognitive Biases

Dill et al. [1997] found that aggressive people, as measured by trait aggression and irritability scales, generate more hostile completions to ambiguously aggressive story stems and perceive greater hostility in observed dyadic interactions. Consistent with prior work on hostility biases [Dodge and Coye, 1987; Nasby et al., 1979], Dill et al. proposed that the aggressive personality leads to hostile expectation and interpretation biases. That is, aggressive personality leads people to behave aggressively primarily because people with aggressive personalities expect others to be hostile and aggressive and perceive more hostility and aggression in observed interpersonal interactions. The Dill et al. findings suggest that personality traverses the cognitive route, but because hostile affect was not measured in that study we cannot conclude that the aggressive personality does not also use the affective route. The present experiment tests the influence of aggressive personality on *both* hostile thoughts and hostile affect.

[1]We propose that aggressive personalities influence both the cognitive and affective routes, but that the sequence and direction of cognitive and affective accessibility is unclear. When hostile cognitions become accessible, they may "prime" aggressive affects, thereby making them more accessible as well. The opposite effect (that of hostile affect accessibility influencing hostile cognitions) may occur, or both may simultaneously become accessible.

Increases in hostile thoughts and schemata, hostile affect, and arousal as a result of an input variable may put the individual in a hostile state of mind or affective state, which may cause the person to not only interpret information in a more malicious manner, but also to seek out information that is consistent with the phenomenological experience. Figure 1 illustrates the GAAM framework. These cognitive biases may influence not only the "passive" appraisal of new stimuli but also the more "active" inclination to seek out aggression or aggressive portrails. The Dill et al. study showed that aggressive personalities result in two types of cognitive biases: hostile expectation and hostile interpretation biases. The present experiment examines the influence of the aggressive personality on a cognitive bias that we will call a "semantic selection" bias.

Summary

Situational and personological variables that are known to influence aggressive behavior may also do so by increasing aggressive thoughts, affect, and arousal, or through

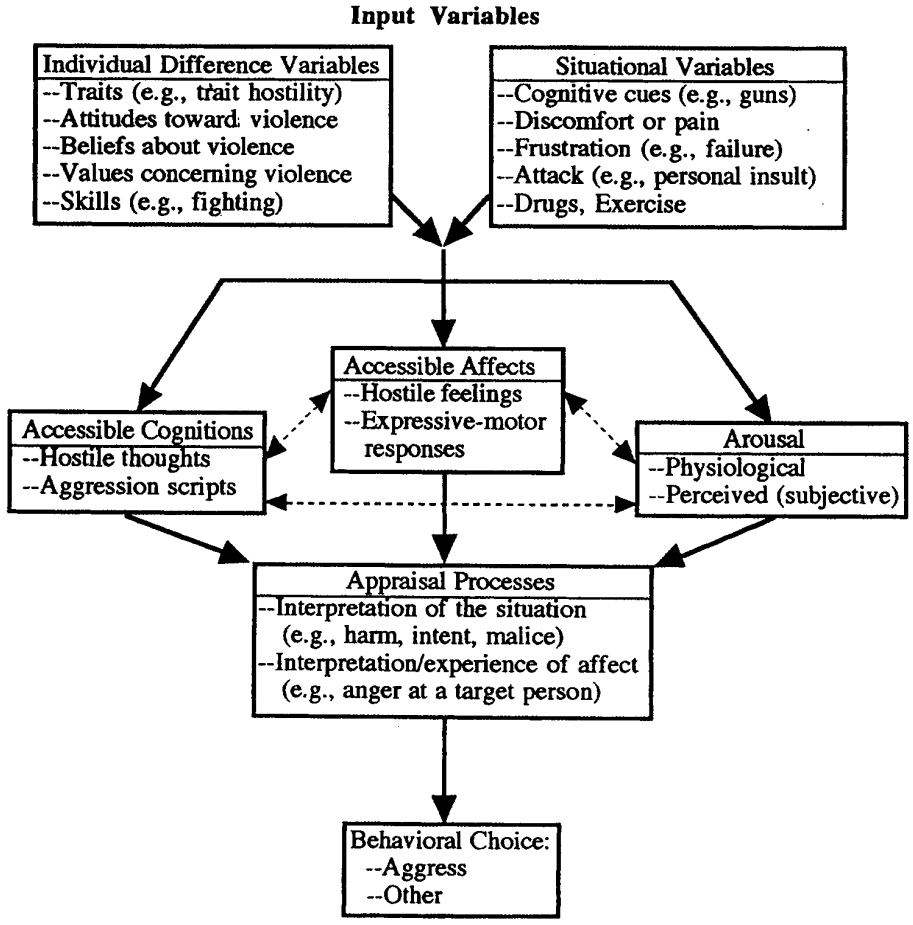

Fig. 1. The General Affective Aggression Model.

more than one of the routes simultaneously. The research reported in this article examines the effects of both a situational and a personality factor on aggressive thoughts and affect and the extent to which traversing these "routes" biases the individual to interpret information in a more hostile manner.

METHOD

Procedure

One hundred sixty undergraduates (104 females and 55 males, the sex of one participant was not recorded) at a large midwestern university participated. The sessions ranged in size from one to three people. Experimental sessions were same sex only.

Pain manipulation. Participants sat in desks separated by a divider so that they were unable to view each other. Participants were told that the experiment tested the effects of distraction on cognitive abilities. The Caprara Irritability Scale [Caprara et al., 1985] was then administered. This scale contains statements of beliefs about how one has typically behaved in the past (e.g., "Sometimes people bother me just by being around"). Ten of these items were reverse scored because they reflected nonhostile beliefs [see Anderson et al., 1995, 1996 for information on use of these 10 items]. Participants rated the extent of their agreement with each statement on a 7-point Likert-type rating scale anchored at "Strongly Disagree" (1) and "Strongly Agree" (7). This scale composed the measure of trait hostility.

The experimenter then explained the rest of the experiment to each participant separately. If more than one person participated in a session, the one or two other people were asked to step into the hallway and to not talk to each other. The next part of the experiment involved a pain manipulation modified from that used by Berkowitz and Troccoli [1990]. The experimenter explained that there were two arm positions in the experiment. Participants in the pain condition were told that "position 1" involved holding the nondominant arm at a 90° angle from their side. These people were also told that "position 2" involved placing their nondominant arm on the desk in front of them. Participants assigned to the no pain condition were told that both positions 1 and 2 involved placing the nondominant arm on the desk in front of them (so participants in this group were to leave their nondominant arms on the desk throughout the experiment). The two arm positions were separately explained for this group. For both groups the experimenter demonstrated the two arm positions, asked participants to perform them, and then asked if they understood the instructions.

Word pair similarity task. All participants were told that they would first maintain their arms in position 1 for 3 min. They would then put their arms in position 2 for 30 sec and then back in position 1. When they put their arms in position 1 the second time, they began the word pair similarity rating task. This task, modified from that developed by Bushman [1996], consists of rating the degree of meaning similarity of each paired combination of 20 words. Ten of these words can be interpreted as either aggression-related words or as aggression-unrelated words (e.g., bottle, night, stick). These words are referred to as ambiguous words. The remaining 10 words are more obviously related to aggression (e.g., butcher, choke, hatchet). Ratings of each word pair were made on a 1 to 7 scale of how similar, associated, or related they were. A rating of 1 represented "not at all similar, associated, or related" and 7 represented "extremely similar, associated, or related." Ratings were paced by computer-generated tones spaced 9 sec apart.

State hostility. After they finished the word pair rating task, participants completed The State Hostility Scale [Anderson et al., 1995]. This scale is composed of 35 statements that contain the words "I feel" followed by a hostility or anger-related adjective (e.g., "I feel furious"). The statements were rated on a Likert-type scale ranging from "Strongly Disagree" (1) to "Strongly Agree" (5). Participants then rated the question "How painful was the experiment?" on a 7-point scale anchored at 1 ("not painful at all") and 7 ("extremely painful"). All participants were then debriefed.

RESULTS

Analysis Strategy

The trait hostility ratings were converted to deviation scores to simultaneously test their unique contributions in main effects and interactions with other independent variables. The similarity ratings for the word pair task were averaged separately for (1) the ambiguous-ambiguous word pairs (AMBAMB), (2) the aggressive-ambiguous word pairs (AGGAMB), and (3) the aggressive-aggressive word pairs (AGGAGG), resulting in three composite scores.

Mixed factorial regression analyses were conducted. They included the between-subjects independent variables of (1) pain, (2) trait hostility, and (3) sex, as well as the three-level within-subjects variable of word pair type on the word pair similarity ratings. Effects of the between-subject variables were also tested for their influence on state hostility. No sex effects were revealed in initial analyses, so the sex term was dropped from further analyses. Cronbach's Alpha for the trait hostility (.85) and state hostility (.96) scales revealed that they were reliable scales.

Manipulation Check

In response to the question "How painful was the experiment?" participants in the pain condition reported feeling substantially more pain ($M = 4.0$) than those in the no pain condition ($M = 1.4, F(1, 153) = 190, P < .0001$). The pain manipulation, therefore, successfully elicited different levels of pain in the two groups.

Word Pair Similarity Ratings

Two main effects resulted from this analysis. A main effect appeared for type of word pair ($F(2, 250) = 162.1, P < .0001$). Similarity ratings increased as the aggressive content of the word pairs increased ($M_{AMBAMB} = 3.04, M_{AGGAMB} = 3.21, M_{AGGAGG} = 4.42$). Planned contrasts revealed that the mean difference between AMBAMB and AGGAMB was significant ($F(1, 125) = 9.78, P < .01$), as was the mean difference between AGGAMB and AGGAGG ($F(1, 125) = 283, P < .0001$). The main effect for trait hostility also was significant ($F(1, 125) = 4.74, P < .05$). In other words, the average slope relating trait hostility to similarity ratings (averaged across word pair types) was significantly different from zero ($b = .007$). The pain main effect and the pain by trait hostility interaction were nonsignificant ($Ps > .10$).

Of most theoretical interest is the three-way interaction of word pair type by trait hostility by pain ($F(2, 250) = 6.20, P < .01$; see Figure 2). As can be seen in Figure 2, the AMBAMB word pair ratings were largely unaffected by pain or by trait hostility, although there was a hint of a positive relation between trait hostility and perceived similarity of these particular word pairs ($b = .008, P < .19$). For both of the other word pair

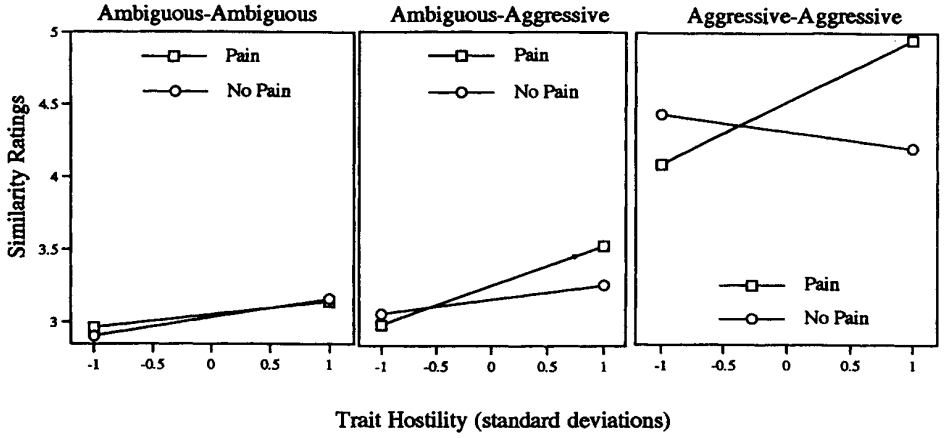

Fig. 2. Word similarity ratings as a function of pain and trait hostility.

types, participants who were high on trait hostility and in the pain condition gave higher similarity ratings than other combinations of the trait hostility and pain variables. In other words, hostile people who were in pain apparently selected more aggressive meanings of the ambiguous and aggressive words, thereby increasing the perceived similarity of the AGGAMB and AGGAGG pairs.

Two specific *a priori* contrast analyses were conducted to further examine this three-way interaction. In both, we used participants' ratings of the AMBAMB word pairs as a control. First, we constrasted the trait hostility by pain interaction pattern for AGGAMB word pairs against the corresponding pattern for AMBAMB word pairs. This contrast was marginally significant ($F(1, 125) = 3.71$, $P = .06$). Second, we contrasted the trait hostility by pain interaction pattern for AGGAGG word pairs against the corresponding pattern for AMBAMB word pairs. This contrast was significant ($F(1, 125) = 6.64$, $P < .01$). The results of these contrast analyses support the hypothesis that hostile people in pain select relatively more aggressive meanings of words when it is possible to do so.

Finally, we conducted univariate analyses on each of the word pair types to individually test the pain effect on similarity ratings for participants high (1 SD above the mean) in trait hostility (see Aiken and West, 1991, for this procedure). Note that this between-subjects procedure is considerably less powerful than the previously described within-subjects analyses. Hostile participants in the pain condition rated the AGGAGG word pairs as more similar (predicted $M = 4.95$) than did hostile participants in the no pain condition (predicted $M = 4.20$), $F(1, 125) = 7.72$, $P < .01$). This same pain effect on similarity ratings by hostile participants occurred for AGGAMB word pairs (predicted $M_{pain} = 3.53$; predicted $M_{no\ pain} = 3.26$). However, this difference was not statistically significant ($F(1, 125) = 1.63$, $P < .21$). The same procedure was conducted to test the significance of the slight difference that was found between the no pain (predicted $M = 4.43$) and pain (predicted $M = 4.09$) conditions for low trait hostile (1 SD below the mean) participants on the AGGAGG ratings. This difference was nonsignificant ($F(1, 125) = 1.69$, $P < .20$).[2]

[2]A slight decline was found in AGGAGG ratings in the no pain condition, showing slightly lower ratings for high trait hostile participants than for those low in trait hostility. This unpredicted trend was nonsignificant ($b = -.005$, $P > .39$).

State Hostility

As predicted, a main effect was found for pain ($F(1, 153) = 6.81$, $P < .01$). Participants in the pain condition reported feeling more hostile (adjusted $M = 2.23$) than those in the no pain condition (adjusted $M = 1.99$). A main effect was also found for trait hostility ($F(1, 153) = 24.0$, $P < .0001$). State hostility increased as trait hostility increased ($b = .010$, $a = 2.23$). Figure 3 illustrates both of these main effects. The interaction did not approach significance ($P > .57$).

DISCUSSION

Although not very surprising, the demonstrated pain effect on state hostility suggests that when pain increases aggressive behavior, it may well do so through the affective route outlined in GAAM. Furthermore, the positive relation between trait hostility and state hostility suggests that the elevated aggression levels commonly found among high trait hostile people may also operate through the affective route.

The most noteworthy finding, though, was the interaction of trait hostility and pain on the similarity ratings for the different word pair types. Trait hostile people who were in pain had the most aggressive thoughts, as indicated by their relatively high similarity ratings for ambiguous-aggressive word pairs and for aggressive-aggressive word pairs—what we have termed the semantic selection bias. This semantic selection bias suggests that the commonly observed effects of pain and trait hostility on aggressive behavior may also operate through the cognitive route outlined by GAAM. In other words, both the affective and cognitive routes to aggression may link pain and trait hostility to aggressive behavior.

CONCLUSIONS

As a whole, the results demonstrate the utility of examining the effects of aggression-related independent variables in the context of a coherent mediational model of

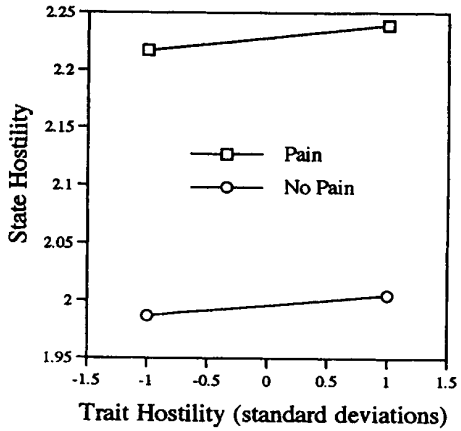

Fig. 3. State hostility as a function of pain and trait hostility.

affective aggression. Trait hostility was positively related to aggressive affect. Pain increased aggressive thoughts, but only in trait hostile people. These individuals displayed a hostile semantic selection bias in their determinations of the meanings of ambiguous words.

The results of the present experiment are interesting in their own right in that they inform us about trait hostility and pain and how they combine to influence current affective and cognitive states. Our results are also relevant to the study of aggression both because they test important aspects of our model of affective aggression and because they indirectly shed light on past studies of aggression. Past work clearly shows strong effects of pain and trait hostility on aggression. The hostile perception and hostile expectation biases identified in earlier work [e.g., Dill et al., 1997], along with the semantic selection bias identified in the present experiment, provide clear routes for individual difference and situational variables to traverse on their way to eliciting aggressive behavior.

Additional research is needed to further investigate these effects. Specifically, what is needed are studies that trace the effects of pain and trait hostility to later stages in GAAM, such as the appraisal and behavioral choice stages shown in Figure 1. Ideally, we would like to follow the effects of various input variables through all stages of GAAM within the same study. Practical problems, such as the possibility that measures at one stage interefere with the processes at later stages, make this a difficult (if not impossible) study to construct. Alternatively, several studies which focus on one or two stages of GAAM may yield sufficiently useful information to further test and refine GAAM. For instance, one study might use pain and trait hostility independent variables, hostile affect as a potential mediating variable, and aggressive behavior as the primary dependent variable. Others could use a measure of hostile cognition or arousal as potential mediating variables. Still others could examine the effects through the appraisal processes.

Perhaps the most interesting finding of the present experiment is the interactive effect of pain and trait hostility on aggressive thoughts, which is quite different from the purely additive effects of pain and trait hostility on aggressive affect. One implication is that in some situations aggressive behavior may be interactively instigated by pain and trait hostility, whereas in others, aggressive behavior may reflect only main effects of pain and trait hostility. More specifically, the interactive pattern on aggressive behavior may occur in situations in which the aggressive behavior is largely determined by cognitions, such as delayed retributive aggression for earlier "injustices." The rumination process involved in such situations may be interactively influenced by pain and trait hostility, so that irritable people who are also in pain experience the largest increase in aggressive thoughts, which in turn produce the biggest increase in aggressive behavior and possibly in ruminative anger as well.

In other situations in which aggressive behavior is more immediately determined by current affect, pain and trait hostility may exert (primarily) main effects on aggressive behavior. In such reactive aggression, both pain and trait hostility may contribute additively to the immediately felt anger. The amount of immediately displayed aggressive behavior would be directly related to this anger. Future research could profitably investigate this fine-grained set of predictions, predictions that emerged from a mediational model view of aggression.

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