

Heat and Violence

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Abstract

The heat hypothesis states that hot temperatures can increase aggressive motives and behaviors. Although alternative explanations occasionally account for some portion of the observed increases in aggression when temperatures are high, none are sufficient to account for most such heat effects. Hot temperatures increase aggression by directly increasing feelings of hostility and indirectly increasing aggressive thoughts. Results show that global warming trends may well increase violent-crime rates. Better climate controls in many institutional settings (e.g., prisons, schools, the workplace) may reduce aggression-related problems in those settings.

Keywords

temperature; aggression; violence; global warming

I pray thee, good Mercutio, let's retire;
The day is hot, the Capulets abroad,
And, if we meet, we shall not 'scape a
brawl,

For now, these hot days, is the mad
blood stirring.

—William Shakespeare,
Romeo and Juliet, Act 3, Scene 1

Does excessive heat increase violence? Social commentators have long noted effects of weather on human behavior and have used heat-related imagery in their works (e.g., Cicero, 106–32 B.C.; Siouxsie and the Banshees, in their song “92°,” 1986). Empirical methods were first applied to this theory in the middle 1700s. Montesquieu (1748/1989) noted that “you will find in the northern climates peoples who have few vices, enough virtues, and much sincerity and frankness. As you move toward the countries of the south, you will believe you have moved away from morality itself: the liveliest passions will increase crime . . .” (p. 234). In the late 1800s and early 1900s, a number of European and North American scholars found that rates of violent crime increased during the hottest times of the year, and were higher in regions with hotter climates (Anderson, 1989). Perhaps Shakespeare was right.

The *heat hypothesis* states that hot temperatures increase aggressive motivation and (under some conditions) aggressive behavior. The *heat effect* is the observation of higher rates of aggression by people who are hot relative to people who are cooler. Methodological difficulties and the lack of modern statistical analyses in early studies made causal statements risky, but causal issues are crucial. For example, more assaults occur during the summer months than during other months, but this could be a spurious artifact of differences in the daily activities people perform at different times of the year. Perhaps people are outside more during the summer, increasing the opportunity for conflicts. Routine activities associated with summer may increase assault rates, and heat-induced discomfort may play no direct causal role in this increase. Such mediated, or indirect, heat effects are important in their own right, of course.

MODERN STUDIES OF THE HEAT HYPOTHESIS

Modern studies (i.e., post-1950) address these methodological issues in several ways. The research can be classed into three broad categories: (a) field studies, all of which focus on some form of aggression; (b) laboratory studies with a focus on aggression; and (c)

laboratory studies with a focus on aggression-related variables, such as hostile feelings, beliefs, and arousal.

The results can be characterized with four summary statements. First, periodic claims that observed heat effects result solely from artifactual processes have, to date, proven false. Second, the ongoing search for conditions under which excessive heat may cause a decline in aggression has largely failed. Third, there has been a growing realization that other aggression-related processes sometimes obscure, exaggerate, or modify the heat effect. Fourth, a simple version of the heat hypothesis (e.g., Berkowitz, 1993)—that people get cranky when uncomfortable—has proven surprisingly robust to all challenges. In short, excessive heat appears to cause increases in aggression in many settings.

In investigating the relation between heat and aggression, my students and I have relied on a well-worn philosophical approach known as triangulation. This involves examining competing explanations of the heat effect from multiple perspectives. Because the weaknesses of one particular methodology differ from those of other methodologies, an explanation of observed heat effects that works across different methodologies is less likely to be invalid than explanations that work only for one or two methods. For example, changes in routine activities may be able to explain summer increases in violent crime, but cannot account for the finding that baseball pitchers are more likely to hit batters with a pitched ball on hot days than on cool days (Reifman, Larrick, & Fein, 1991). The parsimonious explanation is that heat-induced discomfort increases aggressive inclinations on the baseball field and in other naturalistic settings.

Field Studies of Heat and Aggressive Behavior

Field studies may be categorized according to whether they compare aggression rates (usually violent-crime rates) across geographic regions that are similar in many respects but differ in climate, or whether they compare aggression rates in one geographic region but across time periods that differ in temperature.

Studies Comparing Geographic Regions

Data consistently show that violent-crime rates are higher in the South than in other regions of the United States. Similar patterns appeared in the older European studies (Anderson, 1989).

The heat hypothesis is only one of several explanations of the U.S. version of the hot-region effect. One alternative explanation is that, for some reason, a culture of violence (e.g., Nisbett, 1993) developed in the U.S. South, and that this cultural difference has been passed on to present-day inhabitants. Reasons given for this cultural development differ among scholars; analyses of who settled the South, the institution of slavery, and the effects of being a frontier or a herding economy have all been offered. Nonetheless, claims that Southern culture accounts for the observed high violent-crime rate in hotter regions of the United States are contradicted by recent analyses of violent-crime rates in 260 U.S. cities (Anderson, Anderson, Dorr, DeNeve, & Flanagan, 2000). Latent variable statistical techniques were used to estimate the effect of temperature on violent-crime rate, while statistically controlling for the Southernness, population size, and socioeconomic status of the cities. This same analysis estimated the effect of Southernness on violent-crime rate, while statistically controlling

for the temperature, population size, and socioeconomic status of the cities. As shown by the positive path coefficient for the link between temperature and violent crime in Figure 1 (.43), temperature was significantly and positively related to violent-crime rate. That is, hotter cities were more violent than cooler cities even after city-to-city differences in Southernness, population size, and socioeconomic status were statistically controlled. However, the path coefficient for the link between Southernness and violent crime (.14) was not reliably different from zero (no effect), casting further doubt on the claim that a Southern culture of violence is the sole or primary cause of higher violent-crime rates in hotter U.S. cities.

Studies Comparing Time Periods

Field studies comparing aggression rates in hotter versus cooler time periods also support the heat hypothesis. For example, there are about 2.6% more murders and assaults in the United States during the summer than other seasons of the year; hot summers produce a bigger increase in violence than cooler summers; and violence rates are higher in hotter years than in cooler years even when various statistical controls are used (Anderson et al., 2000). Other time-period studies provide consistent results. Aggression—as measured by assault rates, spontaneous riots, spouse batterings, and batters being hit by pitched baseballs—is higher during hotter days, months, seasons, and years.

Several studies have examined the heat hypothesis with time periods even shorter than days. Some have found increases in assaults, rapes, and domestic violence at hotter temperatures (Anderson et al., 2000). Studies that have measured temperature at the exact time that aggressive behaviors occurred

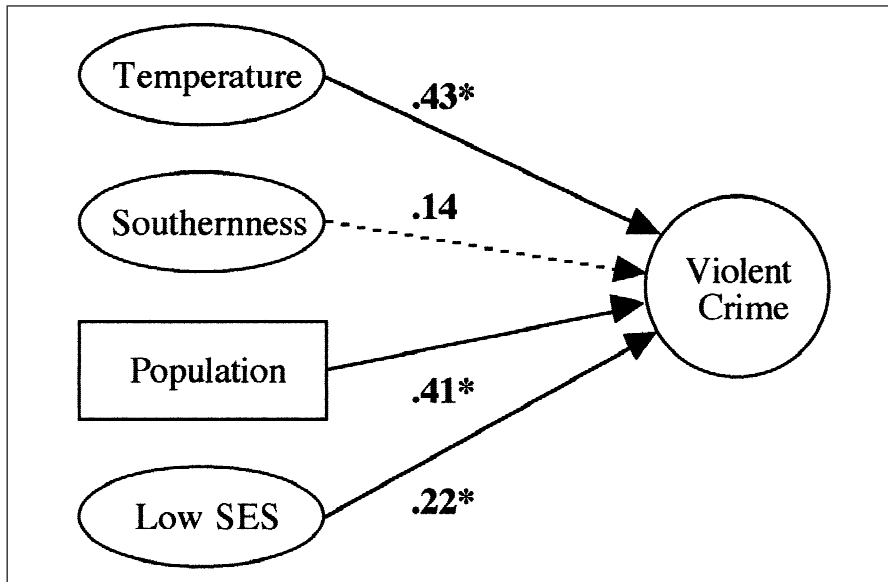


Fig. 1. Latent variable model of effects of temperature and Southernness on violent crime, controlling for population and socioeconomic status (SES). Positive path coefficients (e.g., the .43 above the line connecting “Temperature” to “Violent Crime”) indicate a positive relation between the variables linked by that path. Negative path coefficients would indicate a negative relation between the linked variables. A path coefficient of zero would indicate that the two variables are totally unrelated. Solid lines linking two variables indicate that the associated path coefficient is reliably different from zero (i.e., is statistically significant). The dashed line indicates that the link between the two variables is not reliably different from zero. Adapted from Anderson, Anderson, Dorr, DeNeve, and Flanagan (2000).

have also yielded the standard heat effect. Kenrick and MacFarlane’s (1984) classic study in Phoenix, Arizona, found that aggressive horn honking increased at hotter temperatures, but only for drivers without air-conditioned cars. More recently, Vrij, van der Steen, and Koppelaar (1994) conducted a field experiment in which Dutch police officers performed in a simulated burglary scenario under hot or comfortable conditions. Hot officers reported more aggressive and threatening impressions of the suspect, and were more likely to draw their weapon and shoot the suspect (with laser training weapons), relative to officers in the cool condition.

Summary of Field Studies

Field studies consistently find positive associations between uncomfortable heat and aggression. Most field studies are correlational, so causal interpretation must be

tempered by the possibility that unknown extraneous variables caused a spurious relation between heat and aggression. However, the two major challenges to the heat hypothesis—changes in routine activities and Southern culture—do not fare well from a broad perspective. Each can account for a few findings, but neither can account for the broad array of heat effects. The consistency of findings across many settings and methods provides strong support for the causal version of the heat hypothesis, even from correlational studies. Furthermore, the few experimental and quasi-experimental field studies lend considerable support to the causal interpretation.

Laboratory Studies and Aggressive Behavior

Mixed Results

Lab studies of the heat hypothesis have yielded somewhat mixed

results. The negative-affect escape model (Anderson, 1989; Anderson et al., 2000; Baron & Bell, 1976) postulates that excessive heat increases aggression when the total amount of negative affect a person experiences is in the low to moderate range (the fight response), but that excessive heat decreases aggression when total negative affect gets too high (the flight response). In other words, if other aspects of a particular situation (such as being insulted) also produce negative affect, then further increases in negative affect caused by hot temperature should (according to this model) lead to escape behavior instead of aggressive behavior. In brief, hot temperatures should produce a decline in aggression in situations that have other negative-affect-producing factors present. A meta-analysis (i.e., an analysis combining results across all relevant studies) yielded some support for the standard heat effect (hot temperatures increased aggression) in lab settings that had few extraneous negative-affect-producing factors present. However, there was little support for the predicted decrease in aggression when extraneous negative-affect-producing factors were present (Anderson et al., 2000). Many early lab studies, especially those that used kerosene heaters, suffered from potential suspicion problems. That is, some participants in those studies may have become suspicious about the “true” purpose of the study, and may therefore have behaved in an artificial way. Boyanowsky (1999) recently discussed other methodological problems with early lab studies and provided experimental evidence that when people’s attention is not focused on temperature (as in most naturalistic settings), hot temperatures increase aggression even when additional negative-affect-producing factors (such as being insulted) are present.

One recent experiment using more subtle ways to manipulate temperature than kerosene heaters succeeded in creating conditions that yielded both heat-induced increases and decreases in aggression. Two factors were involved: an ambiguous provocation, followed by multiple opportunities to retaliate. Under these conditions, my colleagues and I found an initial heat-induced increase in aggressive retaliation, followed by a decrease (Anderson et al., 2000). One explanation of this pattern involves two separate processes. The initial outburst of aggression may have been the result of heat-induced increases in aggressive inclinations (via hostile affect and cognition). The later decrease may have been the result of a social justice norm; hot participants may have decided that the initial retaliation was sufficient. Of course, in most natural settings, the initial outburst will itself provoke an aggressive response from the victim, initiating an escalating cycle of retaliatory aggression.

Summary of Laboratory Studies of Aggressive Behavior

In affectively neutral and positive circumstances, hot temperatures cause increases in aggression. Recent lab studies show that even in affectively negative circumstances, heat causes increases in initial retaliatory aggression.

Laboratory Studies and Aggression-Related Variables

Heat effects on affective, cognitive, and arousal variables have proven quite consistent. Exposure to hot temperatures increases heart rate, endorsement of aggressive attitudes and beliefs, and feelings of hostility, all the while decreasing feelings of arousal and comfort. The heat-induced increase in endorsement of aggressive attitudes

and beliefs looks, at first glance, like a cognitive priming effect, automatically increasing the accessibility of aggressive thoughts. However, hot temperatures do not automatically prime aggressive thoughts, at least not in the same way that viewing pictures of guns does (Anderson, Anderson, & Deuser, 1996). Thus, the effects of heat on attitudes and beliefs are indirect, most likely mediated by more direct effects of heat on hostile affect. Uncomfortably warm temperatures also produce biases in the interpretation of observed social interactions. Specifically, heat seems to increase the likelihood that ambiguous social interactions will be interpreted as having aggressive components (Anderson et al., 2000). Finally, heat stress decreases performance on many cognitive tasks.

PSYCHOLOGICAL PROCESSES UNDERLYING THE HEAT EFFECT

Numerous fascinating psychological processes might be involved in the typical effect of high temperatures on aggression and violence. The simplest and most powerful ones all revolve around the "crankiness" notion. Being uncomfortable colors the way people see things. Minor insults may be perceived as major ones, inviting (even demanding) retaliation. This notion is compatible with several well-established theories in social psychology, including Berkowitz's (1984) cognitive neo-association theory and Zillmann's (1983) excitation transfer theory. Our own General Affective Aggression Model (GAAM; e.g., Anderson et al., 2000) explicitly incorporates the key aspects of these earlier models, including the crankiness notion.

GAAM also includes social interaction processes that play a key role in the genesis of violent behav-

ior. Specifically, GAAM highlights the fact that any social interaction involves at least two people. Furthermore, aggression can come about through fairly automatic processes (i.e., impulsively) as well as through careful planning. My colleagues and I believe that most heat-induced increases in aggression, including the most violent behaviors, result from distortion of the social interaction process in a hostile direction. Heat-induced discomfort makes people cranky. It increases hostile affect (e.g., feelings of anger), which in turn primes aggressive thoughts, attitudes, preparatory behaviors (e.g., fist clenching), and behavioral scripts (such as "retaliation" scripts). A minor provocation can quickly escalate, especially if both participants are affectively and cognitively primed for hostility by their heightened level of discomfort. A mild insult is more likely to provoke a severe insult in response when people are hot than when they are more comfortable. This may lead to further increases in the aggressiveness of responses and counterresponses. An accidental bump in a hot and crowded bar can lead to the trading of insults, punches, and (eventually) bullets.

NEW RESEARCH DIRECTIONS

Many of the basic pieces of this puzzle have been found, but several are still missing. Though research on the heat hypothesis has been carried out for many years, my colleagues and I believe that the hardest work lies ahead and that the missing pieces are likely to be found in future laboratory studies. Additional work is needed to answer the following key questions.

1. Does excessive heat bias perceptions in ongoing social interactions?

2. Do people in hot conditions—and who are therefore physiologically aroused (i.e., have an increased heart rate) but psychologically unaroused (i.e., feel lethargic)—misattribute some of their heat-based arousal to minor provoking social events?
3. Do the cognitive effects of heat stress interfere with normal mechanisms for inhibiting aggression?
4. How do escape motives influence the heat effect? The negative-affect escape model specifies that escape motives should play a major role. It predicts that under some circumstances, increases in heat-induced discomfort will increase the desire to escape more than the desire to retaliate, and therefore will reduce aggression if escape is incompatible with aggression. However, no research has explicitly pitted escape motives against aggressive motives.
5. Do social justice processes underlie the finding that excessive heat can at first increase and later decrease aggression?

CURRENT IMPLICATIONS

A broad view of the research—triangulation—suggests that in many settings hot temperatures cause increases in aggression. There are conditions that limit the generality of this conclusion, but the overall pattern of data is impressive and convincing.

The implications of this general conclusion are many. Consider the finding that hot years produce increases in violent-crime rates. If this heat effect is truly caused by heat-induced increases in aggressive motivation, then increased violence can be added to the list of negative social consequences of global warming. Figure 2 illus-

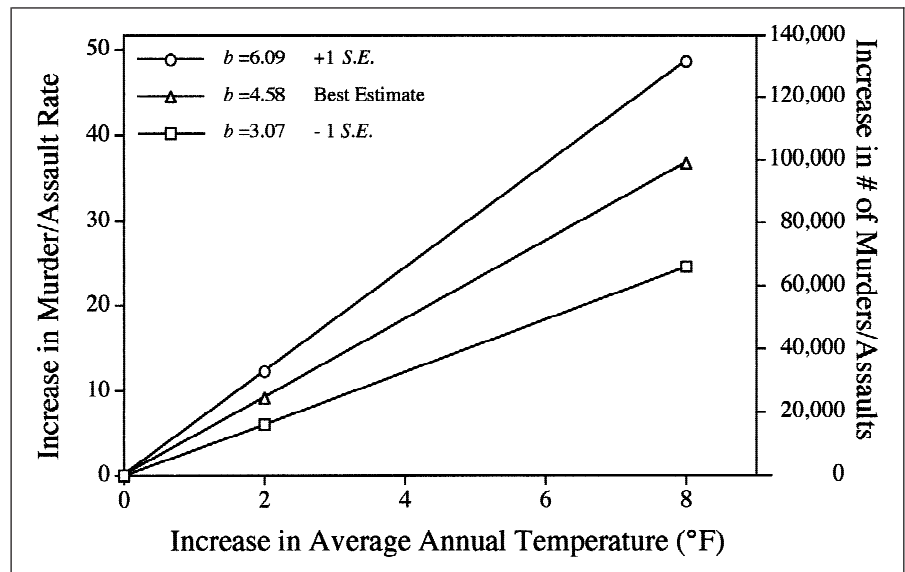


Fig. 2. Estimated effect of global warming on murders and assaults in the United States. The graph shows the estimated increase in the murder-assault rate and in the number of murders and assaults (for a population of 270 million) based on three estimates of the relation between temperature and violence. From Anderson, Anderson, Dorr, DeNeve, and Flanagan (2000).

trates just how much of an increase can be expected, based on several estimates of the true relation between temperature and U.S. murder and assault rates, at several estimated levels of global warming. For example, using the best estimate of how much the violent-crime rate will increase for each 1 °F increase in temperature (i.e., 4.58), we see that a 2 °F increase in average temperature predicts an increase of about 9 more murders or assaults per 100,000 people, or more than 24,000 additional murders and assaults per year in a population of 270 million.

There are numerous institutional settings in which aggression is a problem and in which temperature can be controlled. Schools, prisons, and a wide variety of workplaces are good targets for intervention. Research on the effects of better climate control in such settings might well show that the additional costs are outweighed by the benefits—better learning, lower incarceration costs, less property damage, and increased productivity.

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Note

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