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Climate Change and Psychology: Effects of Rapid Global Warming on Violence and Aggression

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Abstract

Purpose of Review An important question regarding rapid climate change concerns its likely effects on violence. Rapid climate change is likely to produce sociological, political, economic, and psychological changes that will increase the likelihood of violent behavior. This article examines relevant theory and research.

Recent Findings We examine three lines of research: (a) how hot temperatures directly influence aggression and violence; (b) how rapid climate change indirectly increases adulthood violence proneness through its effects on physiological and psychological development; (c) and how ecomigration influences group-level aggression. We also discuss arguments against the effects of climate change on aggression and violence.

Summary Research and theory reveal three ways that rapid global warming can increase aggression and violence. We describe a model showing the relationship between rapid global warming on antisocial behaviors and risk factors for aggression and violence.

Keywords Heat · Temperature · Violence · Ecomigration · Scarcity · Aggression · Conflict

"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)

There is a long history of associating heat with violence. From Cicero (106–32 B.C.E.) to Montesquieu (1748) [1], the link between aggressive behaviors and temperature has been observed [2]. Modern research has confirmed this connection; Perry and Simpson [3] reported that the rates of violent assault (i.e., rape and aggravated assault) are significantly correlated with temperature. The first comprehensive review of the heat effect on violence found substantial consistency across many data sets, some as old as 1899 [4]. As contemporary global warming triggers multiple environmental changes, the need to

understand the likely effects on violent behavior also increases.

Scientific communities have almost universally accepted that human activity is directly responsible for the current rapid increase in average global temperature [5]. Human influence on the amount of heat-trapping "greenhouse gases" is the primary causal route for increases in the planet's temperature and the changes witnessed in a wide range of climate/weather events. For example, it is now widely acknowledged among climate and weather scientists that we are likely to see at least a 2 °C increase in average temperature by the year 2100 [5]. The consequences of a warmer planet include (among many others) a rise in average sea level (about 2 m or 6 ft if we keep the temperature increase to 2 °C) and an increase in the severity and frequency of droughts, tropical storms/hurricanes, and other severe weather-related events such as major flooding [5].

The main point of this article, however, is not to debate the existence of human-caused rapid (in geologic terms) global warming. Instead, our main point is to explore the implications of global warming on human aggression and violence. We do so with two action-oriented goals in mind. One, by delineating how global warming increases the relative frequency of human violence, we hope to increase people's

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motivation to act to reduce the use of fossil fuels, to increase sustainable energy production (such as wind and solar energy), and to explore technologies to remove greenhouse gases from the atmosphere. Second, we hope that by explaining the social and psychological processes involved in global warming–induced increases in violence, we will enable governments and non-governmental organizations (NGOs) to prepare for and to mitigate some of the problems that mediate the global warming effect on violence.

For example, we know that one major consequence of ecological disasters such as prolonged drought or flooding is ecomigration (i.e., the movement of populations caused by ecological disasters) [6]. Furthermore, ecomigration (including refugee crises) often creates political instability, riots, and war (civil or between countries) [7]. Knowing that such consequences of global warming are coming, we should enable nations and NGOs to prepare to deal with the refugees and internally displaced persons in ways that reduce the violence-enhancing potential of future ecological disasters.

Based on well-established modern bio-social-cognitive models of aggression and violence, our research team has discovered three ways in which rapid global warming increases the relative frequency of aggressive and violent behavior [8, 9, 10•]. Before summarizing these, it is useful to define critical terms. "Aggression" is defined by most psychologists as *behavior that is intended to harm another human who wishes to avoid that harm*. Several aspects of this definition warrant additional attention. First, aggression is a behavior, not a wish, emotion, or thought. Second, the person enacting the behavior must believe that the behavior has some reasonable chance of actually harming the individual. Third, accidental harm (e.g., tripping over an extension cord and thereby slamming into another person) and incidental harm (e.g., pain caused by a dental procedure) are not aggressive, because the harm is not intended. Aggression can take many forms, such as physical (e.g., hitting a person), verbal (e.g., calling a person vile names), and relational (e.g., spreading rumors about a person to harm their reputation). There are other approaches to defining aggression, but these are not central to this article [11].

"Violence" is typically defined as physical aggression that is sufficiently severe to yield injury requiring medical attention. Most psychologists view aggression as existing along a continuum, with *violence* being reserved for the more serious forms of physical aggression. In other words, all violence is aggression, but not all aggression is violence. This is an important theoretical point because it allows theory building and theory testing to include studies of milder forms of aggression (i.e., not violence), and makes such studies relevant to understanding more severe forms of aggression (i.e., violence). Note that some scholars use the term "violence" in conjunction with some severe forms of aggression that are not physical, such as emotional violence. In the present article, we are

mostly concerned with physical aggression and violence, although many other forms of aggression also are relevant.

As mentioned earlier, our team has uncovered at least three ways that rapid global warming increases aggression and violence. One is relatively direct and occurs immediately by influencing the person's internal state (i.e., thoughts, feelings, and physiological arousal); the other two are less direct. Of these two indirect paths, one involves risk factors known to increase the likelihood that a young person (from conception through adolescence) will become prone to violence. The other involves risk factors acting at the group level, factors that lead to intergroup conflict. We now turn to these three ways that rapid global warming increases aggression and violence.

In Fig. 1, we display a simplified model illustrating how rapid global warming affects key weather, environmental, and economic factors. In turn, these factors influence the three routes by which global warming can increase violent behavior. The most direct route is through direct effects of heat stress on people's current state of irritability. The other two routes are more indirect and arise from global warming's effects on failing crops, natural disasters, and economic instability.

Direct Effects of Heat on Individuals

Psychologists and sociologists have been studying the relation between heat (uncomfortably warm temperature) and aggression for some time now [2, 12, 13]. Although ethical considerations prevent researchers from conducting experimental studies that measure the extreme types of violent behavior seen in war or violent crimes, researchers can experimentally examine how uncomfortable temperatures can affect individuals' thoughts, perceptions, feelings, and mildly aggressive behavior [14••]. Furthermore, there have been numerous non-experimental studies of the heat-violence relation using a wide range of study designs, statistical controls, and violent behaviors. By looking at the data collected from all of these studies, we get a consistent and convincing overarching view of the psychological and sociological relations between temperature and aggression/violence. Basically, there are three types of studies that have tested the heat-aggression hypothesis: (a) true experimental studies, in which participants are randomly assigned to hot or comfortable-temperature conditions; (b) geographic region studies, which compare violence rates across geographic regions that differ in climate; and (c) time period studies, which compare violence rates across time periods that vary in temperature. All three types converge on the same general finding that heat stress increases aggression and violence.

The primary—and most thoroughly researched—means by which heat stress has this effect is that uncomfortably warm temperatures increase aggressive thoughts and feelings, or
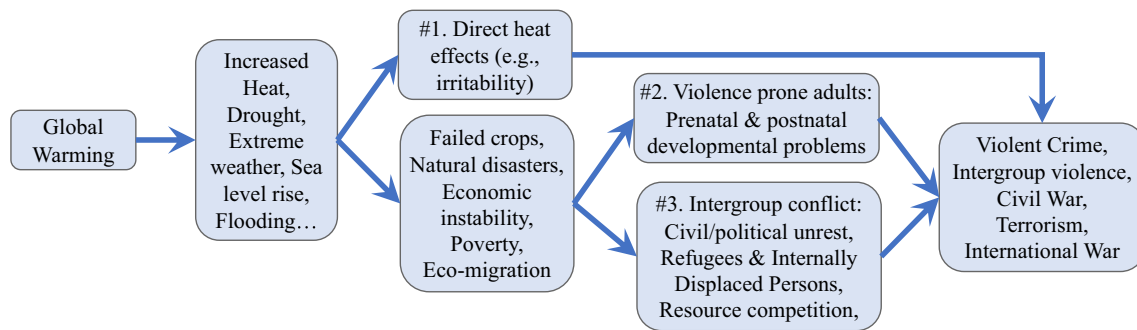
Fig. 1 Three paths through which rapid global warming increases violent behavior

what we call "irritability." Although this increase in irritability is subtle, it can increase aggressive behavior through well-known processes of priming aggressive thoughts (i.e., increasing the accessibility of aggressive ideas) and of the misattribution of emotion (i.e., increasing the likelihood of perceiving oneself to be angry). In other words, when in an irritable state, minor provocation seems major, such that even trivial provocations can trigger excessively aggressive responses, which in turn can trigger an escalation of the violence cycle [8, 15, 16, 17••].

Experimental Studies

Studies using an experimental paradigm to study the relation between aggression and temperature have found that even the idea of heat will cause an increase in aggressive thoughts, feelings, and behaviors. For example, in a study by Wilkowski, Meier, Robinson, Carter, and Feltman (2009) [18], participants were exposed to images related to heat and temperature. They found that those exposed to the heat images were more likely to judge neutral facial expressions as aggressive and were more likely to think aggressively. Similarly, priming participants with thoughts of heat make them more likely to have aggressive thoughts or to interpret neutral behavior as aggressive [9]. Other experiments have found that participants are more likely to be hostile, more likely to perceive others as being hostile, and act more aggressively toward another person after being randomly assigned to sit in an uncomfortably hot room instead of a room at a comfortable temperature [13].

One study manipulated temperature in a police training program [19]. They found those police officers randomly assigned to an uncomfortably hot condition were more likely to respond to a burglary scenario by drawing their weapon and by firing it than those who were in a comfortable-temperature condition. Although these experiments do not show actual violent behavior (e.g., shooting real people), they do provide an important understanding of the fundamental relation between aggression and temperature, and in this case, a link between heat and violence [19].

Comparing Geographic Regions

Another way to test the link between heat and aggression is to compare violent crime rates across geographical regions that are similar in terms of nationality, socioeconomic, and demographic characteristics. According to this research, hotter regions (such as certain cities in the USA) have higher crime rates, even after statistically controlling for other variables that are sometimes associated with violent crime, such as poverty, age distribution, and unemployment [4, 20]. Although these other factors frequently have independent effects on violent behavior, some studies have found that they can also act as "amplifiers" for the effects of climate on aggression [6].

Global data has also been gathered to examine the relation between heat and violence. One study gathered data from 60 different countries and concluded that temperature had an association with violence levels, especially in places already experiencing issues with conflict and instability [21]. The authors concluded that for every degree (Celsius) increase due to climate change, there would be an increase in homicide rates by 6%. Other estimates note that even mild increases in temperature (e.g., 1.1 °C) could result in 25,000 more severe and deadly assaults per year in just the USA [22, 23].

Comparing Violence Over Time

Examining violence rates in warmer or cooler climates involves many possible confounding variables (e.g., types of subcultures in the different regions). Although researchers often do their best to control for such confounds, plausible explanations of the heat-aggression relation may remain. In response to this interpretation problem, other studies have examined the relation between heat and violence within the same regions over various periods of time, from hours, to days, to weeks, to seasons, and to years. Because the cultural and demographic variables within a specific region are largely unchanged across the different time periods, any heat-related effects that arise (e.g., hotter summers giving rise to a larger than usual summer increase in violent crime than cooler summers) cannot be explained by regional differences in subcultures of violence. In such time-period studies, we also find a

consistent pattern: the hotter the period, the higher the rate of violence [4, 12, 24–26]. As noted, this can range from a few hours to days, months, or years [4, 24, 25, 27].

Bushman et al. [25, 26] found that police reports from Minneapolis showed a significant effect for both the heat and time of day in rates of physical assault, over three-hour time slots. Similar results were found in other cities: such as in Brisbane, Australia when looking at domestic violence reports, and in Vancouver, Canada, where physical assaults on bus drivers were more frequent in hotter months [28, 29].

Other types of aggression have been reported as increasing in hotter periods of time as well. These include riots, intake reports from psychiatric hospitals, more aggressive horn honking in drivers without air-conditioned cars, and major league baseball pitchers hitting more batters [30–34]. One study [22] compared 59 years of FBI Crime Reports with the National Oceanic and Atmospheric Administration's weather data and found that violent crime rates rose in hotter years. They also compared crime rates during the summer to the other three seasons, and found that in 53 of the 55 years for which seasonal data were available, violent crime rates were highest in the summer. The authors additionally showed that violent crime rates rose in hotter years, and that hotter summers had relatively higher violent crime rates than cooler summers in the same cities [22].

In sum, converging evidence from three very different types of studies yields consistent conclusions. Being in an uncomfortably hot environment is reliably associated with higher levels of aggressive and violent behavior, and this appears to result mainly from heat stress–induced increases in irritability.

Mechanisms That Underlie Direct Effects of Temperature on Aggression

There are several major theoretical accounts of the empirical link between heat and aggression, both psychological and physiological, but they are not necessarily incompatible. Possible physiological explanations rely on the fact that hot temperatures activate the part of the brain that is responsible for both thermoregulation and emotion regulation. Additionally, adrenaline production increases in the heat, which could lead to more aggressive behavior under certain conditions (e.g., provocation). These links have been observed across numerous socio-cultural areas and suggest that this physiological connection between aggression and behavior is "hardwired" [4, 11, 17••, 25, 30].

Various theories behind psychological mechanisms also exist to explain this relation. The psychological concept of embodied cognition suggests that we respond to stimuli from the environment, which influences how we think. And what we find in the heat-aggression research is that higher temperatures produce discomfort, which increases aggressive

precursors such as irritability and hostile perceptions of others [4, 8]. These two types of explanations are fully compatible with each other. That is, there may be independent effects of heat-induced physiological activation of emotion-regulation parts of the brain, and of heat-induced irritability and perceptual biases. Also, it is possible that the more social psychological explanation (irritability, biased social perceptions) is the direct result of the physiological effects of heat on emotion regulation. The compatibility of these theoretical explanations is why we lump them together in this article as "irritability."

Another prominent theory is the routine activity theory (RAT) [8, 12, 35]. RAT notes that people's routine activities are likely to differ during hot versus cool weather and that such activities may account for some of the observed heat-aggression effects. For example, people without effective air conditioning in their homes may spend more time outside or may drink more beer during hot spells, and this may influence the likelihood of aggressive behavior. To be sure, there is evidence that supports RAT in general, such as data showing that weekends tend to yield higher violent crime rates than weekdays [12, 13]. However, RAT cannot account for all or even most heat-aggression results.

Some concerns are being raised about the research behind the link between temperature and aggression, including the direction of and nature of the relationship between increases in temperature and increases in aggressive behavior. However, these concerns have been repeatedly and thoroughly addressed, and the original findings verified [11, 13, 25].

However, some moderators do exist when looking at the relationship between climate and aggression. Van de Vliert (2011) discusses the relationship between climate-based demands and wealth-based resources [36, 37]. Among numerous findings, he reports that developing countries with demanding cold or hot climates are more prone to repression of the media. Also, political riots and armed attacks do occur more frequently in warmer countries, but these effects are mitigated by a nation's cultural masculinity [38].

Recently, a new model was proposed to help us understand the mitigation of culture with the climate concerning violence. Van Lange, Rinderu, and Bushman (2017) developed the CLASH (Climate, Aggression, and Self-control in Humans) model [39••]. CLASH highlights that the cultures of regions with colder climates (especially in climates where we see great variety in seasons) put more of a focus on the future rather than the present, a stronger focus on self-control, and a slower life history strategy than cultures in warmer climates. Models and studies such as the CLASH model, and Van de Vliert's (2011) work, help us understand that although there is a base level of aggression brought out by heat, this effect can be mitigated or exaggerated by the cultural values and norms.

These direct effects of heat and underlying mechanisms will not be the only effects of global warming on aggression.

There also are subtler, indirect effects on aggression and violence; these are discussed in the next two major sections.

Creating Violence-Prone Adults: Indirect Effects of Climate Change on Individuals

There are two indirect ways in which rapid global warming increases violence. Some of these effects have already begun to emerge, especially those involved in the third major section on group conflict effects (see Fig. 1). Central to the present section, though, is a slower indirect effect that takes many years to develop. Specifically, this is the idea that the likelihood of a child developing into a violence-prone adult will be increased by rapid climate change [40, 41]. The theoretical rationale is simple: known risk factors for a developing fetus or child eventually becoming a violence-prone adult will become more prevalent as a result of climate change–induced ecological disasters. These include tropical storms and hurricanes, prolonged droughts, sea level rise (and consequently the more frequent and severe flooding of coastal communities), water shortages (especially for drinking and agriculture), and changing suitability of local agricultural practices for efficient production of food.

For example, each of the following is a known risk factor for creating violence-prone adults: growing up in poverty, inadequate prenatal and childhood nutrition, dysfunctional families and parenting, disrupted families, exposure to neighborhood violence, exposure to war and conflicts, low education, and poor living conditions [22, 42]. Because of space limitations, we focus here on only four components: food insecurity, economic deprivation, susceptibility to terrorism, and preferential in-group treatment. In a 2015 review looking at 28 major weather events from all seven continents, researchers found that 14 of them were affected by human-induced climate change [43]. The reader is invited to consider how such climate change–induced ecological disasters will increase the percentage of children who are exposed to multiple known risk factors for adulthood violence.

Violence and Food Insecurity

Even in the USA, 1 in 8 households struggle to have a reliable source of food [22]. Worldwide, the figure is much worse. Numerous studies have shown that food insecurity, poor pre-natal nutrition, and poor post-natal nutrition can lead to increased aggressive and antisocial behavior. For example, a study on Mauritanian children looked at their nutritional intake in conjunction with behavioral disorders. They found that children who were malnourished at 3 years old were more likely to become hyperactive and aggressive at age eight than children who were adequately fed [44]. Three years later, those same children were more likely to misbehave in school

and to develop symptoms of conduct disorder. These characteristics, of course, are also risk factors for antisocial and violent behavior in adults.

These findings correspond with the well-known study regarding 100,000 Dutchmen born during and after World War II [45]. From October of 1944, until May of 1945, a German blockade split the western Netherlands and had severe effects on food supplies. This study used birth records to compare men who were malnourished during the first and second trimesters of their mother's pregnancy during the blockade, to those born shortly after it ended and when food was more accessible. The men whose mothers were malnourished during their pregnancies were 250% more likely to develop anti-social personality disorder than those whose mothers were well fed [45].

This relation between malnourishment and antisocial aggression is not a unique result [46], and one possible explanation for this is the release of cortisol from the mother during her pregnancy [47]. Other similar explanations involve the effects of inadequate nourishment on the developing brain. The IPCC and others have strongly warned about climate change's impact on the agriculture of our planet. Given this relation between early-age malnourishment (both pre- and post-natal) and adulthood antisocial behavior; we have reason to expect that the climate change effects on food supply will lead to an increased risk in violent and antisocial behavior for individuals when they become adults [23, 48, 49••].

Economic Deprivation

A changing environment also presents many challenges to current economics on a global scale. The IPCC, in both their 2007 and their 2013 reports, predicted that global warming would indeed produce lower crop yields, poorer grazing land, and the loss of homes due to wildfires and flooding. These effects will be drastic and damaging but will most likely be felt disproportionately by those in poverty and facing other economic disadvantages [50].

We know that poverty and income disparity can lead to risk factors for aggression (such as decreased life satisfaction, increased resentment, and dissent) [51]. For those countries already facing severe economic issues, rapid climate change will heighten the economic stressors felt by their citizens [49••].

Perceiving inequality (whether economic, racial, class, or even age) has also been tied to motivation for violent revenge [52–56], and although actual poverty is not necessarily a condition to foster violent behavior, research suggests that severe economic inequality may induce violent outrage [57]. This effect is heightened if this perception happens rapidly (such as after a natural disaster) and if the perception leads to uneasiness about the individual's future [58–60].

Creating Intergroup Conflict: Indirect Effects of Climate Change on Intergroup Violence

In addition to the direct effect of heat stress and the indirect effect of climate change on the creation of violence-prone individuals, there is a third path to consider. Specifically, we also must consider how larger groups and entire populations will react to these events as well.

Ecomigration refers to group migration in response to some physical, economic, or political instability brought about by some ecological disaster [14••]. Although physical displacement itself is not a direct cause of aggression, the perceived differences between those who are relocating and those who already live in or near the areas to which the migrants are relocating can be a source of tension and future violence. Combining this with other issues, such as competing for resources and infrastructure, we can see how climate change leading to mass ecomigration can lead to mass conflict.

The conflict in Syria is a prime example of ecomigration and civil war brought about in part by an unprecedented drought. Briefly (and somewhat oversimplified), the drought forced large numbers of Syrians to migrate to Syrian cities in search of jobs and food. The government failed to provide the expected jobs, food, and housing, leading to political and civil unrest, which contributed to other co-existing risk factors for civil war. (There has been some debate over the relationship between climate change and the violence in Syria, which we discuss later.) Uganda has suffered a similar drought that has also led to mass migration due to higher food prices and violence within the country. The list of similar examples includes Kenya, Sudan, and Ethiopia. They all have climate-related conflicts, causing scientists to believe that these types of aggressive behaviors (civil wars, protests, coups, rebellions, riots, and large-scale conflicts) will all continue to become more frequent and more violent as the global temperature increases [14••].

Other types of ecological disasters also can play a role in ecomigration and subsequent increases in intergroup violence. For example, numerous environmental issues and socioeconomic factors led more than 10 million people to migrate from Bangladesh into India. As this was happening, many Indian citizens believed that the migrants were stealing farmland, a cause of conflict in the region. This led to a violent outrage, and nearly 2000 migrants were killed as a result [61]. Hurricane Katrina in the USA led to the relocation of thousands of Americans, most moving to neighboring states to seek refuge. In cities that accepted refugees (technically, *internally displaced persons*), homicide rates started to rise, creating a tension between residents of those cities and the refugees staying there. Although these incidents never rose to armed revolts or conflicts, this serves as another example of the role climate change plays in violent behavior.

Terrorism

There is a rather complicated relationship between environmental and social conditions in the genesis of terrorism [49••]. Factors such as losing one's livelihood, family members, and culture (especially when these losses can be blamed on another group), and perceiving the losses as disproportionately affecting their homes and families and their in-group, often make people desperate and ripe for recruitment into terrorist groups and activities. This is especially likely when the victim feels that there is no chance of improving or mending their situation [7, 58, 60]. These were motivating factors for recruits to join militias in Sierra Leone [52, 54], Palestine [53], and Managa [14••]. Furthermore, recruits joined to regain a sense of belonging, meaningfulness, status, power, protection, and economic alleviation [53, 54, 61–67].

One study found that a single standard deviation increase in drought intensity could increase the likelihood of intergroup conflict in a region by as much as 62%. As noted earlier, environmental impacts such as droughts are expected to increase in both severity and frequency because of rapid global warming, and they will create or exacerbate many of the conditions that allow terrorist organizations to thrive [16].

The economic effects resulting from climate change are expected to be disastrous for many regions and countries, and along with the more immediate dangers of poverty and starvation, this research is starting to show us additional bad societal events will occur as a result of these outcomes, events such as terrorism and war [49••]. Children who are in regions afflicted by wars, famine, droughts, and other harmful environments are exposed to many risk factors for the development of violence-prone adolescents and adults. Numerous longitudinal studies have shown us that relatively brief exposure (months or a few years) to these risk factors can put an individual on a high-risk trajectory [22].

A study in 2002 examined the interaction between the genetic alleles involved in producing monoamine oxidase A (MAOA)—an enzymatic degrader that modulates neurotransmitters—and maltreatment on antisocial outcomes. The association between maltreatment and antisocial behavior was found to be conditional on the MAOA genotype. Simply put, 12% of the sample had the low activity MAOA genetic risk factor and had been maltreated, but they accounted for 44% of the total convictions of violent crime. Furthermore, 85% of those who had both the genetic and environmental risks factors developed some form of antisocial behavior. For those who did suffer from maltreatment, the genotypic risk factor did not manifest in behavior [67].

We understand that terrorism is caused by numerous ideological, personal, and societal factors [61]. Because of climate change's massive effects on resources, poverty, and economic stressors, we can expect these conditions to be heightened and

for the risk of terrorist group formation to increase, especially in disadvantaged countries and cultures.

Preferential In-group Treatment

Other, more "defensive" forms of aggression are believed to come from climate change as well, especially in response to resource conflicts with different racial, ethnic, and religious groups [14••]. One study found that aggression toward out-groups increased in response to the threat of climate change [68].

The expected rapid changes to our planet resulting from climate change will force interactions between various out-groups as they are forced together due to these severe conditions. As described earlier, the Syrian drought forced agrarian groups to seek employment, shelter, and food in major cities, which contributed to the current civil war. In addition, thousands of Syrians have migrated (or are attempting to migrate) to countries all over the world, leading to increasing political and economic tensions and occasional acts of intergroup violence.

What we have seen globally is a mixed response to the refugees. Although some countries and political groups have gone out of their way to welcome the refugees and to find them supplies and places to live, a backlash has also occurred in an attempt to either slow the flow of refugees into countries or to end them altogether. The Syrian refugees (and Muslims/Arabs generally) frequently are depicted as terrorists or rapists in Western news and entertainment media (e.g., TV and video games), and social media movements such as #refugeesNOTwelcome have taken off [69•]. This rhetoric has carried itself past the Syrian crisis, and into daily political rhetoric. For example, research shows that exposure to such anti-Muslim/Arab news and entertainment media increases negative attitudes and beliefs about Muslims and predominantly Arab countries, increased support for war against those countries, and increased support for restricting the civil rights of Muslim-Americans [70, 71•].

Syria offers us a glimpse into what the future might look like as the climate continues to change rapidly: weather becomes more severe, and countries begin falling into economic and civil distress. As people are forced to relocate, they will also find themselves in situations much like the Syrian refugees, where they are attacked as an out-group, and as resources become more and more scarce, these divides may only become stronger.

Other Perspectives

There are many critiques and questions raised when discussing the effect of climate change on aggression. Indeed, many factors contribute to violent behavior at the individual level as well as at the intergroup level. Nonetheless, it is evident that rapid global warming creates more opportunities and situations for aggressive and violent behavior to occur.

Another view argues that abundance causes conflict, not scarcity [49••]. The basic premise is relatively simple—the abundance of any given resource is a driving factor for conflicts, not the scarcity of a resource. Therefore, the argument goes, many of the pathways to violence described in earlier sections, such as scarcity of food, will not be a driving cause of violence as a result of climate change. However, one thing to note is that climate change will not only cause scarcity but abundance of new resources as well. An example of this can be found from the ice receding in the Arctic. The ice melting away has exposed new and plentiful reserves of different minerals and petroleum, causing tension between countries such as the USA, Russia, China, and Canada [62].

Another commonly expressed view is just that the climate change's effects on behavior are not significant enough to increase individual aggression or to stimulate wars, so we should ignore them. Most researchers who take this view assert that differing levels of violence that have been attributed to climate change are the result of other pre-existing risk factors, e.g., (poverty, cultural tensions, access to weapons, income inequality) and not due *exclusively* to rapid climate change. Stated in this rather extreme form, this is a valid critique, and for the most part, we agree. All of these factors play significant and vital roles in increasing violent and aggressive behavior. In some of the data examined so far, rapid climate change may have had a relatively minor role in comparison with other pre-existing risk factors. However, recent data and theory strongly suggest that rapid climate change (1) has already played an essential role in violent behavior at the individual and intergroup levels; (2) will play an increasingly significant role in the near future as climate change effects become more severe; and (3) climate change effects exacerbate other pre-existing political/social/economic risk factors that are known to have large effects.

Other concerns about the heat hypothesis (specifically the CLASH model) are being raised as well. Coccia (2017) suggests that income inequality, latitude, and their interactions serve as predictors of intentional homicide [72•]. Coccia looked at 191 countries and found that even when controlling for temperature differences, and seasonal changes, increases in intentional homicide are positively correlated with income inequality. However, other studies that have controlled for income inequality have still yielded significant heat effects on violent crime [22].

Substantial discussion over the role of anthropogenic climate change in the Syrian conflict and other current world events has begun to take place as well. As noted by Selby et al. (2017) [73••], the evidence for the cause of the drought in Syria is not as straightforward as originally proposed.

Although the original authors have refuted many of these claims [74••], the truth—as it almost always is—is quite complicated. When looking at these regions for links between climate and conflict, one must recognize that the regions are already charged politically/environmentally, which complicates the data and interpretations [75••].

We also recognize the debate over the terminology used in this discussion [35], specifically what constitutes an environmental migrant. Stavropoulou (2009) [76] argues that we should in fact coin the term environmental refugee as it may offer a greater sense of responsibility and urgency when discussing who will be displaced by rapid climate change. Even this notion has seen some resistance, Zetter (2017) [17••] notes that "the label is neither sufficiently wide in scope nor appropriate in its meaning to mobilise the range of action and actors that are needed to address the structural and operational challenges."

Also note, however, that despite the definitional, methodological, and interpretational problems that can be seen as disagreements, there still are unifying themes. For example, areas that are underdeveloped, economically/socially challenged, and already at risk for potential conflict will suffer the most from these environmental changes and potential mass migrations. There also is some consensus about what to do. Countries with the resources to take in these migrants or to help them relocate within their own countries should be prepared to do so. This can mitigate the amount and severity of the potential conflicts we will see. We also propose that the psychological variables (out-groups vs. in-groups, the heat hypothesis, developmental risk factors) will also play a role in increasing the potential for conflict due to ecomigration and that these risk factors also can be mitigated.

Warner, Dun, and Stale (2009) [77] suggested that, "Environmentally induced migration occurs when ecological tipping points are exceeded." However, we do see some concerned over the link between certain violent outcomes and their relationship to environmental events. Freeman (2017) [78••] noted that "there is a growing agreement in both the environment-migration and climate-conflict spheres that intervening variables determine if and how environmental change causes population movements and political violence." Our model delineates many of these intervening variables and processes.

In an analysis of climate-induced migrants from 1960 to 2000, some researchers found that there was no significant effect on conflict from climate migrants [79••]. However, other research also seems clear that there must be some effect. For example, we know that areas with water supplies see an increase in violent conflicts in places where water is scarce [80••, 81••].

These kinds of complex findings are common and add a wrinkle to what many consider is a straightforward assumption of climate change ➜ migration ➜ increased conflict.

Many studies note that the best predictor of increased conflict due to migration is not the migration itself, but the willingness and preparedness of the country or region receiving the migrants [79••, 82].

Unfortunately, the places that are most likely to see the most substantial amount of movement (and thus, the potential for conflict) are the places where other risk factors for violence are already present. That is, although ecomigration itself does not directly cause violence, it increases risk in regions that are already at risk; if not anticipated and adequately addressed, it likely will lead to increased violence.

Discussion

We have shown that rapid global warming increases violent behavior via three different paths. Perhaps the most controversial concerns the third path, in which extreme weather events and more prolonged changes in food production and water availability will force some groups of people to move, becoming either refugees or internally displaced persons. In turn, this movement increases the potential for violent behavior, especially in already-vulnerable regions. Well-tested psychological theories of intergroup behavior, and of individual violence (both developmental and environmental), help to reconcile many of the differences between scholars who believe that climate change increases migration and conflict, and those who believe there are other mitigating factors.

Countries that are already going through intense turmoil are particularly vulnerable to violence and conflict. Countries with high population densities that are also experiencing the severe loss of land, water, crops, and livestock are particularly susceptible to increased aggression and violence due to rapid climate change [21, 82–86].

Even countries that are economically advantaged will see their way of life change, and their children exposed to more risk factors for developing violent behavior. For example, crime data from St. Louis, Missouri, found that in disadvantaged neighborhoods, hot temperatures saw a disproportional rise in violent crime [87]. Moreover, although civil war seems unlikely in currently wealthy/stable countries, conflicts and violence due to within-country migration and between current citizens and refugee immigrants have been documented from past (e.g., the Dust Bowl in the USA) and recent eco-disasters (e.g., Hurricane Katrina). So even within the most economically developed countries in the world, those who are disadvantaged will experience a disproportionate amount of the harmful effects of rapid climate change on their lives [49••]. This disproportionate effect of rapid climate change between regions, countries, or even neighborhoods will likely produce breeding grounds for new terrorist (or gang) activity, a global strain on available resources, and the involvement of the

developed countries in small-scale wars breaking out across the globe [51].

Although this news seems bleak and rather grim, there is hope, as there is a global effort among scientist and the public to bring awareness to the severity of the issue and our ability to revert it (even among political strife). On April 29, 2017, marches were held across the globe in response to current political attitudes about climate change and over 200,000 people (in Washington D.C. alone) participated to make their concerns heard about our planet [88•].

We already know of little things around the home that individuals can do to help alleviate greenhouse emissions and to reduce our carbon footprint [9] and the social sciences can help contribute to changing public attitudes about climate change. By using what we know about attitude change, decision-making, and behavior change, we can help educate and encourage the general public, policymakers, and politicians [49••]. For example, psychologists have found that framing climate change in global phrasing, rather than using more local and specific terms, causes people to become more peaceful and less aggressive when discussing and thinking about these topics [49••]. Another study showed that getting people to think about the legacy they would leave behind, and encouraging them to leave a positive one, can motivate them to act pro-environmentally [89].

From past experience with natural disasters, we, as civilized societies, should be able to prepare for future disasters by creating policies and plans, setting aside emergency resources and funds, and actively and quickly come to the aid of refugees and internally displaced persons in humane and conflict-reducing ways. For example, instead of inventing excuses to kick out recently successful immigrants, the USA should be devising policies that welcome and help ecomigrants and other refugees to become productive US residents and eventual citizens. As Freeman [79••] noted, the potential of migrants infusing into another culture and contributing new knowledge and skills is high; so, instead of fearing migrants, we should embrace them and look to see what they can contribute to their new homes. Future research should look into not only how these events will play out and affect us, but how we can proactively mitigate, or prevent, their disastrous outcomes.

Compliance With Ethical Standards

Conflict of Interest   On behalf of all authors, the corresponding author states that there is no conflict of interest.

Human and Animal Rights and Informed Consent   This article does not contain any studies with human or animal subjects performed by any of the authors.

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