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Close replication attempts of the heat priming-hostile perception effect

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HIGHLIGHTS

- Research suggests people hold mental associations between heat and aggression.
- Thus, priming "heat" may increase the accessibility of aggressive cognitions.
- Two close replications failed to replicate the heat priming-hostile perception effect.
- A meta-analysis confirmed the heat priming-hostile perception effect is not different from zero.

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ABSTRACT

DeWall and Bushman (2009; Experiment 2) reported a study in which participants were exposed to heat-related, cold-related, or neutral (i.e., non-temperature-related) primes prior to reading an ambiguously aggressive vignette. Participants exposed to the heat-related primes judged the vignette's protagonist as more hostile than participants in the cold-priming condition ($d = 0.67$) or neutral-priming condition ($d = 0.63$). This suggests that people mentally associate heat-related constructs with aggression-related constructs. To test the reliability of the effect and to estimate a more precise effect size, the current studies closely replicated DeWall and Bushman in two independent samples, each of which was more than two and a half times greater than the samples in the original study (total $N = 688$). These replication attempts failed to find any evidence that exposure to heat primes affected hostile perceptions relative to the cold primes ($ds < -0.06$) or neutral primes ($ds < 0.00$). Further, a meta-analysis estimated that the difference in hostile perceptions between those in a heat priming condition and those in a neutral condition was about one-fifth of a standard deviation and not significantly different from zero, $d = 0.18$, 95% CI[−0.09, 0.44]. Thus, I conclude that priming individuals with heat-related constructs does not reliably affect hostile perceptions.

Experiencing hot temperatures is associated with aggressive cognitions in the lab (Anderson, Anderson, & Deuser, 1996), aggressive behaviors in the lab (e.g., Bell & Baron, 1976; Fay & Maner, 2014), and aggressive behaviors in the "real-world" (e.g., Anderson, 1989; Anderson & Anderson, 1996; Bushman, Wang, & Anderson, 2005; Rotton & Cohn, 2000). Thus, it is vital for social scientists to invest research efforts to understanding the relationship between hot temperatures and aggression. The current studies are close replication attempts of a study by DeWall and Bushman (2009) demonstrating a hypothesized cognitive route where heat-related constructs affect the accessibility of aggression-related constructs even in the absence of experiencing hot temperatures. The implication is that the heightened accessibility of aggressive cognitions increases the likelihood of behaving aggressively (e.g., Anderson & Bushman, 2002).

The proposition is that people have close mental associations between the constructs of hot temperatures and aggression. In this vein, DeWall and Bushman (2009; Experiment 2) reported a study in which participants ($N = 72$) were exposed either to heat-related, cold-related, or neutral (i.e., non-temperature-related) words as part of a priming task (i.e., the scrambled sentence paradigm). All participants then read a story describing an individual who performed ambiguously aggressive behaviors and then judged that individual's hostility. Participants in the heat-priming condition rated the individual as displaying more hostility than participants in either the cold-priming or neutral conditions. These results suggest that those who were exposed to heat-related words had a heightened accessibility of aggressive cognitions, which caused the interpretation of ambiguous information as relatively hostile.

The studies described in the current report were close replication attempts of DeWall and Bushman's (2009) Experiment 2 and had two goals. The first goal was to independently replicate the heat priming-hostile perception effect. Given the ubiquity of experiencing hot temperatures, the importance of hostile perceptions for contributing to aggressive behaviors, and that a single study demonstrating the heat priming-hostile perception effect has subsequently been cited as

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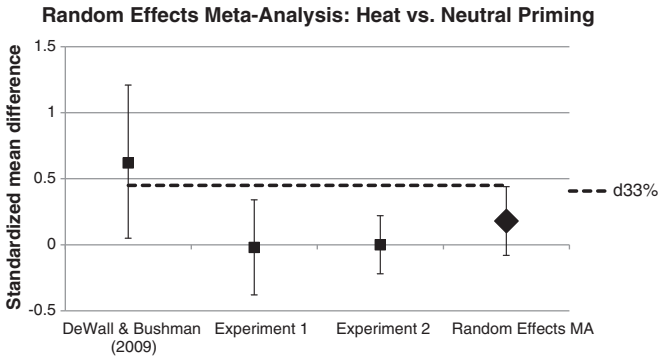

Fig. 1. Random-effect meta-analysis of the three studies examining the association between heat-priming and subsequent hostile perceptions ($k = 3$, $N = 499$). This figure contains the standardized mean differences between those in the heat priming conditions and neutral conditions. Positive values indicate greater perceptions of hostility among those in the heat priming condition relative to the neutral condition. Error bars are 95% confidence intervals. Dashed line $= d_{33\%}$.

established (e.g., DeWall, Anderson, & Bushman, 2011; Fay & Maner, 2014; Pond et al., 2012), it is important to confirm the reproducibility of this effect. Despite DeWall and Bushman's results, a single study is insufficient to consider an effect as scientifically established. To accomplish the goal of replicating the heat priming-hostile perception effect, the current studies used similar research materials, closely followed the methods of DeWall and Bushman, and included samples large enough to detect the hypothesized effect.

The second goal of the current studies was to increase the precision of the heat priming-hostile perception effect. Observed effects are subject to sampling error, which can be considerable with small samples (e.g., Cumming, 2012). Whereas the magnitude of the point estimate of the effect estimated by DeWall and Bushman (2009) was two-thirds of a standard deviation, because of a small sample size, this point estimate ranged from non-zero but small up to effects that are conventionally large (see Fig. 1). Thus, whereas DeWall and Bushman's sample included enough participants to conclude that a true effect of zero (i.e., $\mu_0 = \mu_1$) was implausible, little can be concluded beyond that. To accomplish the goal of increasing the precision of the heat priming-hostile perception effect the current studies each included samples greater than two and a half times larger than the original sample. Further, because replications each generate independent estimates of a population effect, a meta-analysis combining all of the studies examining the effect of heat-priming on hostile perceptions also was conducted.

For the current studies I report how I determined my sample size, all data exclusions (if any), all manipulations, and all measures in the study (Simmons, Nelson, & Simonsohn, 2011, 2012). All hypotheses and analyses were specified prior to data collection and the project was registered according to Brandt et al.'s (2014) replication template on the Open Science Framework. All stimuli needed to replicate the current studies and data needed to replicate the reported analyses can be acquired by contacting the author or by visiting the author's account on the Open Science Framework (https://osf.io/zqwa2//). Finally, the current research was approved by Northern Illinois University's human subjects review board prior to data collection.

Sample size selection

In the current studies, I examined whether the heat priming-hostile perception effect "replicates" by the direction of the mean hostile perceptions such that those in the heat-priming condition perceive the described individual as more hostile than those in the cold-priming conditions or the neutral conditions. To determine a target sample size, a power analysis was conducted using an effect size of $d = 0.60$, $\alpha = .05$ (two-tailed), and desired power of 0.99. Using G*Power 3.1.1, I estimated that I need 104 individuals per condition in the replication samples to achieve this level of desired statistical power. In addition to the direction of the effect, another goal is to increase the precision of the effect size estimate. A precision analysis was conducted using an effect size of $d = 0.60$, a target margin of error to be $f = .03$ or 0.3σ, and an assurance of $\gamma = 99$. Using the ESCI program developed by Cumming (e.g., Cumming, 2012), I estimate that I need 96 individuals per condition to achieve this level of desired statistical precision. These estimates both exceed Simonsohn's (2013) recommendation of having sample sizes in replication studies at least 2.5 times that of the original study. Thus, to meet the minimum sample size estimate I collected data from at least 180 individuals (i.e., 72×2.5) per replication attempt.

Replication Experiment 1: laboratory replication

Participants

One hundred eighty-two participants were recruited from the Introductory Psychology student subject pool at Northern Illinois University. Participants in the sample were mostly (59%) female and non-Hispanic white (52%, 27% black or African–American, 13% Hispanic of Latino/a, 8% Asian or Asian–American). The mean age of the sample was 19.34 years (SD = 1.78), which ranged in age from 18 to 30 years-old.

Materials and procedures

The priming stimuli were obtained from the original authors and the methods of the current experiment exactly replicate those of DeWall and Bushman (2009). After providing consent, participants were given a 3-page packet with the study materials. The first page consisted of stimuli intended to prime heat, cold, or neutral concepts. This page contained 13 sets of five words from which participants were instructed to create complete, four-word sentences. In the heat-priming and cold-priming conditions, six of the 13 word sets contained words related to the concepts of hot temperatures and cold temperatures, respectively. In the neutral priming condition, none of the sentences contained temperature-related words. On the second page, all participants read a story about a man named Donald who performed ambiguously hostile behaviors (e.g., Srull & Wyer, 1979, 1980). For example, the story described Donald arguing with his landlord. Participants then rated Donald on seven traits (i.e., *hostile*, *smart*, *angry*, *honest*, *unfriendly*, *outgoing*, and *unlikable*) using a scale with labels at *0 = not at all* and *10 = extremely*. Finally, participants reported demographic information, were debriefed, and compensated with credit towards a course research requirement.

To minimize distractions and to maximize the potency of the priming manipulations, participants completed the study in individual cubicles in a quiet lab. Further, prior to being debriefed, participants were probed for suspicion of the study hypotheses using a funneled debriefing approach (e.g., Bargh & Chartrand, 2000). One participant correctly guessed that the study tested the relationship between temperature and hostile perceptions. This person was dropped from all subsequent analyses. Two persons indicated suspicion that the two tasks were related but neither mentioned the temperature of the prime nor that the purpose of the study was to measure hostile perceptions. These two participants were included in all subsequent analyses. However, whether these latter two participants were included or not did not alter the results. In all, 181 persons were included in all subsequent analyses.