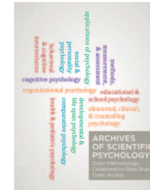
Archives of Scientific Psychology 2017, 5, 10–18
DOI: http://dx.doi.org/10.1037/arc0000031

2169-3269

American Psychological Association

Archives of Scientific Psychology

www.apa.org/pubs/journals/arc



The Effect of Haptic and Ambient Temperature Experience on Prosocial Behavior

Dermot Lynott
Lancaster University

Katherine S. Corker
Grand Valley State University

Louise Connell
Lancaster University

Kerry S. O'Brien
Monash University

ABSTRACT

Temperature is an ever-present feature of the environment, but we are still unsure how changes in temperature experience affect human behavior. On the one hand, some studies have shown that higher temperature experience is linked with more prosocial behaviors (e.g., greater gift giving, altruism), while on the other hand, some studies have shown that higher temperatures are associated with less prosocial behavior (e.g., more violence, aggression). In this study we investigated whether higher temperatures are associated with more or less prosocial responding. At different ambient temperatures, participants took part in a "product evaluation" study of hot or cold therapeutic gel packs. At the end of the study, each participant could choose between taking a reward for themselves (the self-interested option) or giving the reward to someone else (the prosocial option). While the pack temperatures did not influence the choices people made, we found a weak relationship between the ambient temperatures at the time of the study and whether the participant responded prosocially or not; as temperatures increased, participants were more likely to choose the prosocial option. However, further analysis suggests that this finding should be considered inconclusive and we urge caution in interpreting these results.

SCIENTIFIC ABSTRACT

Research in social embodied cognition has found numerous positive associations between higher temperatures and prosocial behavior, with "warmer is better" effects demonstrating greater altruism, social proximity, and affective

This article was published May 25, 2017.

Dermot Lynott, Department of Psychology, Lancaster University; Katherine S. Corker, Department of Psychology, Grand Valley State University; Louise Connell, Department of Psychology, Lancaster University; Kerry S. O'Brien, School of Social Sciences, Monash University.

This research was funded by a grant to the Dermot Lynott and Katherine S. Corker from the Center for Open Science. This study was originally preregistered as part of a special issue of the journal *Social Psychology*, where we subsequently reported effects of prop temperature on prosocial choices (Lynott et al., 2014). However, the work presented here addresses a different independent variable, ambient temperature, and therefore reports original, unpublished work. We thank the reviewers (Hans IJzerman and Daniël Lakens) for their extremely helpful reviews, and also Zoltan Dienes and Neil McLatchie for statistical advice regarding Bayes Factors.

The authors have made available for use by others the data that underlie the analyses presented in this article (see Lynott, Corker, Connell, & O'Brien, 2017), thus allowing replication and potential extensions of this work by qualified researchers. Next, users are obligated to involve the data originators in their publication plans, if the originators so desire. For further discussion on this topic, please visit the *Archives of Scientific Psychology* online public forum at http://arcblog.apa.org.

Correspondence concerning this article should be addressed to Dermot Lynott, Department of Psychology, Fylde College, Lancaster University, Bailrigg, Lancaster LA1 4YF, United Kingdom. E-mail: d.lynott@lancaster.ac.uk

attributions. However, recent failures to replicate experimental findings in this area have called some effects into question. By contrast, epidemiological research has frequently observed that higher ambient temperatures are correlated with increases in societal volatility and antisocial behaviors, with "warmer is worse" effects demonstrated by increases in warfare, city-center rioting, and sporting aggression. Using a sample size ($N = 611$) larger than many previous studies in the social priming domain, we examined whether higher ambient temperature and/or higher prop temperature (i.e., holding a hot/cold therapeutic pack) lead to more prosocial behavior. Results showed that warmer ambient temperatures were weakly associated with more prosocial than selfish choices. However, calculation of Bayes Factors suggests that the evidence is better characterized as inconclusive. As previously published analyses of the same data set used in this study show (Lynott et al., 2014), prop temperature did not lead to increased prosocial responding, which fails to support predictions from particular accounts of social embodiment. We discuss possible reasons for the inconclusive findings and for the broad range of effect sizes observed more generally in the literature.

Keywords: temperature, embodiment, prosocial, ambient, haptic
Supplemental materials: http://dx.doi.org/10.1037/arc0000031.supp
Data repository: http://dx.doi.org/10.3886/ICPSR36761.v1

In recent years, a number of high-profile studies have highlighted relationships between ambient temperature and human behavior, such as warmer conditions linked to changes in interpersonal interactions (e.g., Bargh & Shalev, 2012; IJzerman & Semin, 2009; Williams & Bargh, 2008) or climate change linked to prevalence of conflict (e.g., Burke, Miguel, Satyanath, Dykema, & Lobell, 2009; Hendrix & Glaser, 2007; Hsiang, Meng, & Cane, 2011; Zhang, Brecke, Lee, He, & Zhang, 2007). However, closer examination of these studies reveals some conflicting patterns, in terms of the strength and the direction of these relationships, according to the theoretical perspective taken and the methods of investigation used. Below, we consider the patterns of results from social priming and population-based studies, to generate a set of predictions relating to the effects of ambient temperature experience (i.e., the temperature of the surrounding environment) and haptic temperature experience (i.e., temporary interaction with a hot or cold object) on prosocial decision making.

Findings From Social Embodiment

Experimental research from a social embodiment perspective has frequently observed "warmer is better" effects; that is, a positive statistical relationship between increased temperatures and measures of interpersonal interactions (e.g., IJzerman et al., 2012; IJzerman & Semin, 2009; Williams & Bargh, 2008). Inspired in part by linguistic metaphors linking physical warmth and interpersonal feelings (e.g., *warm personality*, *cold character*; Lakoff & Johnson, 1980), by early work on impression formation (Asch, 1946), and by the posited importance of warmth in the development of maternal-infant attachment (Bowlby, 1969; Harlow, 1958), Williams and Bargh (2008) investigated whether providing a sensory experience of warmth via an experimental prop (a coffee cup in Study 1 and a therapeutic gel pack in Study 2) would enhance interpersonal feelings of warmth as measured by prosocial behaviors. For example, participants who handled a warm therapeutic gel pack, ostensibly completing a product evaluation, exhibited more prosocial behavior (i.e., choosing a gift for a friend instead of themselves), compared with people who handled a cold version of the therapeutic pack. Similar patterns were observed using the same manipulation by Kang et al., (2011) and Storey and Workman (2013). Asking participants to hold a hot coffee cup produced a similar effect, with participants rating a target individual as having warmer personality traits.

Williams and Bargh (2008) concluded that providing a physical experience of warmth seemed to enhance positive interpersonal feelings and promote prosocial behaviors. IJzerman and Semin (2009) found similar effects, demonstrating that increased temperatures induced feelings of greater social proximity. Participants were handed either a warm or cold beverage and subsequently completed a questionnaire evaluating their personality overlap with another unnamed individual they knew. Participants who were in the warm condition rated themselves to have significantly greater overlap than those who were in the cold drink condition. The increase in overlap was interpreted as a greater sense of social proximity between a given participant and a target individual. More broadly, warmer temperature experiences have been associated with a host of different behaviors, with IJzerman and colleagues suggesting in a recent review (IJzerman et al., 2012) that people may self-regulate against physically colder experiences by seeking socially warmer experiences, such as demonstrating an interest in romance movies (Hong & Sun, 2012), showing feelings of nostalgia (Sedikides et al., 2015), or demonstrating a greater need for affiliation (Van Acker et al., 2015).

The warmer is better relationship also appears to operate in the reverse causal direction, with social proximity influencing sensory perceptions of actual ambient temperature. Zhong and Leonardelli (2008) found that people who are socially excluded (i.e., by playing a virtual ball game where no one throws the ball to them) perceive that the room temperature is lower than those who are included in the game. Furthermore, individuals who are socially excluded also show behavioral changes, with a greater desire to consume hot food over cold food, perhaps in an effort to overcome their perception of increased coldness (see IJzerman et al.'s 2015 overview of thermoregulation). Indeed, IJzerman et al. (2012) have found that it is not simply that people "feel" colder after social exclusion but that their body temperature readings are actually lower than those who have not been excluded. Together, these findings suggest a bidirectional, positive relationship between higher temperature experiences and prosocial behaviors.

At this point, it is important to note possible differences between the effects of ambient temperature (i.e., the temperature of the surrounding environment) and those of haptic temperature (i.e., the temperature of a specific object) experiences. As far as we are aware, these two forms of temperature experience have not been directly empirically contrasted, and in much of the published work in this arena, no theoretical distinctions have been drawn. For example, in developing hypotheses for haptic, object-based temperature effects, researchers will often extrapolate from findings that have used ambient temperature manipulations, and vice versa, assuming that one form of temperature experience is comparable with another (e.g., Hong & Sun, 2012; Kolb, Gockel, & Werth, 2012). The interrelatedness of haptic and ambient temperature experiences could then be supported by drawing on a more general framework of embodied cognition (e.g., Barsalou, 1999).

However, transient tactile experience of temperature and prolonged environmental exposure to warmth or cold are very different bodily experiences, and so they should also be distinguished theoretically (e.g., IJzerman et al., 2012). Williams (2008) makes explicit the possible difference between the two types of experience and suggests that from the metaphor or social priming perspective "ambient temperature priming should not impact people's feelings of psychological warmth, because when developing the concept of psychological warmth, ambient temperatures do not matter; physical contact with caring, warming human beings matters." Therefore, because physical contact plays a greater role in learning associations between temperature experience and interpersonal warmth (i.e., such as between caregivers and their offspring), one should expect transient temperature priming (mimicking the transient nature of human contact) to lead to changes in interpersonal responding (i.e., prosocial vs. self-interested behavior), consistent with Williams and Bargh's (2008) studies. By contrast, because ambient temperature does not necessarily co-occur with interpersonal contact and prosocial outcomes, learned associations are not constructed between higher ambient temperature and greater prosocial responding. Thus, from this social priming perspective, we speculate that we should observe an effect of haptic temperature manipulations, but not of ambient temperature manipulations, on people's prosocial responding.

However, despite the findings of Williams and Bargh (2008), and ongoing work suggesting that temperature-behavior links are reasonably robust (e.g., IJzerman and Schönbrodt's, in press), there have recently been concerns about the reliability and robustness of findings from this theoretical tradition. First, reported sample sizes in the social embodiment literature are often small, with approximately 20–25 participants per experimental condition (e.g., IJzerman & Semin, 2009; Leander, Chartrand, & Bargh, 2012; Williams & Bargh, 2008), suggesting that studies have often been underpowered in the past and that estimates of effect sizes are very imprecise (Lakens & Evers, 2014). Whereas more recent studies have seen a notable increase in sample sizes (e.g., see Fay & Maner, 2015; Schilder, IJzerman, & Denisson, 2014), small sample sizes have certainly been an issue in much of the literature. Second, where effects are found, they are generally small, and often hover around significance at an α level of $p < .05$ (e.g., IJzerman & Semin, 2009, Study 2; Williams & Bargh, 2008, Study 1), a pattern suggestive of false-positive results that should, therefore, be interpreted with caution (Simmons, Nelson, & Simonsohn, 2011).

Such problems can be somewhat overcome by exact replications (cf., Schimmack, 2012), but a general lack of replication of findings in the area of unconscious priming has been raised as a concern for the field more generally (e.g., Doyen, Klein, Pichon, & Cleeremans, 2012; Simons, 2014). Indeed, there have been few attempts to replicate the above studies. In one recent replication attempt, conducted by the current authors and others (Lynott et al., 2014), the findings of Williams and Bargh's (2008) Experiment 2 (hot and cold therapeutic packs) were not reproduced (i.e., no relationship between pack temperature and prosocial behaviors was observed), despite using sample sizes of hundreds of participants across multiple testing sites. Of course, it could be that such an effect is less stable than others in the literature, and some unknown contextual factors resulted in a different pattern of results (although see Ebersole et al., 2015 for discussion of replication robustness despite contextual differences). In short, it is unclear to what extent there exists a reliable correspondence between physical and social or psychological "warmth" in the social embodiment sense. Although the study presented here provides a test of this relationship, we must also consider a contrasting pattern of association between temperature and behavior observed in population-based studies.

Findings From Epidemiology

In contrast to findings from social embodiment, epidemiological and population-level research has generally, but not exclusively, demonstrated "warmer is worse" effects; that is, negative consequences of increased temperatures on societal behavior (e.g., Anderson, 2001; Burke et al., 2009; Rotton & Cohn, 2004). There are now many examples of correlations between rising temperatures and increases in societal instability, conflict, and aggression. Over a 20-year period (1981–2002), and a wide geographical area (sub-Saharan Africa), Burke et al. (2009) observed that temperature increases corresponded to increases in civil wars and regional conflicts. Furthermore, in various models, they found that temperature was the only reliable predictor of civil conflict, with little contribution from other factors tested, such as rainfall, income, or form of political regime.[1] City-center riots also appear to be more common during warmer summer months and less frequent during cooler winter months (Anderson & Anderson, 1984, 1996), and nighttime calls for police services also increase with higher ambient temperatures (Rotton & Cohn, 2000). Similarly, U.S. cities with higher mean temperatures show higher rates of violent crime compared with cities with cooler mean temperatures (Anderson, 1987); by contrast, such differences do not appear for nonviolent crime. This pattern is mirrored by Ranson's (2014) work, showing an association between higher temperatures and a range of criminal activities.

There is some evidence that global temperature fluctuations correlate with the intensity of war over long periods of time, although the patterns have been conflicting. Hsiang et al. (2011) found that warmer temperatures were associated with increases in conflict between 1950 and 2004, whereas Zhang et al. (2007) found associations between cooler periods and increased conflict during the much longer period from 1400–1900. In general, the trend has been to find associations between higher temperatures and greater violence and instability. In a meta-analysis, Hsiang, Burke, and Miguel (2013) observed that for every 1 *SD* increase in temperature, there is a corresponding 4% increase in violence and a 14% increase in interpersonal conflict, although we should be careful not to overstate the causal link here. Nonetheless, given that temperatures in some parts of the world are expected to increase by 2–4 *SD*s by the year 2050, the implications of such findings for society could be significant indeed.

Whereas the population-based analyses focus on conflict and acts of violence on a large-scale, the effects of ambient temperatures are also manifest in the mundane events of everyday life. For example, people are more likely to honk their car horns in frustration when driving during warm weather than during cold weather (Kenrick & McFarlane, 1986). In baseball, Larrick, Timmerman, Carton, and Abrevaya (2011) found that ambient temperature predicted the likelihood of a pitcher deliberately hitting a batter during the game, with higher temperatures associated with more aggressive pitches. Overall, there appears to be a general trend at the group or societal level for increased ambient temperatures to correspond to greater negative social behaviors, as captured by various measures of conflict, violence, and aggression.

Theoretically, the warmer is worse effects are explained by a combination of the *temperature-aggression hypothesis* or "heat hypothesis" (e.g., Anderson, Anderson, Dorr, DeNeve, & Flanagan,

[1] Note, however, that others have questioned the approach of Burke et al., and whether appropriate measures of conflict were used. Buhaug (2010) found that using a broader definition of conflict, temperature was not a reliable predictor of conflict outcomes, but that other geo-political factors were better predictors.

2000) and by increased pressure on resources and greater societal volatility at the population level (Hsiang & Burke, 2014). We briefly consider these views and what plausible predictions can be derived for the current study from these accounts.

The heat hypothesis states that as temperatures increase, people exhibit an increase in aggressive motives, attitudes, and behavior. As people become more uncomfortable, they can misattribute their discomfort to those around them leading to greater hostility and aggression. The specific mechanism by which this occurs is unclear, although it has been suggested that hormonal variations because of temperature change may mediate aggressive responding (Anderson, 1987). Notwithstanding the lack of specific mechanism, the heat hypothesis is clear that higher ambient temperatures should lead to greater aggression and more antisocial responding. Thus, we might predict that where study participants are presented with a prosocial or self-interested choice, people will be less likely to take the prosocial options as temperatures increase. By contrast, when it comes to transient experience of warmth or cold (such as handling an object), it is not clear that any strong prediction should be derived from this account.

Hsiang and Burke (2014) note the difficulty in unpacking the causal mechanisms linking climatic factors to violence, and in fact offer numerous possible mechanisms that still require differentiation (e.g., misattribution, effects on food prices, and government stability). As above, we do not require a specific mechanism to determine a reasonable prediction, because the bulk of population-level data points to an association between higher temperatures and greater societal and interpersonal conflict. In summary, the prediction from this account would be that higher ambient temperatures should be associated with a reduction in prosocial responding, with no clear predictions based on higher transient temperature experience, such as holding the experimental prop.

The Current Study

Given the contrasting evidence and different theoretical stances, the apparent conflict between epidemiological and experimental research regarding the relationship between temperature and social behavior, this relationship needs to be investigated and clarified. Epidemiological research offers the power of large (i.e., population-level) sample sizes in showing that higher ambient temperatures are associated with a reduction in prosocial behavior and an increase in aggression and conflict (Anderson, 2001). While longitudinal studies go some way to allowing causal inferences, many geographical studies in this domain are correlational, and do not naturally allow us to conclude causation. The experimental approach in social embodiment research has the advantage of allowing stronger causal inferences, but its traditionally small sample sizes mean that estimates of effect sizes are imprecise, which may limit the conclusions that can be drawn.

In the current study, we aimed to overcome some of the difficulties of previous experimental work in social embodiment. First, we tested a considerably larger sample size than the norm. Second, we examined the ability of ambient temperature to predict prosocial behavior, partly because the stronger effects observed in epidemiological studies may be due in part to the focus on ambient temperature of the surrounding environment (that affects the whole body) rather than temperature of hot or cold props (that affects only the hands or other individual body part). Third, we directly contrast ambient temperature and object temperature experience in predicting prosocial choices. As outlined in the previous sections, there are contrasting predictions both within social embodiment accounts (e.g., that only transient temperature experience should matter) and between broader embodied and epidemiological accounts (e.g., with higher temperatures associated with more or less prosocial responding, respectively).

Method

Participants

In total, 611 participants took part in this study. Based on the effect size from Williams and Bargh, Study 2, and requiring statistical power of .95 with an α level of .05, a target sample size of 300 was required. Thus, independent samples from Manchester ($N = 305$) and Kenyon Ohio ($N = 306$) each had independent power of approximately .95. University of Manchester (U.K.) participants were recruited between during September and October 2013, at indoor and outdoor events around the university (open days, welcome week, and community events) with a small proportion tested at an army reserve training day ($N = 13$). Kenyon College (U.S.) participants were recruited at an outdoor community event in June and July 2013 ($N = 289$). A small number of additional participants were psychology research pool participants ($N = 17$) who were tested indoors in September 2013. The mean age of participants was 34.41 ($SD = 17.126$), 49% of participants were female and 87% of participants were native speakers of English. The rewards for taking part in the study were a voucher for either a fruit juice or a fruit smoothie (Manchester) and either a voucher for a cupcake or a bottled Snapple drink (Kenyon).

Participants in this study were originally recruited for a registered replication study of Williams and Bargh (2008, Study 2; see Lynott et al., 2014), and so represent a subsample of participants from Lynott et al., 2014. However, only prop temperature, and not ambient temperature, was included as a factor in that study. In the current study we directly compared the effects of ambient temperature and prop temperature, which to our knowledge, has not been done before.

Materials and Procedure

Researchers set up tables and testing areas at each event, and passers-by were approached to take part in a product-evaluation study. Participants were brought to the testing area, where they were separated from the researcher and other participants by partitions. Once the consent form was signed, participants were given a questionnaire booklet. The cover page served to hide the second page that instructed the participant which of two boxes in front of them they should open; one box contained a hot pack, and one contained a cold pack. Brand names (HeatMax and Dynarex) were obscured on the hot and cold instant therapeutic packs with black marker: the measurements of each pack type were identical at 10×12.5 cm. The cover page ensured that researchers were blind to the temperature pack condition to which participants were assigned. On the questionnaire, participants evaluated the effectiveness of either the hot or cold pack on a scale ranging from (1) *not at all* to (7) *extremely* and indicated to what extent they would recommend the product to their family, friends, or strangers on the same 7-point scale. Finally participants estimated the internal temperature of the gel pack in degrees Celsius (Manchester) or Fahrenheit (Kenyon). The first four questions were included in the original study by Williams and Bargh (2008) to support the initial cover story, and the final question was intended as a manipulation check.

Once participants completed these questions, the questionnaire directed them to place the therapeutic gel pack product back in its original box. This also served to ensure that researchers remained unaware of each participant's condition. The next page of the questionnaire included the main dependent variable, which consisted of the reward choice.[2] Each participant then completed a short funneled debriefing questionnaire, which allowed us to evaluate whether the participant was suspicious of the study or guessed the underlying hypothesis. Once the participants had completed the funneled debriefing, they were led away from the testing area and were given their chosen reward together with an info sheet explaining the true nature of the study.

For the Manchester sample, measurement of the ambient temperature was planned a priori, and temperature was measured using a standard digital thermometer (accurate to ±0.1°C). Temperatures ranged from 10.0 to 24.0°C. For the Kenyon sample, recording of ambient temperature was not originally planned, but we used data from local weather stations to calculate the daily temperature for each testing session, with temperatures ranging from 17.0 to 25.0°C. Overall the mean ambient temperature was 20.46°C ($SD = 4.835$).[3] Approximately equal numbers of hot and cold packs were handled during each testing session and hence for each measurement of ambient temperature. It is worth noting that many epidemiological and lab-based studies have incorporated a broader temperature range than we observed at these testing locations, an issue we consider in the general discussion.

Design and Analysis

The dependent variable was whether participants made a prosocial choice (voucher for a friend) as opposed to a selfish choice (voucher for self) on the critical reward question. Data were analyzed using hierarchical stepwise binary logistic regression, where we evaluated model fit by examining both the null hypothesis significance test (NHST) parameter estimate for the added predictor variable (Wald χ^2), and Bayesian model comparison using Bayesian Information Criterion (BIC) to calculate Bayes Factors for the alternative model (BF; Wagenmakers, 2007). The Bayesian model comparison approach allows us to compare the fit of the data under the null hypothesis, compared with the alternative hypothesis, providing better quantification of the strength of evidence for and against each model being considered (Jarosz & Wiley, 2014; Dienes & McLatchie, 2016). At each hierarchical step, a predictor variable was retained in the model if either NHST or Bayesian criteria suggested its inclusion was worthwhile. All continuous variables were centered before analysis.

We first ran an omnibus analysis of all the data to examine the effect of ambient temperature, where Step 1 entered ambient temperature (continuous measurement), Step 2 entered study location (coded as Manchester = −0.5, Kenyon = 0.5), and Step 3 entered the interaction of ambient temperature and study location. We then analyzed the data separately for each testing location (Manchester and Kenyon) because of slight design differences between the two locations (e.g., gift choices were not identically presented), possible a priori differences in prosociality between the samples, and also because of the possible confound between testing location and temperature (i.e., those tested indoors were almost always at higher temperatures). Because of these differences, we urge caution in the interpretation of the combined analysis, which may be susceptible to Simpson's Paradox (i.e., where a trend for separate samples appears or disappears when samples are combined; see, e.g., Kievit et al., 2013) The models for each study location comprised only a single hierarchical Step 1 of adding ambient temperature.

We then examined haptic temperature effects, namely whether pack temperature (i.e., the transient, haptic experience of a hot or cold therapeutic pack) had any effect on prosocial behavior when ambient temperature had already been taken into account, by continuing hierarchical logistic regressions from the models already established. We did this using two alternative measures of pack temperature: *binary pack temperature* (coded as cold = −0.5, hot = 0.5) according to how the therapeutic packs were objectively classified, and *estimates of pack temperature* (continuous estimates in °C) based on participants' subjective impressions of perceived warmth. These alternative variables were examined in separate hierarchical sequences. In the omnibus analysis, Step 4a included binary pack temperature as a predictor, Step 5a included the interaction of ambient temperature and binary pack temperature, Step 6a included the interaction of study location and binary pack temperature, and Step 7a included the three-way interaction of ambient temperature, study location, and binary pack temperature. Alternative Models 4b–7b examined continuous subjective estimates of pack temperature in place of binary pack temperature. In the separate analysis per study location, Step 2a included binary pack temperature as a predictor, and Step 3a included the interaction of ambient temperature and binary pack temperature. Alternative Models 2b–3b examined continuous subjective estimates of pack temperature in place of binary pack temperature.

Results

Participants were excluded if they met any of several a priori agreed-upon rules for exclusion (see Lynott et al., 2014): (a) being ±3 *SD* away from the mean within each condition for pack temperature estimation, (b) failing to choose a reward for participation (the key dependent measure), or (c) making a connection in the debriefing form between physical and interpersonal warmth. Forty-four participants were excluded on this basis, leaving $N = 566$ for analysis. Regardless, results are similar with these participants included. Both cold ($M = 4.35$, $SD = 1.55$) and hot ($M = 4.16$, $SD = 1.52$) packs were rated by participants as equally effective, Welch's $t(562.58) = 1.52$, $p = .134$.

Analysis of Ambient Temperature Effects

In the omnibus analysis, for Step 1, ambient temperature was significantly related to making a prosocial choice, unstandardized $\beta = 0.060$, $SE = 0.018$, Exp (β) = 1.062, 95% confidence interval (CI) [1.025, 1.100], Wald's χ^2 (1) = 11.034, $p = .001$. For example, a 10°C increase in temperature is associated with a 1.82 times higher likelihood of acting prosocially. An estimated BF of 12.061 suggested the data were 12.061 times more likely under a model that includes ambient temperature, compared with a model without. A BF of this size can be described as providing positive support for the alternative model (Goodman, 1999; Jeffreys, 1961; Kass & Raftery, 1995). Figure 1 shows a scatterplot of the relationship.

For Step 2, study location was also found to have a significant effect, $\beta = 0.676$, $SE = 0.189$, Exp (β) = 1.965, 95% CI [1.357, 2.846], Wald's χ^2 (1) = 12.787, $p < .001$, with more prosocial responses in the Kenyon sample (56.6%), than the Manchester sample (43.4%), but the addition of study location now meant that ambient

[2] In the Manchester sample, we originally intended to counterbalance that reward items were framed as the self-interested and prosocial options, but because of a printing error, fruit juice was always the self-interested option in the warm condition, whereas fruit smoothie was always the self-interested option in the cold condition. This modification should not impact our results as (a) the items (fruit juice, smoothie) were chosen for their similarity, (b) the specifics of the reward item are not theoretically relevant, only whether participants make the prosocial or the self-interested choice, and (c) no effect of temperature condition on type of reward was observed in Lynott et al., (2014). Rewards were fully counterbalanced in the Kenyon sample.

[3] Unfortunately, we could not calculate ambient temperature information for a third sample of participants from Michigan State University as testing time and date were not recorded.

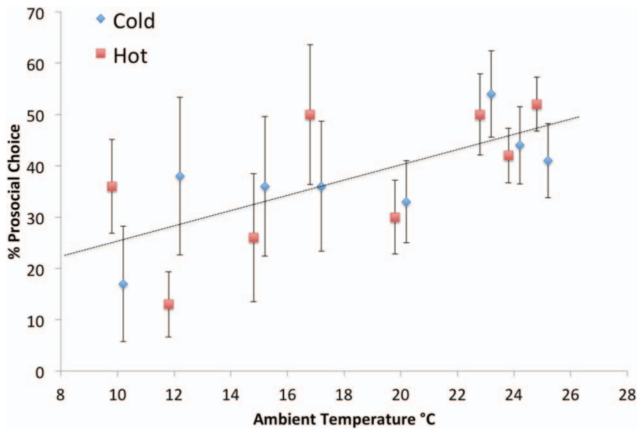


Figure 1. Line of best fit showing positive relationship between ambient temperature and tendency to make a prosocial choice, unmoderated by temperature of the therapeutic pack, indicated by diamonds (Cold) and squares (Hot). Error bars indicate 1 *SEM*.

temperature was no longer a statistically significant predictor, β = 0.031, *SE* = 0.0199, Exp (β) = 1.031, 95% CI [0.992, 1.072], Wald's χ^2 (1) = 2.412, *p* = .120. Overall however, the addition of study location did lead to a better model fit, with BF = 27.14 compared with a model containing only ambient temperature. For Step 3, there was no reliable interaction between study location and ambient temperature, β = −0.080, *SE* = 0.0409, Exp (β) = 0.924, 95% CI [0.852, 1.001], Wald's χ^2 (1) = 3.776, *p* = .052, with a BF = 0.283, providing positive support for a model *without* the interaction term, and indicating that there was no substantive difference in the effect of ambient temperature between the two test locations.

Analyzing the data separately for each study location, we observed an effect of ambient temperature for the Manchester sample alone: β = 0.064, *SE* = 0.0264, Exp (β) = 1.066, 95% CI [1.012, 1.122], Wald's χ^2 (1) = 5.815, *p* = .016. The BF for the Manchester model was 1.184 compared with an intercept-only model, equivalent to inconclusive evidence for ambient temperature. For the Kenyon sample alone, we did not observe an effect of temperature: β = −0.016, *SE* = 0.0313, Exp (β) = 0.984, 95% CI [0.926, 1.046], Wald's χ^2 (1) = 0.257, *p* = .612. The BF for the Kenyon model was 0.068, suggesting a model *without* ambient temperature is 14.8 times more likely (i.e., positive support for the null model).

Analysis of Haptic Temperature Effects

In the omnibus analysis (Step 4a), we found that binary pack temperature had a significant effect on prosocial responding, β = −0.382, *SE* = 0.1736, Exp (β) = 0.683, 95% CI [0.486, 0.959], Wald's χ^2 (1) = 4.833, *p* = .028, where people who received the warm packs were *less* likely to make the prosocial choice. However, a BF of 0.477 puts support for this model in the inconclusive range.

In each of the subsequent steps, the addition of the interaction of ambient temperature and binary pack temperature (Step 5a: β = −0.004, *SE* = 0.365, Exp (β) = 0.996, 95% CI [0.927, 1.070], Wald χ^2 (1) = 0.010, *p* = .919, BF = 0.042), the interaction of study location and binary pack temperature (Step 6a: β = −0.230, *SE* = 0.3476, Exp (β) = 0.795, 95% CI [0.402, 1.571], Wald χ^2 (1) = 0.436, *p* = .509, BF = 0.052), the three-way interaction of ambient temperature, study location, and binary pack temperature (Step 7a: β = −0.002, *SE* = 0.799, Exp (β) = 0.998, 95% CI [0.854, 1.168], Wald χ^2 (1) = 0.000, *p* = .984, BF = 0.042) did not improve model fit, with all BF providing positive support for a model without these predictors.

As reported previously (Lynott et al., 2014), analyzing the effect of pack temperature for study locations separately showed that, for the Kenyon sample, there was a significant effect of pack temperature, with people handling the warm pack less likely to respond prosocially—unstandardized, β = −0.492, *SE* = 0.2404, Exp (β) = 0.611, 95% CI [0.382, 0.979], Wald's χ^2 (*df* = 1) = 4.187, *p* = .041. The BF for this model was 0.489, indicating that given the data, a model containing pack temperature as a predictor is 2.04 times *less* likely than the model without pack temperature. For the Manchester sample, there was no significant effect of pack temperature: unstandardized β = −0.264, *SE* = 0.2528, Exp (β) = 0.768, 95% CI [0.468, 1.26], Wald's χ^2 (*df* = 1) = 1.094, *p* = .299. The BF for this model was 0.103, indicating that given the data, a model containing pack temperature as a predictor is 9.7 times *less* likely than the model without pack temperature.

The same effects emerged when we examined subjective estimates of pack temperature: the mean estimated temperature was 17.06°C overall (*SD* = 18.599), at 2.34°C (*SD* = 6.6) for the cold packs and 31.56°C (*SD* = 14.84) for the hot packs. Estimated pack temperature (Step 4b) was unrelated to prosocial choice (β = −0.002, *SE* = .0047, Exp (β) = .998, 95% CI [.988, 1.007], Wald χ^2 (*df* = 1) = 0.243, *p* = .622). For Steps 5b–7b, there was no improvement in model fit with the addition of the interaction of ambient temperature and estimated pack temperature (Step 5b, β = 0.001, *SE* = .001, Exp (β) = 1.001, 95% CI [.999, 1.002], Wald χ^2 (*df* = 1) = 0.288, *p* = .592, BF = 0.049), the interaction of study location and estimated pack temperature (Step 6b, β = 0.001, *SE* = .0094, Exp (β) = 1.001, 95% CI [.982, 1.019], Wald χ^2 (*df* = 1) = 0.005, *p* = .941, BF = 0.042), or the three-way interaction of ambient temperature, study location, and estimated pack temperature (Step 7b, β = −0.001, *SE* = .002, Exp (β) = 0.999, 95% CI [.995, 1.003], Wald χ^2 (*df* = 1) = 0.134, *p* = .714, BF = 0.046), again with all BFs providing positive support for models without these predictors.

Analyzing the effects of estimated pack temperature separately for each study location revealed no effects of estimated pack temperature on prosocial responding (Kenyon: β = −0.001, *SE* = .0067, Exp (β) = 0.999, 95% CI [.986, 1.012], Wald χ^2 (*df* = 1) = 0.050, *p* = .824, BF = 0.062; Manchester: β = −0.003, *SE* = .0067, Exp (β) = 0.997, 95% CI [.984, 1.010], Wald's χ^2 (*df* = 1) = 0.193, *p* = .661, BF = 0.066), nor any interaction between estimated pack temperature and ambient temperature responding (Kenyon: β = 0.000, *SE* = .00015, Exp (β) = 1.000, 95% CI [.997, 1.003], Wald χ^2 (*df* = 1) = 0.005, *p* = .945, BF = 0.06; Manchester: β = −0.001, *SE* = .0014, Exp (β) = 1.001, 95% CI [.998, 1.004], Wald's χ^2 (*df* = 1) = 0.370, *p* = .543, BF = 0.072). For all models, BFs indicate strong positive support for models without estimated pack temperature or its interactions as predictors.[4]

Summary

For the ambient temperature analysis overall, from a null hypothesis significance testing (NHST) perspective, there appears to be a weak positive relationship between higher temperatures and *greater*

[4] At a reviewer's suggestion we separately examined whether there were any effects of participant gender or age in isolation on prosocial responding. There was no effect of participant gender on prosocial choice (β = .241, *SE* = .1719, Exp (β) = 1.272, 95% CI [.908, 1.782], Wald χ^2 (*df* = 1) = 1.964, *p* = .161), but there was an effect of age, with older participants less likely to choose the prosocial option (β = −.014, *SE* = .005, Exp (β) = .986, 95% CI [.976, 996], Wald χ^2 (*df* = 1) = 7.688, *p* = .006).

prosocial responding, with one sample showing a significant effect and a second showing no effect (although there is no meaningful difference between the samples). By considering the BFs, however, the evidence is only in the inconclusive range, and slightly in favor of the null models, suggesting that ambient temperature does not reliably influence prosocial responding. For haptic temperature experience, there was a weak relationship between warmer packs and *reduced* prosocial responding, but again, BFs suggest evidence is more strongly in favor of models that do not contain binary pack temperature. There was no evidence to support models that included estimated pack temperature as a predictor.

General Discussion

We found that ambient temperature was weakly associated with social decision-making, such that warmer ambient temperatures were associated with more prosocial than selfish choices. However, although this pattern was observed in an omnibus analysis, it was only reflected in one of the two independent study locations, where Bayesian analysis suggested that the role of ambient temperature was, at best, inconclusive. Therefore, we conclude that ambient temperature has a very small and nonrobust effect on prosocial behavior, and that caution is required in drawing any firm conclusions either for or against a definite effect. Moreover, as previously reported (Lynott et al., 2014), there was no indication that perceiving hot or cold temperatures with the hands predicted a reliable increase in prosocial behavior. From a null hypothesis significance testing point of view, the present findings are consistent with the broader social embodiment perspective that experiencing physical warmth may prime prosocial behavior in interpersonal interactions, but only via ambient temperature, and not via brief haptic experience. However, Bayesian analysis suggests much more caution is required in interpreting these findings and that the evidence should be considered inconclusive. Finally, we can say that the results do not clearly follow predictions derived from epidemiological accounts, which would suggest that higher temperatures would be associated with reduced prosocial responding.

Thus, although there is no evidence to support the role for brief exposure to higher haptic temperature in enhancing prosocial responding (BFs consistently supported null models in this direction), there is mixed evidence associating higher ambient temperature experience and prosocial responding. We first consider why ambient temperature might predict prosocial choices when prop temperature does not. We then consider alternative interpretations of the observed data, remaining cognizant of the fact that the current data suggest the association between ambient temperature and prosocial responding should be treated with caution.

Ambient temperature has the capacity to alter whole-body temperature, whereas props, such as a therapeutic pack or coffee cup, exert only localized temperature changes to the hands. Although handling a warm or cold object may prime participants to respond in a particular way (e.g., because of implicit associations between physical warmth and prosocial behavior), changes in ambient temperature may induce broader physiological responses that could drive prosocial responses. As suggested previously, temperature associations could be associated with hormonal fluctuations that may, in turn, lead to changes in behavioral outcomes (see, e.g., Anderson, 1987, for suggestions along these lines).

However, even if ambient temperature were a robust predictor of prosocial responses, there may be other explanations for the current data that we cannot discount. For example, it is always possible that individuals with more chronic prosocial tendencies were present at the warmer locations than at the colder locations where data were collected. We did not measure trait prosociality, so we cannot rule out this as a possible explanation. A social embodiment account may suggest a more parsimonious explanation of the findings, but, first, this account is not conclusively supported, and second, it remains possible that trait prosociality (or some other third variable) explains the observed patterns.

We can say that we observed a different pattern here than studies following an epidemiological or population-based approach. Whereas population-level research has repeatedly found higher temperatures to be associated with antisocial behaviors, such as rioting (Anderson & Anderson, 1984, 1996), warfare (Burke et al., 2009; Hsiang et al., 2011), violent crime (Anderson, 1987), and sporting aggression (Larrick et al., 2011), the current effects tended in the opposite direction, albeit weakly, with higher temperatures associated with increased prosocial responding. Why should social embodiment effects differ so markedly from effects in a cognate field? One possible explanation lies in the range of temperatures used in our and other social embodiment work. Our temperature range was 10–25°C, and, for example, IJzerman and Semin's (2009) Experiments 2 and 3 (where warmer is better effects were observed) used a range from 14–24°C. In contrast, temperatures in Larrick et al.'s study of baseball aggression ranged from about 10–35°C, and Anderson, Deuser, and DeNeve (1995) classified temperature ranges of 22–25, 26–30, and 31–34°C as "Comfortable," "Warm," and "Hot," respectively. It could be that had we observed higher ambient temperatures, we would have seen a reduction in prosocial responding at these higher temperatures. However, this remains an empirical question, and where possible, it will be important for future work to incorporate a wide range of temperatures.

Of course, a possible explanation for the wide range of observed effect sizes and even differences in the direction of effects throughout the temperature-behavior literature is that much of the published literature consists of small sample studies. In the presence of publication bias and questionable research practices that have been a major issue in psychology (at least historically), it behooves us to consider the possibility that inconsistencies from study to study are simply because of sampling error, and in reality, there may be a very small or near-zero true effect underlying all the noise. Taking into account the Bayesian analysis conducted for the present study (i.e., suggesting that the data are inconclusive), it will only be with new, high-powered, preregistered tests that a clearer picture and better understanding of this fraught area can emerge. From a Bayesian perspective, one can overcome "inconclusive" levels of evidence by continuing to recruit more participants to a study until strong evidence emerges (e.g., reaching a BF greater than 10 or less than 0.1). For an example, Field et al. (2016) proposed recruiting 200 participants, and sampling successive groups of 100 participants until strong evidence emerged, either for the null or alternative models. Such sampling was not possible with the present studies, but could be a viable approach for future work.

In the present article, we have shown that ambient temperature—but not handling a hot or cold prop—is weakly associated with an increase in prosocial responding, a pattern that follows the predictions of some views of social embodiment but is in the opposite direction to trends observed in epidemiological research. We have shown that Bayesian model comparison can also be usefully used to better differentiate between models derived from competing theoretical perspectives, and these comparisons lead us to the conservative interpretation that the overall picture from the ambient temperature data is inconclusive.

Of course no single study can or should be taken as the final word on a given research question. Rather, a single study should only be considered a data point within a broader meta-analytic framework, where many studies—preferably free of publication bias in comprising both positive and null effects—combined can provide a more accurate picture of the relationships between variables of interest. Furthermore, it is also likely that knowing more about the social context in which behaviors occur, and the specific tasks in which people are engaged, will provide a more coherent picture of the relationship between temperature and behavior, particularly in population-level studies. Thus, it is important that additional studies are conducted in this domain, allowing us to establish the robustness of temperature-behavior effects, to deepen our understanding of environment-behavior interactions more generally, and to consider the real-world consequences of such effects. It is reasonable to say that some empirical effects in embodied cognition and psychology more generally may have limited real-world ramifications. However, if ambient temperature does exert an independent influence on behavior, then given the projected increases in global temperatures, we surely owe it to ourselves to more fully investigate this possibility.

References

Anderson, C. A. (1987). Temperature and aggression: Effects on quarterly, yearly, and city rates of violent and nonviolent crime. *Journal of Personality and Social Psychology, 52,* 1161–1173. http://dx.doi.org/10.1037/0022-3514.52.6.1161

Anderson, C. A. (2001). Heat and violence. *Current Directions in Psychological Science, 10,* 33–38. http://dx.doi.org/10.1111/1467-8721.00109

Anderson, C. A., & Anderson, D. C. (1984). Ambient temperature and violent crime: Tests of the linear and curvilinear hypotheses. *Journal of Personality and Social Psychology, 46,* 91–97. http://dx.doi.org/10.1037/0022-3514.46.1.91

Anderson, C. A., & Anderson, D. C. (1996). Violent crime rate studies in philosophical context: A destructive testing approach to heat and southern culture of violence effects. *Journal of Personality and Social Psychology, 70,* 740–756. http://dx.doi.org/10.1037/0022-3514.70.4.740

Anderson, C. A., Anderson, K. B., Dorr, N., DeNeve, K. M., & Flanagan, M. (2000). Temperature and aggression. *Advances in experimental social psychology, 32,* 63–133.

Anderson, C. A., Deuser, W. E., & De Neve, K. (1995). Hot temperatures, hostile affect, hostile cognition, and arousal: Tests of a general model of affective aggression. *Personality and Social Psychology Bulletin, 21,* 434–448. http://dx.doi.org/10.1177/0146167295215002

Asch, S. E. (1946). Forming impressions of personality. *The Journal of Abnormal Psychology, 41,* 258–290. http://dx.doi.org/10.1037/h0055756

Bargh, J. A., & Shalev, I. (2012). The substitutability of physical and social warmth in daily life. *Emotion, 12,* 154–162. http://dx.doi.org/10.1037/a0023527

Barsalou, L. W. (1999). Perceptions of perceptual symbols. *Behavioral and brain sciences, 22,* 637–660.

Bowlby, J. (1969). *Attachment and loss*. London, UK: Hogarth Press.

Buhaug, H. (2010). Climate not to blame for African civil wars. *Proceedings of the National Academy of Sciences, 107,* 16477–16482.

Burke, M. B., Miguel, E., Satyanath, S., Dykema, J. A., & Lobell, D. B. (2009). Warming increases the risk of civil war in Africa. *Proceedings of the National Academy of Sciences of the United States of America, 106,* 20670–20674. http://dx.doi.org/10.1073/pnas.0907998106

Dienes, Z., & McLatchie, N. (2016). *Four reasons to prefer Bayesian over orthodox statistical analyses*. Manuscript under review.

Doyen, S., Klein, O., Pichon, C. L., & Cleeremans, A. (2012). Behavioral priming: It's all in the mind, but whose mind? *PLoS ONE, 7,* e29081. http://dx.doi.org/10.1371/journal.pone.0029081

Ebersole, C. R. Atherton, O. E. Belanger A. L. Skulborstad, H. M. Adams, R. B., Allen, J., & Nosek B. A. (2015). *Many Labs 3: Evaluating participant pool quality across the academic semester via replication*. Retrieved from osf.io/ct89g

Fay, A. J., & Maner, J. K. (2015). Embodied effects are moderated by situational cues: Warmth, threat, and the desire for affiliation. *British Journal of Social Psychology, 54,* 291–305.

Field, S. M., Wagenmakers, E. J., Newell, B. R., Zeelenberg, R., & van Ravenzwaaij, D. (2016). Two Bayesian Tests of the GLOMOsys Model. *Journal of Experimental Psychology: General, 145,* e81–e95. http://dx.doi.org/10.1037/xge0000067

Goodman, S. N. (1999). Toward evidence-based medical statistics. 2: The Bayes factor. *Annals of Internal Medicine, 130,* 1005–1013. http://dx.doi.org/10.7326/0003-4819-130-12-199906150-00019

Harlow, H. F. (1958). The nature of love. *American Psychologist, 13,* 673–685. http://dx.doi.org/10.1037/h0047884

Hendrix, C., & Glaser, S. M. (2007). Trends and triggers: Climate, climate change and civil conflict in Sub-Saharan Africa. *Political Geography, 26,* 695–715. http://dx.doi.org/10.1016/j.polgeo.2007.06.006

Hong, J., & Sun, Y. (2012). Warm it up with love: The effect of physical coldness on liking of romance movies. *Journal of Consumer Research, 39,* 293–306.

Hsiang, S. M., & Burke, M. (2014). Climate, conflict, and social stability: what does the evidence say? *Climatic Change, 123,* 39–55.

Hsiang, S. M., Burke, M., & Miguel, E. (2013). Quantifying the influence of climate on human conflict. *Science, 341*(6151), 1235367.

Hsiang, S. M., Meng, K. C., & Cane, M. A. (2011). Civil conflicts are associated with the global climate. *Nature, 476,* 438–441. http://dx.doi.org/10.1038/nature10311

IJzerman, H., Coan, J. A., Wagemans, F. M., Missler, M. A., van Beest, I., Lindenberg, S., & Tops, M. (2015). A theory of social thermoregulation in human primates. *Frontiers in psychology, 6,* 464.

IJzerman, H., Gallucci, M., Pouw, W. T. J. L., Weißgerber, S. C., Van Doesum, N. J., & Williams, K. D. (2012). Cold-blooded loneliness: Social exclusion leads to lower skin temperatures. *Acta Psychologica, 140,* 283–288. http://dx.doi.org/10.1016/j.actpsy.2012.05.002

IJzerman, H., & Schönbrodt, F. (in press). *Social thermoregulation: A meta-analysis*. Unpublished dataset.

IJzerman, H., & Semin, G. R. (2009). The thermometer of social relations: Mapping social proximity on temperature. *Psychological Science, 20,* 1214–1220. http://dx.doi.org/10.1111/j.1467-9280.2009.02434.x

Jarosz, A. F., & Wiley, J. (2014). What are the odds? A practical guide to computing and reporting Bayes Factors. *The Journal of Problem Solving, 7,* 2. http://dx.doi.org/10.7771/1932-6246.1167

Jeffreys, H. (1961). *The theory of probability*. Oxford, England: Oxford University Press.

Kang, Y., Williams, L. E., Clark, M. S., Gray, J. R., & Bargh, J. A. (2011). Physical temperature effects on trust behavior: The role of insula. *Social Cognitive and Affective Neuroscience, 6,* 507–515. http://dx.doi.org/10.1093/scan/nsq077

Kass, R. E., & Raftery, A. E. (1995). Bayes factors. *Journal of the American Statistical Association, 90,* 773–795. http://dx.doi.org/10.1080/01621459.1995.10476572

Kenrick, D. T., & MacFarlane, S. W. (1986). Ambient temperature and horn-honking: A field study of the heat/aggression relationship. *Environment and Behavior, 18,* 179–191. http://dx.doi.org/10.1177/0013916586182002

Kievit, R. A., Frankenhuis, W. E., Waldorp, L. J., & Borsboom, D. (2013). Simpson's paradox in psychological science: A practical guide. *Frontiers in Psychology, 4,* 513. http://dx.doi.org/10.3389/fpsyg.2013.00513

Kolb, P., Gockel, C., & Werth, L. (2012). The effects of temperature on service employees' customer orientation: An experimental approach. *Ergonomics, 55,* 621–635.

Lakens, D., & Evers, E. R. (2014). Sailing from the seas of chaos into the corridor of stability: Practical recommendations to increase the informational value of studies. *Perspectives on Psychological Science, 9,* 278–292. http://dx.doi.org/10.1177/1745691614528520

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, IL: University of Chicago press.

Larrick, R. P., Timmerman, T. A., Carton, A. M., & Abrevaya, J. (2011). Temper, temperature, and temptation: Heat-related retaliation in baseball. *Psychological Science, 22,* 423–428. http://dx.doi.org/10.1177/0956797611399292

Leander, N. P., Chartrand, T. L., & Bargh, J. A. (2012). You give me the chills: Embodied reactions to inappropriate amounts of behavioral mimicry. *Psy-*

chological Science, 23, 772–779. http://dx.doi.org/10.1177/0956797611434535

Lynott, D., Corker, K. S., Connell, L., & O'Brien, K. (2017). *Effects of ambient and haptic temperature experience on prosocial choices (US/UK 2014)*. (ICPSR36761-v1) [Data set]. Ann Arbor, MI: Inter-university Consortium for Political and Social Research.

Lynott, D., Corker, K. S., Wortman, J., Connell, L., Donnellan, M. B., Lucas, R. E., & O'Brien, K. (2014). Replication of "Experiencing physical warmth promotes interpersonal warmth" by Williams & Bargh (2008, Science). *Social Psychology, 45,* 216–222. http://dx.doi.org/10.1027/1864-9335/a000187

Ranson, M. (2014). Crime, weather, and climate change. *Journal of Environmental Economics and Management, 67,* 274–302. http://dx.doi.org/10.1016/j.jeem.2013.11.008

Rotton, J., & Cohn, E. G. (2000). Violence is a curvilinear function of temperature in Dallas: A replication. *Journal of Personality and Social Psychology, 78,* 1074–1081. http://dx.doi.org/10.1037/0022-3514.78.6.1074

Rotton, J., & Cohn, E. G. (2004). Outdoor temperature, climate control, and criminal assault: The spatial and temporal ecology of violence. *Environment and Behavior, 36,* 276–306. http://dx.doi.org/10.1177/0013916503259515

Schilder, J. D., IJzerman, H., & Denissen, J. J. (2014). Physical warmth and perceptual focus: A replication of IJzerman and Semin (2009). *PloS ONE, 9*(11), e112772.

Schimmack, U. (2012). The ironic effect of significant results on the credibility of multiple-study articles. *Psychological Methods, 17,* 551–566. http://dx.doi.org/10.1037/a0029487

Sedikides, C., Wildschut, T., Routledge, C., Arndt, J., Hepper, E. G., & Zhou, X. (2015). To nostalgize: Mixing memory with affect and desire. *Advances in Experimental Social Psychology, 51,* 189–273. http://dx.doi.org/10.1016/bs.aesp.2014.10.001

Simmons, J. P., Nelson, L. D., & Simonsohn, U. (2011). False-positive psychology: Undisclosed flexibility in data collection and analysis allows presenting anything as significant. *Psychological Science, 22,* 1359–1366. http://dx.doi.org/10.1177/0956797611417632

Simons, D. J. (2014). The value of direct replication. *Perspectives on Psychological Science, 9,* 76–80. http://dx.doi.org/10.1177/1745691613514755

Storey, S., & Workman, L. (2013). The effects of temperature priming on cooperation in the iterated prisoner's dilemma. *Evolutionary Psychology, 11,* 52–67. http://dx.doi.org/10.1177/147470491301100106

Van Acker, B., Kerselaers, K., Pantophlet, J., & IJzerman, H. (2015). *Homely thermoregulation: How physical coldness makes an advertised house a home*. Available at http://ssrn.com/abstract=2576421

Wagenmakers, E. J. (2007). A practical solution to the pervasive problems of *p* values. *Psychonomic Bulletin & Review, 14,* 779–804. http://dx.doi.org/10.3758/BF03194105

Williams, L. E. (2008). *Metaphor priming: How basic perceptual experiences nonconsciously shape evaluations, decisions, and emotional experiences*. New Haven, CT: Yale University.

Williams, L. E., & Bargh, J. A. (2008). Experiencing physical warmth promotes interpersonal warmth. *Science, 322,* 606–607. http://dx.doi.org/10.1126/science.1162548

Zhang, D. D., Brecke, P., Lee, H. F., He, Y. Q., & Zhang, J. (2007). Global climate change, war, and population decline in recent human history. *Proceedings of the National Academy of Sciences of the United States of America, 104,* 19214–19219. http://dx.doi.org/10.1073/pnas.0703073104

Zhong, C. B., & Leonardelli, G. J. (2008). Cold and lonely: Does social exclusion literally feel cold? *Psychological Science, 19,* 838–842. http://dx.doi.org/10.1111/j.1467-9280.2008.02165.x

Received July 9, 2015
Revision received October 10, 2016
Accepted October 12, 2016 ■