

Running Head: PHYSICALLY WARM, INTERPERSONALLY WARM

On Feeling Warm and Being Warm:

Daily Perceptions of Physical Warmth Fluctuate with Interpersonal Warmth

Adam K. Fetterman¹, Benjamin M. Wilkowski², and Michael D. Robinson³

¹University of Texas at El Paso

²University of Wyoming

³North Dakota State University

Word Count: 4845

Correspondence can be sent to Adam Fetterman, University of Texas El Paso, Department of Psychology, 500 W. University Ave., El Paso, TX, 79902; Email: akfetterman@utep.edu.

Author Bios: Adam Fetterman is an assistant professor at the University of Texas at El Paso.

His work focuses, broadly, on emotion, attitudes, and personality. His specific areas of interest are metaphor, wrongness admission, meaning, nostalgia, and politics/religion.

Benjamin M. Wilkowski is an associate professor of psychology at the University of Wyoming. His research is broadly focused on emotion, self-regulation, and personality in daily life.

Michael Robinson is a Professor of Psychology at North Dakota State University. His research interests include personality, cognition, emotion, and self-regulation.

Abstract

Previous investigations have linked laboratory manipulations of physical warmth to momentary increases in interpersonal warmth. However, replication concerns have occurred in this area and it is not known whether similar dynamics characterize daily functioning. Two daily diary studies (total $N = 235$) suggest an affirmative answer. On days on which participants felt physically warmer, they perceived themselves to be interpersonally warmer and more agreeable, irrespective of outdoor temperature. These findings are consistent with frameworks proposing that people draw on concepts of physical warmth to represent feelings of interpersonal warmth and they highlight the value of using daily diary and within-subject designs to investigate embodied cognition as well as other priming effects.

Keywords: physical warmth, interpersonal warmth, daily diary, metaphor, embodiment

On Feeling Warm and Being Warm:

Daily Perceptions of Physical Warmth Predict Daily Interpersonal Warmth

The adjectives “warm” and “cold” can be used to describe both temperature and people, such that a warm person is friendly and supportive and a cold person is distant and hostile (Asch, 1958; Wiggins & Trapnell, 1996). Such forms of overlap could be entirely coincidental, similar to how people use the word “bank” to describe both a repository of money and the side of a river. Alternatively, these forms of overlap could indicate something deeper about psychological representations, with people borrowing from the temperature domain when they seek to represent their more abstract social experiences of affiliation versus distancing (IJzerman & Semin, 2009; Lakoff & Johnson, 1980). To the extent that processes of this type are operative, feeling warm or cold in a subjective temperature-related sense could prime correspondent social experiences, either through embodied associations (IJzerman & Semin, 2009) or metaphor (Landau, Meier, & Keefer, 2010). In the present research, we applied the daily diary approach (Bolger, Davis, & Rafaeli, 2003), in a novel way, to investigate possible links of this type.

Interpersonal Warmth and Physical Warmth: A Brief History of Controversy

Associations between warmth and affection likely began in infancy, as the provision of caregiving was frequently linked to the warmth of bodily contact (Bowlby, 1969), and we may be biologically prepared to make connections of this type (IJzerman et al., 2015a). These covariations in experience would then serve as an embodied model for thinking about social relationships more generally (Williams, Huang, & Bargh, 2009), such that closer, more communal relationships could be thought of in terms of warmer rather than colder temperatures (IJzerman & Koole, 2011). Whether through the mechanism of perceptual symbols (Barsalou, 1999) or conceptual metaphors (Landau et al., 2010), such associations

could then give rise to the possibility that warmer, relative to colder, temperatures could activate prosocial thoughts and feelings.

A seminal study in this area was conducted by Williams and Bargh (2008). Participants who were randomly assigned to handle warm objects (e.g., a warm cup), relative to cold objects (e.g., a cold cup), made judgments that were more prosocial and they seemed to act in a prosocial manner. If effects of this type are reliable, they would essentially represent a new form of priming, one based on sensory inputs and metaphor-like associations rather than semantic inputs and schematic associations (Landau et al., 2010). The results of Williams and Bargh (2008) were novel, but they have been conceptually replicated a number of times (e.g., Fay & Maner, 2012; IJzerman & Semin, 2009; Schilder, IJzerman, & Denissen, 2014; see Williams, 2014, for a partial review).

Nonetheless, failures to replicate have also been reported. Lynott et al. (2014) were not able to replicate Williams and Bargh (2008) and Donnellan, Lucas, and Cesario (2014) were not able to replicate Bargh and Shalev (2012). These and other high profile replication failures have led to skepticism concerning embodied influences on social cognition. In our view, this skepticism has value, but its primary value may be methodological. Incidental bodily priming manipulations may often fail to influence behavior because they are too surreptitious (Molden, 2014). And the between-subjects design is almost unacceptably noisy in the context of small sample sizes (Loersch & Payne, 2016). In the present research, we show how a very different sort of design – based on the experience-sampling method – can be used to overcome some of the limitations of laboratory-based priming research.

Examining Embodied Associations in Daily Life

We were guided by conceptual metaphor theory (Landau et al., 2010) in making our predictions, though they could follow from other theories of embodied social cognition (e.g., Barsalou, 1999; IJzerman et al., 2015a; Williams et al., 2009) as well. If these theories

capture important truths about the human condition, then they should be capable of making predictions about people's daily lives (Bolger et al., 2003). To determine whether this is the case for temperature-related metaphors and associations, we conducted two daily diary studies in which we assessed daily feelings of felt temperature as well as day-to-day fluctuations in interpersonal warmth.

Following the idea that people use physical warmth as a cue to social warmth, we hypothesized that higher levels of felt temperature would vary with higher levels of friendliness. That is, people may feel more caring toward others, and they may engage in friendly behavior to a greater extent, on days that they feel physically warmer. Although we treat felt temperature as a predictor in these models, we actually think of these relationships as bidirectional, following considerable precedent (IJzerman & Koole, 2011; Lee & Schwarz, 2012). Further, the causal limitations of the daily diary design are offset by its ecological validity (Bolger et al., 2003), and we emphasize this strength in the present studies.

Beyond questions of ecological validity, the daily diary design is useful because it samples thoughts, feelings, and behaviors repeatedly (i.e., across days). This design feature allows one to assess within-person rather than between-person processes, with high power (Conner, Tennen, Fleeson, & Barrett, 2009). Accordingly, designs of this type can examine the possibility of particular priming influences in ways that are more likely to replicate (Loersch & Payne, 2016), which has value in our replication-conscious era.

Current Investigation

The daily diary method has been underutilized as a way of examining embodied influences in daily life. In two studies of this type, we asked people to report on how warm or cold they felt each day for two weeks in a row. We focused on subjective personal temperature rather than the weather because people can, and often do, compensate for variations in weather, for example by their clothing choices or time spent indoors (IJzerman

et al., 2015a). In addition, people reported on their daily levels of agreeableness as well as whether they felt warm or cold toward others (Wiggins & Trapnell, 1996). We hypothesized that both interpersonal warmth and agreeableness would increase on days that people felt physically warmer¹.

Study 1

Method

Participants and Overview

Participants were undergraduate students from North Dakota State University. We recruited as many as possible within a week because previous experience indicated that such procedures would provide good statistical power for our within-subject hypotheses. Out of the 151 participants who started the study, 132 (94 female) provided usable data. The primary analyses were based on 1540 daily reports, and thus good statistical power.

Procedurally, participants signed up for a two-week daily diary study. They initially attended a lab session in which personality-based measures of interpersonal warmth and agreeableness were administered and instructions for the daily protocol were provided. Subsequently, they completed the daily diary protocol described below.

Personality Measures

Personality measures were included for the purpose of validating the daily protocol. Interpersonal warmth was assessed with the corresponding dimension of the IAS-R, which is a well-validated instrument (Wiggins, Trapnell, & Phillips, 1988). Participants also

¹As is customary for intense, time-consuming protocols, the measures testing the current hypotheses were embedded among other measures testing other, quite different hypotheses (Finkel, Eastwick, & Reis, 2015). Additional assessments in the laboratory sessions included cognitive tasks (e.g., the Stroop task) and unrelated features of personality (e.g., neuroticism). Additional daily measures primarily focused on questions of stress-reactivity, thus including measures of stress, goals, and coping in addition to probes of emotional experience.

completed Goldberg's (1999) agreeableness scale, which aligns itself with the warmth-coldness dimension of the interpersonal circumplex (Wiggins & Trapnell, 1996).

Interpersonal warmth has a 6-point scale ($M = 5.21$; $SD = 0.66$; $\alpha = .92$) and agreeableness has a 5-point scale ($M = 4.20$; $SD = 0.61$; $\alpha = .85$).

Daily Diary Procedures and Measures

The daily protocol began on the Tuesday following the lab session. We sent participants emails at 5 p.m. every day for 14 days in a row, with participant numbers and links to the daily survey (SurveyMonkey). Participants had until 3 a.m. the next morning to complete each report. On an *a priori* basis, we dropped 11 participants who failed to complete at least 9 surveys or who gave the same answers every day. The remaining 132 participants completed 90% of their reports.

We assessed daily variations in interpersonal warmth (or friendliness) in two ways. Participants were asked how accurately (1 = extremely inaccurate; 5 = extremely accurate) their daily behaviors could be characterized by 4 adjectives ("caring", "cold", "distant", and "warm") modelled on the IAS-R (Wiggins et al., 1988). The "cold" and "distant" adjectives were reverse-scored ($M = 3.54$; $SD = 0.60$; $\alpha = .78$ with days as the units of analysis). In addition, using the same 5-point agreement scale, participants indicated how accurately a single statement ("Today, I was agreeable") described their personality that day ($M = 3.58$, $SD = 0.60$). This single item measure has been successfully used in previous experience-sampling studies (e.g., Fetterman, Meier, & Robinson, in press).

We hypothesized that people would report their behavior as friendlier on days that they felt physically warmer. Accordingly, we asked people to indicate their felt temperature each day using a single face-valid item: "How did you feel, in terms of temperature, today?" Participants responded to this question using a 4-point scale (1 = very cold; 4 = very warm), with the average day marked by a moderate level of felt warmth ($M = 2.51$, $SD = 0.72$). The

temperature question was at the end of the survey so that responses to this question would not be used as a basis of inferring one's social behavior and additional survey items (see footnote 1) served as distractors with respect to the hypotheses.

Results

Between-Person Correlations

For preliminary purposes, we averaged across days for the daily measures and then correlated these average scores with each other as well as with the laboratory personality variables. As shown in Table 1, the personality measures predicted their daily counterparts, providing validity evidence for the daily measures. In addition, the daily measures of interpersonal warmth and agreeableness predicted average levels of felt temperature, providing some initial evidence for our hypotheses, though we emphasize the within-person relationships reported below.

Table 1. Between-Person Correlations

Scale	1	2	3	4
1. IAS-R Warmth				
2. Big 5 Agreeable	.53***			
3. Daily Warmth	.47***	.22**		
4. Daily Agreeable	.18*	.26**	.54***	
5. Daily Temp	.12	-.01	.24**	.25**

Note: * = $p < .05$; ** = $p < .01$; *** = $p < .001$

Within-Person Relationships

To test for the possibility of within-subject relationships, our main analyses employed multi-level modelling (Raudenbush & Bryk, 2002). To properly distinguish within-person and between-person sources of variance, we person-centered the daily predictor variables (Enders & Tofighi, 2007). To ensure that the standard errors for the within-subject predictors

were properly specified, we also included corresponding random effects for these variables (Barr, Levy, Scheepers, & Tily, 2013). Finally, we used an autoregressive covariance structure to properly model serial correlations for the outcome measures across successive days. Analyses were conducted using SAS Proc Mixed (Singer, 1988). Although all models included random and autoregressive effects, we only report the fixed within-subject effects in this manuscript, as these test the hypotheses of substantive interest.

Our primary hypotheses were supported. On days that people felt physically warmer, they characterized their interpersonal behavior as warmer as well, $b = .14$, $t = 6.78$, $p < .001$, 95% CI [.099,.181]. Daily levels of agreeableness also positively varied by felt temperature, $b = .06$, $t = 3.06$, $p = .002$, 95% CI [.023,.106]. Accordingly, people see themselves as friendlier and nicer on days that they feel physically warmer.

Additional Analyses

Temperature metaphors seem central to the interpersonal adjectives of “warm” and “cold” (Asch, 1958). The present findings appear to extend beyond these adjectives, though, in that felt temperature also predicted daily variations in agreeableness. Nonetheless, we ran four additional MLMs, one for each of the interpersonal adjectives included in the daily protocol. Felt temperature was a positive predictor of the extent to which people felt both “caring”, $b = .08$, $t = 3.82$, $p < .001$, 95% CI [.083,.126], and “warm”, $b = .20$, $t = 6.66$, $p < .001$, 95% CI [.143,.263]. There was a non-significant inverse relationship with “distant”, $b = -.04$, $t = -1.53$, $p = .13$, and a significant inverse relationship with “cold”, $b = -.24$, $t = -6.71$, $p < .001$, 95% CI [-.304,-.166]. Altogether, we emphasize that the results were generally parallel across items, but such considerations will be revisited in Study 2.

Our hypotheses were about subjective or personal temperature rather than actual (outdoor) temperature. Nonetheless, we sought to investigate the role of actual temperature in driving the results. For these analyses, we obtained average daily temperature values for

Fargo, North Dakota for the 14 days of data collection, using National Weather Service figures ($M = 44.05^{\circ}\text{F}$, $SD = 7.87^{\circ}\text{F}$). Daily average temperature was a significant predictor of felt temperature, $b = .03$, $t = 11.30$, $p < .001$, 95% CI [.021,.030], a marginal predictor of interpersonally warm behavior, $b = .00$, $t = 1.72$, $p = .08$, but was not a significant predictor of agreeableness, $b = .00$, $t = -1.56$, $p = .12$. Furthermore, when we controlled for average daily temperature, felt temperature continued to predict interpersonal warmth, $b = .15$, $t = 6.87$, $p < .001$, 95% CI [.106,.191], and agreeableness, $b = .06$, $t = 2.72$, $p = .01$, 95% CI [.017,.103]. With felt temperature controlled, by contrast, outdoor temperature did not predict either outcome, $ps > .25$.

Social activities could be more prevalent during weekends than weekdays, which could be affecting the results. To gain some insights here, we reran our key models after excluding weekend-based reports. In these follow-up analyses, daily felt temperature continued to predict interpersonal warmth, $b = .15$, $t = 5.59$, $p < .001$, 95% CI [.094,.196], and agreeableness, $b = .05$, $t = 2.01$, $p = .04$, 95% CI [.001,.089], suggesting that the week versus weekend comparison was not entirely responsible for key results.

As actual temperature decreased during the course of the study, $r = -.75$, $p < .001$, we ran 2 MLMs in which we controlled for day (1-14) and thus linear trends. Day did not predict either outcome variable in these analyses, $ps > .15$, whereas felt temperature predicted both, $ps < .012$.

Discussion and Study 2

People may ground the more abstract social dimensions of their lives in terms of more concrete, bodily-based experiences such as temperature (IJzerman & Koole, 2011; Landau et al., 2010). If so, changes in felt temperature could give rise to changes in social behavior or feeling. Study 1 provided support for this idea in the form of daily diary patterns: People reported that they were more agreeable and friendlier on days that they felt physically

warmer. Even so, the results of Study 1 were novel and they were not the primary focus of the initial protocol. Accordingly, we sought to closely replicate (Simons, 2014) these results in a second study in which we made the same predictions in a results-informed manner.

Method

Participants, Procedures, and Measures

A new sample of 145 undergraduate students from the same university as Study 1 enrolled in a daily diary study. We utilized the same recruitment materials and sampling plan. During an initial laboratory session, participants completed the same agreeableness questionnaire (Goldberg, 1999) of Study 1 ($M = 4.09$; $SD = 0.64$; $\alpha = .88$), but did not complete the IAS-R. They also completed tasks not relevant to the present hypotheses.

Procedures for the daily diary protocol were parallel to the first study. In Study 2, 8 people were dropped for failing to complete at least 9 surveys or inattentive responding. The remaining 137 (67 female) participants completed 88% of their reports and we collected 1530 reports in total. The daily interpersonal warmth ($M = 3.51$; $SD = 0.78$; $\alpha = .92$), agreeableness ($M = 3.61$; $SD = 0.85$), and physical warmth ($M = 2.75$; $SD = 0.66$) measures were identical to those administered in Study 1. The physical warmth question appeared last so that its content would not be used as a basis for answering other questions.

Results

Between-Person Correlations

The Big 5 trait of agreeableness predicted both average daily agreeableness ($r = .27$, $p = .002$) and average daily interpersonal warmth ($r = .35$, $p < .001$), validating the daily measures. Trait agreeableness did not predict average daily temperature ($r = .01$, $p = .912$).

Within-Person Relationships

Multi-level models, which were identical to Study 1, were conducted to determine whether daily fluctuations in felt temperature predicted day-to-day variations in interpersonal

functioning. Although random and autoregressive effects were included in the models, only the fixed effects testing the main hypotheses are reported here. As hypothesized, felt temperature predicted greater interpersonal warmth, $b = .17, t = 8.18, p < .001, 95\% \text{ CI } [.131, .214]$, and daily agreeableness, $b = .05, t = 2.52, p = .01, 95\% \text{ CI } [.020, .105]$. These results directly replicate Study 1 and suggest that friendliness varies with whether one feels physically warm or cold on a given day.

Additional Analyses

As in Study 1, we wanted to examine whether the interpersonal adjective effects were limited to the terms “warm” and “cold”. We therefore ran 4 secondary MLMs, with felt temperature predicting each interpersonal item. Felt temperature was a positive predictor of the extent to which people felt “caring”, $b = .09, t = 3.39, p = .001, 95\% \text{ CI } [.037, .142]$, and “warm”, $b = .21, t = 6.80, p < .001, 95\% \text{ CI } [.149, .272]$. Felt temperature was also a significant inverse predictor of the extent to which people felt “distant”, $b = -.11, t = -3.81, p < .001, 95\% \text{ CI } [-.163, -.052]$, and “cold”, $b = -.28, t = -9.69, p < .001, 95\% \text{ CI } [-.340, -.225]$. Thus, felt temperature affected all of the items, ostensibly metaphoric or not.

We also conducted analyses to determine if these effects could be ascribed to actual outdoor temperature, with values obtained from the National Weather Service. Average daily temperature ($M = 17.42^\circ\text{F}, SD = 9.60^\circ\text{F}$) was a significant zero-order predictor of felt temperature, $b = .01, t = 6.62, p < .001, 95\% \text{ CI } [.009, .016]$, and interpersonally warm behavior, $b = .01, t = 3.18, p = .002, 95\% \text{ CI } [.002, .009]$, but not daily agreeableness, $b = .00, t = 0.58, p = .56$. With average temperature controlled, felt temperature continued to predict interpersonal warmth, $b = .17, t = 7.97, p < .001, 95\% \text{ CI } [.128, .234]$, and agreeableness, $b = .06, t = 2.93, p = .003, 95\% \text{ CI } [.020, .105]$. With felt temperature controlled, by contrast, outdoor temperature did not predict either outcome, $ps > .20$.

We ran an additional set of MLMs with weekends excluded. Felt temperature continued to predict interpersonally warm behavior, $b = .17$, $t = 7.55$, $p < .001$, 95% CI [.128,.218], and agreeableness, $b = .05$, $t = 2.08$, $p = .038$, 95% CI [.002,.101], within the specific context of weekdays. We also ran 2 other models that controlled for day (1-14), as there was a linear rise in outdoor temperature during this time period ($r = .84$, $p < .001$). Felt temperature was significant in both analyses, $ps < .004$, but day was not, $ps > .20$.

Discussion

In Study 2, we directly replicated the findings of Study 1. This gives us more confidence concerning the association between physical warmth and interpersonal warmth, which appears to be robust in within-person analyses.

General Discussion

Phrases like “warm personality” and “cold shoulder” make it apparent that we often use temperature-related content to speak about the interpersonal domain. What is less clear is whether such expressions capture important underlying truths – such as that people sometimes or often base their inferences of social warmth on their experiences of physical warmth (IJzerman & Koole, 2011; Williams et al., 2009). The present findings provide unique evidence for relationships of this type in that people felt more caring toward others, and viewed the self as more agreeable, on days that they felt physically warmer. These data suggest that associations between felt temperature and interpersonal warmth appear to be operative in daily life. In fact, the present sort of design might be uniquely suited to make statements of this type.

Implications and Theoretical Considerations

From one perspective, whether we feel warm or cold may seem inconsequential. Such perceptions will wax or wane with a number of variables such as the weather and how we are dressed. And, unless our temperature deviates too radically from acceptable ranges, we are

likely to ignore it. On the contrary, our findings, like those of IJzerman and Semin (2009), suggest that whether we feel warm or cold is more consequential, socially, than is typically appreciated. Because of the representational links between warmth and friendliness, and between coldness and social distance (Lakoff & Johnson, 1999), one's felt temperature could have systematic implications for social functioning (Williams et al., 2009).

Indeed, the systematic nature of the present findings is consistent with a wide scope of potential operation. Due to representational links between physical warmth and interpersonal warmth (Williams et al., 2009), we may find ourselves less than sympathetic to others when we are physically cold. By contrast, we may be more likely to give others the benefit of the doubt when we feel warm. Such dynamics could affect friendship formation, romantic intimacy, and even evaluations within interpersonal contexts like interviews (Fay & Maner, 2012). The former two domains can be studied in daily diary studies (Finkel et al., 2015) and it would be useful to extend the present findings along these lines. That is, we recognize that our social functioning items were somewhat general and that different measures could reveal more particular details about which sorts of relational processes vary by felt temperature.

Following several theories (IJzerman & Koole, 2011; Landau et al., 2010), we emphasize the idea that more concrete perceptual inputs typically scaffold more abstract representational processes (Williams et al., 2009). In the present studies, that is, we think that felt temperature served as an input to one's social inclinations on a given day (IJzerman & Semin, 2009; Williams & Bargh, 2008). Nonetheless, it is also possible that friendly thoughts and feelings could make people feel warmer as this direction of influence has also received some support in the literature (e.g., Szymkow, Chandler, IJzerman, Parzuchowski, & Wojciszke, 2013). Ultimately, then, links between felt temperature and interpersonal warmth could be bidirectional. Although daily diary designs cannot separate these directions of

influence (Bolger et al., 2003), more momentary designs (Conner et al., 2009) might be capable of doing so in future research.

We drew from conceptual metaphor theory (Lakoff & Johnson, 1999) in making our predictions. However, we also emphasize that there are major sources of overlap among theories of embodied cognition, conceptual metaphor, perceptual symbols, and developmental scaffolding (IJzerman & Koole, 2011; Williams et al., 2009), and each theory can fill gaps in the other (Crawford, 2009; Slepian, 2015). For example, being held by caregivers likely served as an important impetus to the development of associations between social warmth and physical warmth (IJzerman & Koole, 2011). In this context, we think that our results are consistent with multiple theories of grounded cognition, including those focused on scaffolding (Williams et al., 2009), perceptual symbols (Barsalou, 1999), or thermoregulatory processes (IJzerman et al., 2015a).

Even so, the relative contributions of embodiment, thermoregulation, and conceptual metaphor could be parsed, perhaps by using an individual difference strategy. Embodiment, for example, should increase with body awareness (Häfner, 2015), whereas metaphor-related processes should be enhanced among people who use metaphors more often (Fetterman, Bair, Werth, Landkammer, & Robinson, 2016). We might also compare directions of influence (Schneider, Rutjens, Jostmann, & Lakens, 2011), or contrast those processes that do versus do not implicate bodily sensations (Gibbs, 2011). We need more efforts of this type, including in daily diary work.

Methodological Considerations

The vast majority of support for embodied social cognition has come from between-subjects experimental priming designs. Although many of these studies capture the imagination, there has been an increased scrutiny of such designs (e.g., Lakens, 2014) and failures to replicate are becoming increasingly common (e.g., Lynott et al., 2014). Our sense

is that these sorts of designs are finicky and their implementation can falter for many unknown reasons. Although large sample sizes can compensate for some of these issues (e.g., IJzerman, Janssen, & Coan, 2015b; Schilder et al., 2014), they may not compensate for all of them (Loersch & Payne, 2016; Molden, 2014), and there are other options. In this context, we offer the under-utilized daily diary protocol as an alternative or “first step” in studying embodied or metaphoric social influences. In the present investigation, we were able to show that there is a relationship between felt temperature and social behavior without relying on either incidental bodily primes or between-subjects designs, which are inherently less powerful.

Furthermore, if theories of embodied social cognition are to have lasting importance, support for them should not be limited to the momentary effects of holding warm coffee cups or heating pads in a laboratory context (Williams & Bargh, 2008). Rather, the postulates of these theories should ideally also be relevant to people’s everyday lives. For good reason, we think that daily diary methods are uniquely suited to providing evidence of this type (Bolger et al., 2003). By prompting people to report on their lives for 14 days in a row, we were able to gain a relatively complete picture of whether and how felt temperature varied with inclinations toward social warmth and agreeableness. Experimental priming experiments cannot provide ecologically-valid data of this type.

We thus recommend the broader usage of daily designs to investigate mental associations and priming effects. These include potential links between power and sex (Bargh, Raymond, Pryor, & Strack, 1995), morality and cleanliness (Zhong & House, 2014), and pessimism and darkness (Meier, Robinson, & Clore, 2004), among many others. If these elements fail to predict each other in daily life, then the relevant associations may not be particularly consequential. If they do predict each other, then one has provided evidence for their relevance to daily life, thus encouraging further empirical and theoretical attention.

Final Comments

We asked people about their subjective feelings rather than actual body temperature, as this is the sort of information that people have access to. How warm or cold people feel on particular days is likely determined by a number of factors, including weather, dress, and activity level. Regardless of these inputs, to the extent that they affect felt temperature, they should be capable of influencing interpersonal thoughts and feelings. That is, conceptual metaphors, and perhaps embodied associations more generally, are likely to work at this level of felt (or conceptualized) temperature, somewhat irrespective of the factors that gave rise to it (Lakoff & Johnson, 1999). In support of this idea, felt temperature significantly predicted social thoughts and feelings in the present studies, but actual temperature did not.

There are a couple of methodological questions worth commenting on. First, one might wonder whether participants made a connection between the different items and responded accordingly. We think this is unlikely because temperature is ostensibly a very different thing than one's social behavior. Furthermore, we separated the items and put the temperature item last to guard against such order effects. Ultimately, though, people did self-report their temperature and the findings may need to be understood in such terms. Second, we should admit that we could not control for the settings that people found themselves in from day to day. We did show that our results replicate when excluding weekends, but there could have been other activities or features of the setting that varied by both felt temperature and social behavior. Although we highlight the ecological validity of the findings, then, we admit that other approaches are useful in controlling for possible third variables.

There are also theoretical questions worth thinking about. Temperature-related metaphors may not be universal (Koptjevskaja-Tamm, 2015), and the embodied influences of temperature could be innate (Mizukami, Kobayashi, Ishii, & Iwata, 1987). Such considerations point to the value of considering mechanisms other than conceptual metaphor

in findings of the present type (IJzerman & Koole, 2011). We should also note that compensatory findings are sometimes found in the present area of research. For example, Van Acker and colleagues found that people see houses as more home-like when they feel physically colder (Van Acker, Kerselaers, Pantophlet, & IJzerman, 2016). Findings like these fit the proximity/warmth metaphor, but additionally suggest the presence of regulatory or motivational factors under some circumstances (Bargh & Shalev, 2012). Even so, we suggest that priming factors will generally favor an assimilation-related relationship between felt temperature and interpersonal warmth, and the present findings support this idea.

References

- Asch, S. (1958). The metaphor: A psychological inquiry. In: R. Tagiuri & L. Petrullo (Eds.), *Person, perception, and interpersonal behavior* (pp. 86-94). Stanford, CA: Stanford University Press.
- Bargh, J. A., Raymond, P., Pryor, J. B., & Strack, F. (1995). Attractiveness of the underling: An automatic power–sex association and its consequences for sexual harassment and aggression. *Journal of Personality and Social Psychology*, *68*, 768–781.
- Bargh, J. A., & Shalev, I. (2012). The substitutability of physical and social warmth in daily life. *Emotion*, *12*, 154-162.
- Barr, D. J., Levy, R., Scheepers, C., & Tily, H. J. (2013). Random effects structure for confirmatory hypothesis testing: Keep it maximal. *Journal of Memory and Language*, *68*, 255-278.
- Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences*, *22*, 577-660.
- Bolger, N., Davis, A., & Rafaeli, E. (2003). Diary methods: Capturing life as it is lived. *Annual Review of Psychology*, *54*, 579-616.
- Bowlby, J. (1969). *Attachment and loss*. London, UK: Hogarth.
- Conner, T. S., Tennen, H., Fleeson, W. & Barrett, L. F. (2009). Experience sampling methods: A modern idiographic approach to personality research. *Social and Personality Psychology Compass*, *3*, 292-313.
- Crawford, L. (2009). Conceptual metaphors of affect. *Emotion Review*, *1*, 129-139.
- Donnellan, M. B., Lucas, R. E., & Cesario, J. (2015). On the association between loneliness and bathing habits: Nine replications of Bargh and Shalev (2012) Study 1. *Emotion*, *15*, 109-199.

- Enders, C. K., & Tofighi, D. (2007). Centering predictor variables in cross-sectional multilevel models: A new look at an old issue. *Psychological Methods, 12*, 121-138.
- Fay, A. J., & Maner, J. K. (2012). Warmth, spatial proximity, and social attachment: The embodied perception of a social metaphor. *Journal of Experimental Social Psychology, 48*, 1369-1372.
- Fetterman, A. K., Bair, J. L., Werth, M., Landkammer, F., & Robinson, M. D. (2016). The scope and consequences of metaphoric thinking: Using individual differences in metaphor usage to understand the utility of conceptual metaphors. *Journal of Personality and Social Psychology, 110*, 458-476.
- Fetterman, A. K., Meier, B. P., & Robinson, M. D. (in press). The predictive power of the sweet taste metaphor for agreeableness and daily life. *Journal of Individual Differences*.
- Finkel, E. J., Eastwick, P. W., & Reis, H. T. (2015). Best research practices in psychology: Illustrating epistemological and pragmatic considerations with the case of relationship science. *Journal of Personality and Social Psychology, 108*, 275-297.
- Gibbs, R. W. (2011). Evaluating conceptual metaphor theory. *Discourse Processes, 48*, 529-562.
- Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. In: I. Mervielde, I. Dreary, F. De Fruyt, & F. Ostendorf (Eds.), *Personality psychology in Europe* (Vol. 7, pp. 7-28). Tilburg, The Netherlands: Tilburg University Press.
- Häfner, M. (2013). When body and mind are talking: Interoception moderates embodied cognition. *Experimental Psychology, 60*, 255-259.

- IJzerman, H., Coan, J. A., Wagemans, F. M., Missler, M. A., van Beest, I., Lindenberg, S., et al. (2015a). A theory of social thermoregulation in human primates. *Frontiers in Psychology, 6*. ArtID: 464.
- IJzerman, H., & Koole, S. L. (2011). From perceptual rags to metaphoric riches-Bodily, social, and cultural constraints on sociocognitive metaphors: Comment on Landau, Meier, and Keefer (2010). *Psychological Bulletin, 137*, 355-361.
- IJzerman, H., Janssen, J. A., & Coan, J. A. (2015b). Maintaining warm, trusting relationships with brands: Increased temperature perceptions after thinking of communal brands. *PloS One, 10*. ArtID: e0125194.
- IJzerman, H., & Semin, G. R. (2009). The thermometer of social relations: Mapping social proximity on temperature. *Psychological Science, 20*, 1214-1220.
- Koptjevskaja-Tamm, M. (2015). *The linguistics of temperature*. Amsterdam, Netherlands: John Benjamins Publishing Company.
- Lakens, D. (2014). Grounding social embodiment. *Social Cognition, 32*, 168-183.
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, IL: University of Chicago Press.
- Lakoff, G., & Johnson, M. (1999). *Philosophy in the flesh: The embodied mind and its challenge to Western thought*. New York: Basic Books.
- Landau, M. J., Meier, B. P., & Keefer, L. A. (2010). A metaphor-enriched social cognition. *Psychological Bulletin, 136*, 1045-1067.
- Lee, S. W. S., & Schwarz, N. (2012). Bidirectionality, mediation, and moderation of metaphorical effects: The embodiment of social suspicion and fishy smells. *Journal of Personality and Social Psychology, 103*, 737-749.
- Loersch, C., & Payne, B. K. (2016). Demystifying priming. *Current Opinion in Psychology, 12*, 32-36.

- Lynott, D., Corker, K. S., Wortman, J., Connell, L., Donnellan, M. B., Lucas, R. E., et al. (2014). Replication of 'Experiencing physical warmth promotes interpersonal warmth' by Williams and Bargh (2008). *Social Psychology, 45*, 216-222.
- Meier, B. P., Robinson, M. D., & Clore, G. L. (2004). Why good guys wear white: Automatic inferences about stimulus valence based on brightness. *Psychological Science, 15*, 82-87.
- Mizukami, K., Kobayashi, N., Iwata, H., & Ishii, T. (1987). Telethermography in infant's emotional behavioural research. *The Lancet, 330*, 38-39.
- Molden, D. C. (2014). Understanding priming effects in social psychology: What is "social priming" and how does it occur? *Social Cognition, 32*, 1-11.
- Raudenbush, S. W., & Bryk, A. S. (2002). *Hierarchical linear models: Applications and data analysis methods* (Vol. 1). Thousands Oaks, CA: Sage.
- Schilder, J. D., IJzerman, H., & Denissen, J. J. A. (2014). Physical warmth and perceptual focus: A replication of IJzerman and Semin (2009). *PloS One, 9*. ArtID: e112771.
- Schneider, I. K., Rutjens, B. T., Jostmann, N. B., & Lakens, D. (2011). Weighty matters: Importance literally feels heavy. *Social Psychological and Personality Science, 2*, 474-478.
- Simons, D. J. (2014). The value of direct replication. *Perspectives on Psychological Science, 9*, 76-80.
- Singer, J. D. (1998). Using SAS PROC MIXED to fit multilevel models, hierarchical models, and individual growth models. *Journal of Educational and Behavioral Statistics, 23*, 323-355.
- Slepian, M. L. (2015). Disentangling multimodal processes in social categorization. *Cognition, 136*, 396-402.

- Szymkow, A., Chandler, J., IJzerman, H. Parzuchowski, M., & Wojciszke, B. (2013). Warmer hearts warmer rooms: How positive communal traits increase estimates of ambient temperature. *Social Psychology, 44*, 167-176.
- Van Acker, B. B., Kerselaers, K., Pantophlet, J., & IJzerman, H. (2016). Homelike thermoregulation: How physical coldness makes an advertised house a home. *Journal of Experimental Social Psychology, 67*, 20-27.
- Wiggins, J. S., & Trapnell, P. D. (1996). A dyadic-interactional perspective on the five-factor model. In: J. Wiggins (Ed.), *The five-factor model of personality: Theoretical perspectives* (pp. 88-162). New York: Guilford Press.
- Wiggins, J. S., Trapnell, P., & Phillips, N. (1988). Psychometric and geometric characteristics of the Revised Interpersonal Adjective Scales (IAS—R). *Multivariate Behavioral Research, 23*, 517-530.
- Williams, L. E. (2014). Improving psychological science requires theory, data, and caution: Reflections on Lynott et al. (2014). *Social Psychology, 45*, 321-323.
- Williams, L. E., & Bargh, J. A. (2008). Experiencing physical warmth promotes interpersonal warmth. *Science, 322*, 606-607.
- Williams, L. E., Huang, J. Y., & Bargh, J. A. (2009). The scaffolded mind: Higher mental processes are grounded in early experience of the physical world. *European Journal of Social Psychology, 39*, 1257-1267.
- Zhong, C. B. & House, J. (2014). Dirt, pollution, and purity: A metaphorical perspective on morality. In: M. Landau, M. D. Robinson, & B. P. Meier (Eds.), *The power of metaphor: Examining its influence on social life* (pp. 109-131). Washington, DC: American Psychological Association.