



Case Report

Physical temperature affects response behavior

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ABSTRACT

Physical temperature can fundamentally affect psychological processes. Among other things, physical warmth typically fosters the motivation to affiliate. We argue that physical warmth can increase affirmative and acquiescent response behavior in psychological surveys and experiments as a result of such an affiliative motive. In Study 1, we find that participants give more biased answers in a memory test in warmer, compared to colder, environments. In Studies 2–3b, physical warmth fosters a response bias toward the affirmation of unrelated items in questionnaires. In Study 4, the effect of physical warmth on the affirmation bias is amplified when the person reading a participant's answers is a friend (stronger affiliation prime) compared to a stranger. Taken together, temperature affects general response behavior by fostering affirmation. Thereby, physical temperature has deeper psychological as well as methodological consequences than previously thought.

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1. Introduction

Physical temperature is a ubiquitous and influential environmental feature that deeply affects humans not only physically, but also psychologically (Ijzerman et al., 2015). As a consequence, something as simple as the room temperature can reduce social distance (Ijzerman & Semin, 2009), alleviate loneliness (Bargh & Shalev, 2012), and spark trust (Kang, Williams, Clark, Gray, & Bargh, 2010). Broadly speaking, physical warmth orients people toward others: For instance, physical warmth leads people to conform to others and to affiliate with them (Fay & Maner, 2012, 2015; Huang, Zhang, Hui, & Wyer, 2014).

If physical warmth (compared to cold) motivates people to conform and to affiliate, temperature might also affect response behavior more generally. The literature has demonstrated how interpersonal processes can influence different (e.g., acquiescent or affirmative) response patterns (Smith, 2004). Similarly, affiliation might affect not only people's responses, but also their response styles. Therefore, we test the hypothesis that physical warmth increases affirmative and acquiescent response behavior. If this is indeed the case, physical temperature has a much broader impact on social cognition and motivation than previously thought: Over and above affecting *what* people think and do, physical temperature might generally affect *how* people respond to questionnaires and experiments.

1.1. Physical temperature

Over the last decade, research has amassed evidence for the existence of a multi-faceted and reciprocal relationship between physical temperature and both social cognition and motivation. From this literature, some fundamental findings have emerged: When the concept of physical warmth is activated, people assimilate their perception and behavior to the experience of psychological warmth (Zhang & Risen, 2014). For instance, under warmer conditions, people perceive others as warmer (Williams & Bargh, 2008), feel psychologically closer and more similar to others (Ijzerman & Semin, 2009; Steinmetz & Mussweiler, 2011), and report more social belonging (Chen, Poon, & DeWall, 2015). Psychological and physical warmth seem to share similar neurobiological mechanisms (Inagaki & Eisenberger, 2013), which might underlie the relationship between warmth and social connection. In all, the literature provides compelling evidence that physical warmth promotes an orientation toward others, such that people in warmer environments show more conformity with others' opinions and a higher motivation to affiliate (Fay & Maner, 2015; Huang et al., 2014).

Precisely because physical temperature influences people's orientation toward others, we hypothesize that physical temperature can affect general response behavior through affiliation (Fay & Maner, 2015). More specifically, we expect that physical warmth leads people to respond in ways that signal affirmation to questions. Conversational norms suggest that affirmation is usually the pragmatic, expected answer, and consequently, questions are per default processed as affirmative questions (Hasson & Glucksberg, 2006). Because a survey or an experiment can be understood as an act of communication between the experimenter or researcher and the participant (Schwarz, 1999),

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physical temperature might affect this (however remote) interpersonal relationship in the same way as temperature affects more proximal relationships and interactions. In line with this notion, previous research has shown that people give more positive evaluative judgments when exposed to warmth (Zwebner, Lee, & Goldenberg, 2013). In our research, we set out to extend these findings by demonstrating instances in which warmth affects response patterns beyond evaluative judgments. Furthermore, we explore whether affiliation moderates the effects of physical warmth on affirmative response behavior.

1.2. Response biases

The communicative aspect of response behavior has received considerable attention for decades (for a review, see Schwarz, 1999). This research shows that responses in surveys and experiments are guided by the same communicative principles as other conversations (Grice, 1975). For instance, questions and their wording can communicate information to the participant and can thereby change responses (Loftus, 1975). Even beyond such “leading” questions, responders in surveys might not only focus on the literal meaning of the questions, but also on the pragmatic meaning, that is, the assumed intention of the person asking the questions. Thus, responses in surveys and experiments can be affected by the same implicit rules and mechanisms as any other communication (Schwarz, 1999). Based on the understanding of response behavior as communication, we hypothesize that the more the responder is motivated to affiliate (e.g., with the researcher), the more might the responder try to infer the researchers’ expectations and answer accordingly, resulting in biased response behavior.

Without further information on the researcher’s expectation, one could assume that agreement with the questions and their underlying concepts would be the researcher’s expected answer. Indeed, such a response tendency (or bias) has been documented in the literature: Affirming or acquiescent response behavior has been described as a bias “to agree rather than disagree with items, regardless of item content” (van Herk, Poortinga, & Verhallen, 2004, p. 347). Responding in an acquiescent way could thus mean to affirm more to all items (main effect) or to affirm more to the underlying concepts even when these concepts are unrelated (positive correlation between unrelated concepts), or both, depending on the inferred pragmatic meaning of the questions. Thus, in the present research, we explore whether physical warmth increases affirmative, acquiescent response behavior across different response contexts. Furthermore, we test whether acquiescent response behavior is especially pronounced when people are primed with affiliation.

2. The present research

Because physical warmth increases affiliation (Fay & Maner, 2015), we expect that higher temperatures co-activate people’s affiliation with the researcher asking the questions. A simple and easy way for a participant to express affiliation toward the researcher is to agree with whatever the researcher is asking. Thus, we expect affiliation to result in more affirmative, acquiescent response behavior. We investigate this hypothesis by employing different manipulations of physical temperature, and by measuring response styles across a variety of items.

In Study 1, we test the basic effect of temperature on response behavior by exploring whether physical warmth induces a higher tendency to answer affirmatively in a memory recognition task. We expect that participants in warmer conditions show more affirmative response behavior (independent of performance), resulting in a bias toward affirming that an item has been seen (versus has not been seen). In Studies 2–3b, we explore a more complex form of the acquiescence bias by testing whether physical warmth leads to a correlation of

unrelated concepts (Study 2), and to higher agreement on questionnaire scales (Studies 3a and 3b).

In Study 4, we directly test whether priming affiliation moderates the effect of temperature on affirmation. We ask participants to respond to unrelated items in a questionnaire (as in Studies 3a–3b) assuming that a friend versus a stranger will read their answers. We expect the friend (versus stranger) condition to amplify affiliation because a friend is presumably the more frequent target of affiliation, resulting in higher agreement with items. We manipulate physical temperature by varying the lab temperature in Study 1, by conceptual priming in Study 2, and by capturing individual difference in the experience of warmth and cold in Studies 3a, 3b, and 4.

In each of the studies, we explain how the sample size was determined. The sample size was determined a-priori in all studies, and we did not inspect the data before the data collection was finished. We report all measures and manipulations. No data were excluded from analyses in any of our studies.

2.1. Study 1

2.1.1. Method

2.1.1.1. Participants and design. We recruited 125 students at the University of Cologne (89 female, $M_{age} = 21.74$, $SD = 3.59$) in exchange for a chocolate bar or coffee voucher for a one-factorial between subjects design (warmth versus cold). We predetermined a sample size of at least 60 participants per experimental condition, based on power analysis of an estimated effect size of 0.45 and a desired power of 0.80 with an alpha level of 0.05 (Ijzerman, Schrama, & Pronk, 2016; Sassenrath, Sassenberg, & Semin, 2013).

2.1.1.2. Materials and procedure. To manipulate how warm or cold participants felt, the experimenter seated them in a lab room that was either 16.0–18.7 °C in the cold condition or 22.4–24.2 °C in the warm condition (based on: Ijzerman, Karremans, Thomsen, & Schubert, 2013; Ijzerman & Semin, 2009; Steinmetz & Mussweiler, 2011).

First, participants indicated on two initial questions whether they were aware of their bodies and of their surroundings (0 = not at all, 10 = very much), to focus participants on the present moment before working on the main task. There was no effect of the room temperature on these two initial items, $ps > 0.547$.

The main task was a classic recognition memory paradigm (Roediger & McDermott, 1995). In the initial learning phase, participants saw 8 wordlists, each consisting of 15 neutral words unrelated to temperature (e.g., bread, chair, building, chess). The words appeared sequentially on the screen, for 2 s each. Subsequently, in the testing phase, participants saw a list of 48 words, half of which had been presented in the learning phase. Participants then indicated whether they had seen a particular word in the learning phase (question and response translated from German: “Have you previously seen the following word?” 1 = have seen, 2 = have not seen). We expected that affirmation to these items (i.e., responding with “have seen”) signals affiliation because affirmation is the more common and expected answer in communication.

2.1.2. Results

To examine whether participants in the warm environment responded in a more confirmatory way to the question whether they had seen a word before, we calculated the response bias c based on the Signal Detection Theory (Green & Swets, 1996). This measure is unaffected by the correct categorization of old items as seen and of new items as not seen (the sensitivity d'). Values lower than 0 on c indicate a more liberal response criterion, in our case, a more confirmatory answer style toward categorizing an item as “seen”. For example, if participants showed the same sensitivity d' , participants with a lower c made most of their mistakes by falsely

responding “seen”, whereas participants with a higher c would mistakenly lean toward “not seen” more often.²

As expected, participants in the warm environment responded more liberally ($M = -0.305$; $SD = 0.293$) than participants in the cold environment ($M = -0.142$; $SD = 0.278$), $t(123) = 3.178$, $p = 0.002$, $d = 0.575$, 95% CI [0.061, 0.264]. This answer bias did not affect participants' overall ability (d') to disentangle old from new items per se ($M_{warm} = 1.113$, $SD = 0.694$; $M_{cold} = 1.166$, $SD = 0.602$), $t(123) = 0.286$, $p = 0.776$, 95% CI [-0.196, 0.263]. These results indicate that the physical temperature did not affect the overall memory accuracy but rather biased responses toward affirming that an item has been seen before.

2.2. Study 2

2.2.1. Method

2.2.1.1. Participants and design. We recruited 122 participants on Amazon Mechanical Turk (47 female, $M_{age} = 35.78$, $SD = 11.60$) in exchange for \$0.30 for a one-factorial between subjects design (warmth versus cold). As in Study 1, we predetermined a sample size of at least 60 participants per condition.

2.2.1.2. Materials and procedure. To activate the concepts of warmth or cold, respectively, we asked participants to imagine themselves in pictures of very warm (a desert or a lava lake) or very cold (a glacier or a snowy landscape) environments for 30 s. Then, participants wrote down what they had imagined. Pictures of warm and cold environments have been used in previous research as temperature primes to shift participants' preferences and thinking styles accordingly (Halali, Meiran, & Shalev, 2016; Steinmetz & Risen, 2016).

As a measure of participants' response behavior, participants completed the Philadelphia Mindfulness Scale (Cardaciotto, Herbert, Forman, Moitra, & Farrow, 2008). This scale consists of two typically uncorrelated subscales; the Present-Moment Awareness Scale (10 items, e.g., “I am aware of what thoughts are passing through my mind”, 1 = never, 5 = very often) and the Acceptance scale (10 items, e.g., “I try to distract myself when I feel unpleasant emotions”, 1 = never, 5 = very often). We chose this scale because, to our knowledge, so far no relationship has been documented between physical warmth and responses to the Mindfulness scale that could interfere with participants' response behavior to the two subscales.

Finally, participants reported how they currently felt (1 = sad, 9 = happy), and how warm or cold they currently felt (1 = very cold, 9 = very warm). There was no difference between conditions on these two items, $ps > 0.392$, indicating that the pictures primed participants with the concepts of warmth and cold, respectively, independent of participants' current moods and temperature feelings. As previous literature has suggested, the activation of a physical concept (e.g., warmth) can produce psychological effects that resemble those found when the physical concept is actually experienced (Halali et al., 2016; Zwebner et al., 2013). Similarly, in this study, we explored whether such a conceptual activation can be sufficient to affect participants' response behavior.

2.2.2. Results

To test whether the correlation between the two mindfulness subscales was influenced by conceptual warmth, we computed the correlation between the subscales separately for the warm and cold condition. The two scales were uncorrelated in the cold condition, $r = -0.034$, $p = 0.793$ (as in previous literature, see Cardaciotto et al., 2008), but

were positively correlated in the warm condition, $r = 0.402$, $p = 0.001$ (see Fig. 1), Fisher's $z = 2.48$, $p = 0.013$. The significant difference between the two correlations shows that activating the concept of physical warmth lead to an acquiescent response style of giving similar responses to conceptually unrelated items.

2.3. Study 3a

2.3.1. Method

2.3.1.1. Participants and design. We recruited 120 participants on Amazon Mechanical Turk (51 female, $M_{age} = 32.23$, $SD = 9.30$) in exchange for \$0.40 for a one-factorial correlational design. We predetermined a sample size of at least 120 participants per correlational factor, based on power calculation with an expected correlational coefficient of $r = 0.25$ and a desired statistical power of 0.80 (IJzerman et al., 2016).

2.3.1.2. Materials and procedure. To measure participants' subjective experience of warmth and cold, we asked participants directly how warm or cold they currently felt (1 = very cold, 9 = very warm). Additionally, to be able to control for variations in objective physical temperature and participants' temperature preferences, participants estimated the temperature of the room they were currently in (in degree Fahrenheit). Furthermore, participants indicated their preference to be in a colder or warmer environment (1 = would prefer cooler environment, 9 = would prefer warmer environment).

To measure participants' response behavior, we used a widely known scale that captures interdependent and independent self-construal with two subscales (1 = agree not at all, 7 = fully agree) with twelve items in each subscale (Singelis, 1994). We chose this scale because its two subscales are typically uncorrelated (Singelis, 1994; Singelis, Bond, Sharkey, & Lai, 1999), and to our knowledge so far no effect of physical warmth on responses to the Singelis scale has been demonstrated. A typical item for interdependent self-construal is: “I often have the feeling that my relationships with others are more important than my own accomplishments.” A typical item for independent self-construal is: “I am comfortable with being singled out for praise or rewards.”

For the purpose of testing for biased response behavior, we combined all twenty-four items of the self-construal scale into a single measure (higher values indicate higher agreement). Note that this procedure did not test for effects of temperature on participants' self-construal, but simply served the purpose to test whether feeling warmer affects response behavior to scales. Because one might wonder whether a relationship exists between warmth and interdependence (Fiske, Cuddy, & Glick, 2007; IJzerman & Semin, 2009), we combined the interdependent subscale with the independent subscale (which should be unaffected by warmth) to create a scale that measures response behavior more generally. Thus, a correlation between the combined scale and feelings of warmth suggests that physical warmth leads to higher affirmative responses even when the scale is conceptually meaningless.

2.3.2. Results

Participants subjective feeling of warmth or cold correlated ($r = 0.239$) significantly with agreement on the combined Singelis scale, $\beta = 0.095$, $SE = 0.036$, $t(118) = 2.670$, $p = 0.009$, 95% CI [0.025, 0.166]. Thus, participants showed a higher tendency to agree with the items they were presented with, the warmer they physically felt.

The same pattern emerged when controlling for differences in room temperature and participants' preferences for warmer or colder environments by including these variables in the regression. Although room temperature itself marginally affected responses to the Singelis scale, $p = 0.068$, and preferences for warmer environments significantly correlated with responses to the Singelis scale,

² All Signal Detection Theory parameters were based on Stanislaw and Todorov (1999). Hit rates and false alarm rates of 1 were substituted by $(n - 0.5) / n$ and values of 0 by $0.5 / n$, where n equaled the number of presented items ($n = 24$).

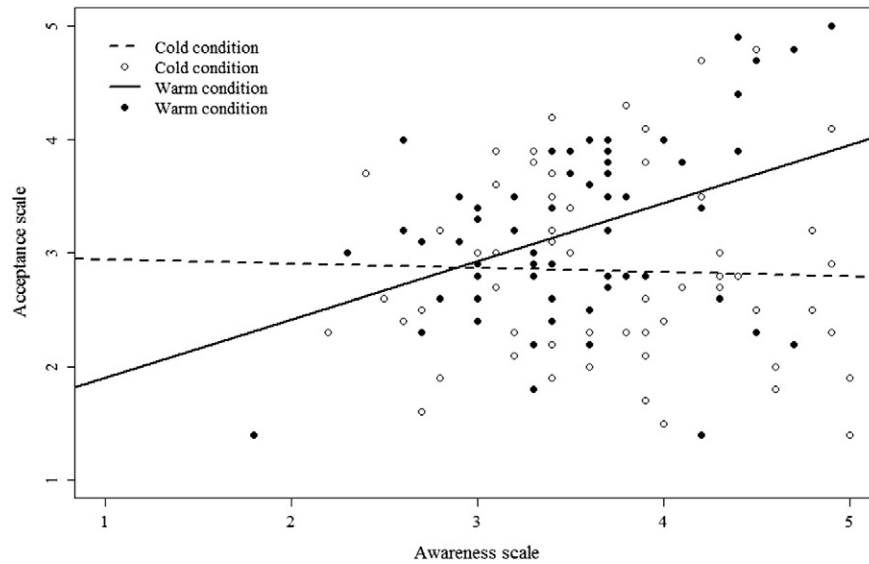


Fig. 1. The correlation of the two sub-scales in Study 2 as a function of imagining cold versus warmth.

$p = 0.023$, the pattern and the significance of the main effect of feeling warm on affirmative responses remained unchanged when controlling for these variables, $t(116) = 2.124$, $p = 0.036$.

One might speculate whether a correlation between physical warmth and feelings of interdependence (in line with reduced social distance; Ijzerman & Semin, 2009) is responsible for our effect. However, when looking at the results separately by subscale, how warm or cold participants feel correlated positively with the independence subscale, $r = 0.209$, $p = 0.022$, but not significantly with the interdependence subscale, $r = 0.141$, $p = 0.126$.

2.4. Study 3b

2.4.1. Method

2.4.1.1. Participants and design. We recruited 119 participants on Amazon Mechanical Turk (53 female, $M_{age} = 35.21$, $SD = 11.19$) in exchange for \$0.25 for a one-factorial correlational design. We again predetermined a sample size of at least 120 participants per correlational factor.

2.4.1.2. Materials and procedure. Study 3b replicated Study 3a, with two variations: First, we only asked participants how warm or cold they currently felt (1 = very cold, 9 = very warm), without assessing room temperature estimates or preferences for warmer or colder environments, because in Study 3a, these variables were not particularly informative.

More importantly, in Study 3b, participants answered the twenty-four item combined Singelis scale not about themselves, but instead about the average American (e.g., “The average American is comfortable with being singled out for praise or rewards”). This variation allowed us to address whether more pronounced socially desirable responding under conditions of physical warmth might influence our effects. In Study 3a, participants might have shown more agreement the warmer they felt in order to portray themselves in a more positive light, thinking that the Singelis items represented positive traits and behaviors. However, we expect physical warmth to increase affirmative responses more generally (over and above social desirability) also on neutral items. In Study 1, we found that warmth increased affirmation to neutral memory items that do not convey socially desirable information about the responder. Study 3b distinguished more directly between affirmation and social desirability, because affirming to questions about an average person does

not convey any socially desirable information about the participant. Instead, affirmation to items about an average person suggests a more general tendency to affirm.

2.4.2. Results

Participants' subjective feelings of warmth or cold correlated significantly ($r = 0.261$) with responses to the combined Singelis scale, $\beta = 0.118$, $SE = 0.040$, $t(117) = 2.920$, $p = 0.004$, 95% CI [0.038, 0.198]. As in Study 3a, the warmer they physically felt, the more participants affirmed to the items. Higher feelings of warmth correlated with the independence subscale ($r = 0.203$, $p = 0.026$) as well as with the interdependence subscale ($r = 0.247$, $p = 0.007$).

2.5. Study 4

2.5.1. Method

2.5.1.1. Participants and design. We recruited 303 participants on Amazon Mechanical Turk (140 female, $M_{age} = 34.60$, $SD = 11.10$) in exchange for \$0.25 for a one-factorial between subjects design (audience: friend versus stranger) with one correlational factor. We predetermined a sample size of at least 120 participants per condition and correlational factor (as in Studies 3a–3b), and were able to collect more data than anticipated.

2.5.1.2. Materials and procedure. To measure participants' response behavior, we again used the combined twenty-four item Singelis scale. To test whether affiliation influenced the effect of physical warmth on response behavior, we varied the target audience of participants' responses (friend versus stranger). Before working on the scale, participants in the friend condition (affiliation prime) read: “When you work on the following questionnaire, please imagine that a good friend of yours will read your answers afterwards.” Participants in the stranger condition (no affiliation prime) read: “When you work on the following questionnaire, please imagine that a random stranger you will never meet will read your answers afterwards.” Note that the stranger condition resembled standard psychological surveys and experiments, in which the experimenter or researcher who looks at participants' responses is typically a stranger. Therefore, we expected a replication of Study 3a in the stranger condition. However, in the friend condition, we expected an amplified relationship between physical warmth and biased response behavior because affiliation should be more salient.

Next, we asked participants directly how warm or cold they currently felt (1 = very cold, 9 = very warm). Then, participants estimated the temperature of the room they were currently in (in degree Fahrenheit). Note that, unlike in Studies 3a–3b, we asked about how warm or cold participants felt and about participants' room temperature estimates after assessing the dependent variable. Thus, no attention was directed at feeling warm or cold before working on the dependent measure.

2.5.2. Results

As in Studies 3a–3b, higher values on the combined Singelis scale indicated higher agreement with the items. Again, participants' self-reported perceptions of warm and cold constituted our main independent variable (z -transformed for the purpose of the interaction term in the regression).³

How warm or cold participants felt had a main effect on their responses to the Singelis scale, $\beta = 0.221$, $SE = 0.033$, $t(300) = 6.628$, $p < 0.001$, 95% CI [0.156, 0.287]. Whether the audience was a friend or stranger had no main effect on responses, $\beta = 0.048$, $SE = 0.033$, $t(300) = 1.433$, $p = 0.153$, 95% CI [−0.018, 0.113]. The interaction of the condition with how warm or cold participants felt was significant, $\beta = 0.070$, $SE = 0.033$, $t(300) = 2.102$, $p = 0.036$, 95% CI [0.004, 0.136]. This significant interaction indicated a difference between the correlations depending on condition. Specifically, in the stranger condition, how warm or cold participants felt correlated with their responses to the Singelis scale, $r = 0.247$, $p = 0.002$. This correlation was similar to the correlation we found in Study 3a, in which participants expected their answers to be read by the researcher (a stranger). Importantly, however, the correlation between participants' temperature experience and their response behavior was more pronounced in the friend condition, $r = 0.459$, $p < 0.001$ (see Fig. 2), Fisher's $z = 2.10$, $p = 0.035$. Taken together, feeling warmer led to more affirmative responses. This effect was even larger when the target audience of the responses was a friend (compared to a stranger), which supports our hypothesis that temperature affects response behavior due to affiliation.

Whereas room temperature itself did not affect responses to the Singelis scale in this study, $p = 0.358$, the pattern and the significance of all main and interaction effects remained unchanged when controlling for the room temperature (main effect feeling of warmth: $t(299) = 6.671$, $p < 0.001$; main effect friend versus stranger: $t(299) = 1.389$, $p = 0.166$; interaction: $t(299) = 2.184$, $p = 0.030$). Higher feelings of warmth correlated with the independence subscale ($r = 0.352$, $p < 0.001$) and the interdependence subscale ($r = 0.178$, $p = 0.002$) when collapsing across the friend and stranger condition.

3. Discussion

In five studies, we demonstrate that physical temperature affects how people respond to questions in experiments and questionnaires. Our findings are based on the notion that responses in experiments and questionnaires constitute an instance of communication (Schwarz, 1999). Therefore, as physical warmth can prime affiliation, physical warmth can lead to a higher acquiescent or affirmative bias in the communication with the researcher. More specifically, physical warmth biased responses toward affirmative answers (i.e., signaling agreement) in a memory test (Study 1) and fostered a positive correlation between unrelated items and scales (Studies 2–3b). This bias became more pronounced when responses were understood as communication with a friend, suggesting that warmth affected response behavior even more when affiliation was salient (Study 4).

Note that the effects of temperature on response behavior go beyond effects of socially desirable responding. In Study 1, the socially desirable response would be to maximize accuracy in the memory test (i.e.,

minimizing false positives and false negatives). Yet, we found no difference between the warm and the cold condition in memory accuracy. Instead, in the warm condition, participants' responses were biased toward false positives, because they were more likely to make errors by falsely affirming (item has been seen) than by falsely rejecting an item. Indicating that an item has been seen conveys no desirable information about the participant, but instead results from a bias toward affirmation. Similarly, in Study 3b, the warmer participants felt, the more affirmative were their responses to items asking about an average person. Responses to these items revealed nothing about the participant that could be construed as socially desirable, but nevertheless these responses were subject to biased response behavior. Also note that our results show that temperature affects response behavior not only by making responses more positive (Zweber et al., 2013). Although in Studies 1–3b, more positive responding might have led to similar response patterns (that is, higher affirmation), in Study 4, we found that priming affiliation moderated the effect of temperature on response behavior. This moderation by audience (high versus low affiliation) would not be predicted by a positivity account. We conclude that although temperature affects positivity, positivity alone cannot explain why we find that temperature influences response behavior.

Because we base our hypothesis on the notion that warmth increases affiliation and thereby affirmation, we expect no effect of temperature if affirmation to a particular item undermines affiliation. As the conventions of communication suggest (Grice, 1975), affirmation is usually the expected response and should thereby be especially pronounced under conditions of affiliation. If, however, affirmation to a specific item signals an explicit motivation to distance oneself from the person asking the question, we would not expect warmth to foster affirmation. To test this boundary condition, we re-ran Study 3b ($N = 121$ MTurk participants), in which we measured participants' feelings of warmth and their responses to the Singelis scale from the perspective of the average American. In addition, we measured participants' responses to three items on which affirmation signals lacking affiliation (e.g., “I would like to avoid doing further studies from this researcher”, $\alpha = 0.62$). In this additional study, we replicated Study 3b, and showed that higher feelings of warmth led to increased affirmation on the combined Singelis scale from the perspective of the average American, $r = 0.192$, $p = 0.035$. However, we found a marginal tendency of reversal of our effect on the three items that signal negative affiliation, $r = -0.164$, $p = 0.072$. We conclude from this study that warmth increases affirmative responding, unless the content of the question undermines affiliation.

One alternative explanation for our effects might be that physical temperature improves people's mood. In that case, warmth would foster affirmative response behavior because people in positive moods often think less critically about the questions or they answer more heuristically (e.g., Forgas, 1998). However, previous literature has documented that physical warmth per se does not affect mood (Ijzerman & Semin, 2009; Ijzerman, Leung, & Ong, 2014; Williams & Bargh, 2008). Similarly, in Study 2, we found no effect of the temperature manipulation on mood (we assessed mood only in Study 2).

Our findings identify temperature as one important moderator that might be easily overlooked when replicating previous work. Recently, attempts to replicate classical social psychological findings have often led to inconclusive results (e.g., Wagenmakers et al., 2016). Our research suggests that including physical temperature or other incidental information about the physical environment of the study (e.g., the current temperature or season) could contribute to the understanding of successful or failed replications. When looking at the warm condition in Study 2 in isolation, one could have concluded that the Awareness and Acceptance scales (Cardaciotto et al., 2008) are significantly correlated. However, attempting to replicate this correlation in colder conditions could have led to the discovery of a null effect.

³ We found no correlation between the two independent variables (friend versus stranger) and how warm or cold participants feel, $p = 0.449$.

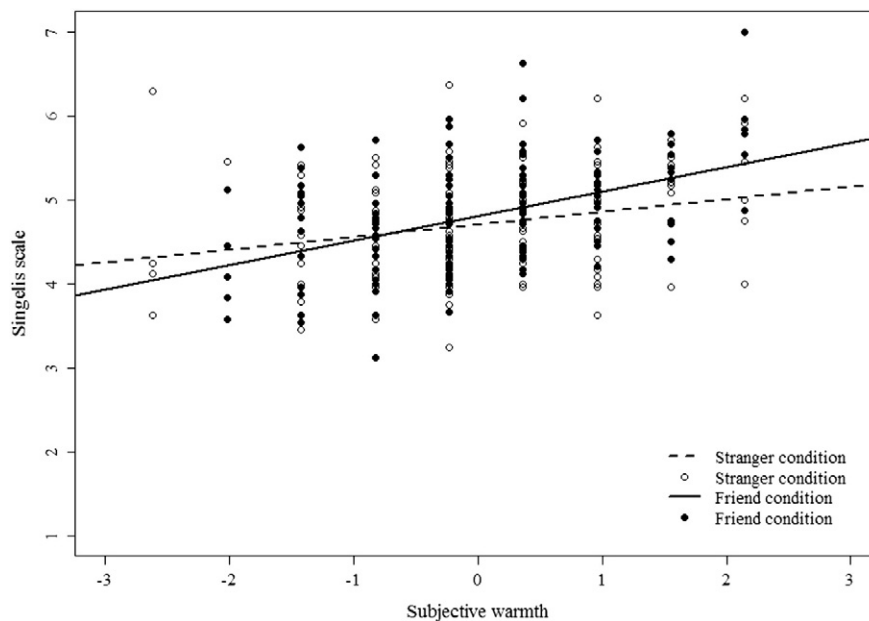


Fig. 2. The correlation between subjective warmth (z-transformed) and responses to the Singelis scale, dependent on audience type (friend versus stranger) in Study 4.

One may also speculate whether previous work on physical warmth could have been affected by biased responding. Individual findings that show psychological effects of exposing participants to warm versus cold conditions might originate from people's tendency to affirm under warm conditions, instead of true cognitive or motivational shifts. To prevent potential artifacts and spurious correlations, future research on physical temperature could take special care to incorporate preventive measures against acquiescent responding (e.g., using semantic differentials instead of Likert scales, Friberg, Martinussen, & Rosenvinge, 2006; or correcting rating scale data, Greenleaf, 1992).

Taken together, we show that physical temperature can affect the way people respond to questions, as a result of affiliation. Thus, warmth and cold can influence general patterns of behavior, and can thereby fundamentally impact psychological research by engendering spurious correlations and fostering systematic biases in people's responses.

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