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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.

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