Commentary

Does Physical Warmth Prime Social Warmth?

Reply to Chabris et al. (2019)

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Is there a psychological link between physical and social warmth? The Williams and Bargh (2008) coffee study is one data point among many that bear on this question. Since its publication there has been a surge of further research on the association between physical and social warmth, especially in neuroscience and medical science. As a result, there is now an array of evidence relevant to (1) the reality of the physical-social warmth pathway and (2) its possible anatomical location and neurochemical mechanisms.

The latest data point in this literature is a particularly important one: Chabris, Heck, Mandart, Benjamin, and Simons (2019) attempted replication of the original work of Williams and Bargh (2008). Because replication is so essential to the scientific process, Chabris et al.'s (2019) findings demand careful consideration. To that end, we situate Chabris et al.'s (2019) findings in the broader literature by providing a summary of the range of evidence bearing on the warmth priming effect, and offer some thoughts as to why Chabris et al.'s (2019) findings diverged from those of Williams and Bargh (2008).

Considering the Full Range of Evidence From Behavioral, Neuro-Imaging, and Neuro-Chemical Research

Chabris et al.'s (2019) findings are part of a larger literature that provides a range of evidence for the physical-to-social warmth link. First came conceptual replications of the coffee study. In one of several successful replications and extensions, IJzerman and Semin (2009) found that after holding a warm beverage, participants reported feeling closer to the significant others in their life compared to participants who had just held a cold beverage (see Schilder, IJzerman, & Denissen, 2014, for an exact replication). Similarly, a controlled study in the UCLA hospital found that participants' body temperatures, taken by nurses every hour during the course of a day, covaried with the participants' hourly ratings of how close they felt to other people at that moment (Inagaki, Irwin, Moieni, Jevtic, & Eisenberger, 2016): the higher their body temperature, within normal range, the closer they felt. Extending this result, Inagaki and Human (in press) found that participants' tympanic temperature, a measure of internal body temperature, assessed several times a day over a 1-week period, covaried with feelings of social connectedness. The same effect held in the field: using "daily diary" methods, Fetterman, Wilkowski, and Robinson (2018) found that for 235 participants going about their daily life outside the lab, on days when the participants reported feeling physically warmer (independently of the actual outdoor temperature), they also rated themselves as more interpersonally warm and agreeable.

The effect also operates in the reverse direction: using a precision body temperature measurement device, IJzerman et al. (2012; also see IJzerman et al., 2015) found that an experience of social coldness (being rejected by others) caused participants to actually become colder – their body temperatures decreased 0.6 of a degree on average following the rejection experience. Also, in a brain imaging study, our research team showed that the same small region of insula became active when participants held something cold as when they were betrayed by their partner (social coldness; the partner kept all the money for themselves) in an online economics game (Kang, Williams, Clark, Gray, & Bargh, 2011).

Brain imaging studies have also supported the existence of an association between physical and social warmth. Inagaki and Eisenberger (2013) showed that the same region of the insula became active when the participant held something physically warm, as when they engaged in socially warm activities such as reading loving messages from their family and friends. And Inagaki, Hazlett, and

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Andreescu (in press) found that both social and physical forms of warmth led to increased activity in the ventral striatum and middle-insula, and did so via the same opioid dependent pathway – the opioid antagonist, naltrexone, blocked this neural activity as well as the emotional responses to both forms of warmth.

Relatedly, "warmth therapy" has been used successfully to treat clinical levels of depression in humans. Hanusch et al. (2013) found in an open trial that whole body hyperthermia (WBH) using an infrared device was effective in significantly and substantially reducing the emotional suffering of hospitalized major depression disorder (MDD) patients over the subsequent 1-week period. These results were replicated in a larger, randomized, sham-controlled trial (Janssen et al., 2016), which found that a single session of WBH reduced depressive symptoms compared to a sham treatment over the study's 6-week follow-up period (see also Inagaki et al., 2016; Raison, Hale, Williams, Wager, Lowry, 2015).

Potentially Important Procedural Differences Between the Replication and the Original Study

So why did Chabris et al. (2019) not replicate Williams and Bargh (2008)? One possible answer has to do with the temperature of the coffee that participants held. Williams and Bargh (2008) took steps to keep the coffee comfortably warm; the coffee shop they used was several blocks away from the site of the experiment, and they used a microwave for subsequent participants to keep the coffee at a pleasantly warm temperature. In contrast, Chabris et al. (2019) purchased a hot or cold coffee at a coffee shop and then conducted the experiment right outside the coffee shop, immediately handing that fresh, hot cup of coffee to passersby who volunteered to take part in the study. Thus, those participants likely held a *piping hot* coffee, unlike in the original study.

If the coffee was piping hot, then, according to the theory that motivated Williams and Bargh, it should not activate the concept of social *warmth* – a positively valenced, pleasant concept. Importantly, "hot" is not the same as "more warm" – it participates in a quite different metaphor having to do with negative emotionality, as in "hot-headedness" (see Metcalfe & Mischel, 1999), and hot, rather than warm, ambient temperatures are linked to increased aggression and violence (Anderson, 1989). Thus, a hot, rather than warm, cup of coffee might be expected to activate concepts such as anger, which are antithetical to social warmth. Consistent with this hypothesis is the fact that the peripheral nervous system tracks skin heating over distinct temperature ranges via separate types of thermoreceptors, including *warm thermoreceptors* (which specifically detect skin temperatures from ~34–42 °C) and *heat nociceptors* (which specifically detect temperatures > 42 °C) (Hale, Raison, & Lowry, 2013; Lowry, Flux, & Raison, 2018; Patapoutian, Peier, Story, & Viswanath, 2003; Raison et al., 2015; Raja, Meyer, Ringkamp, & Campbell, 1999; Rolls, Grabenhorst, & Parris, 2008; for reference, coffee is normally served at temperatures between 70 °C and 85 °C).

If our hypothesis is on track, then we should expect the coffee-warmth effect of Williams and Bargh (2008) to replicate in the Chabris et al. (2019) study after the fresh-from-the-shop hot coffee had cooled down a bit, so that it was more similar in temperature to the coffee used in the Williams and Bargh (2008) study. And indeed, if you look at the Chabris et al. (2019) data broken down by *time since the coffee was purchased*, the warmth priming effect does seem to appear where it would be expected to appear.

Chabris et al. (2019) handed the same cup of coffee to as many as 7 participants before purchasing a new cup. Because of that feature of their procedure, we can check if the physical-to-social warmth effect emerged after the cups were held by the first few participants, at which point the hot coffee (presumably) had gone from piping hot to warm. See in Figure 1 what Chabris et al.'s (2019) data look like when the effect of hot versus cold coffee on ratings of social warmth is broken down by the number of people who previously held that cup of coffee.

Among the first 3 participants to hold a newly purchased hot or cold cup of coffee (0, 1, and 2 on the *x*-axis), no

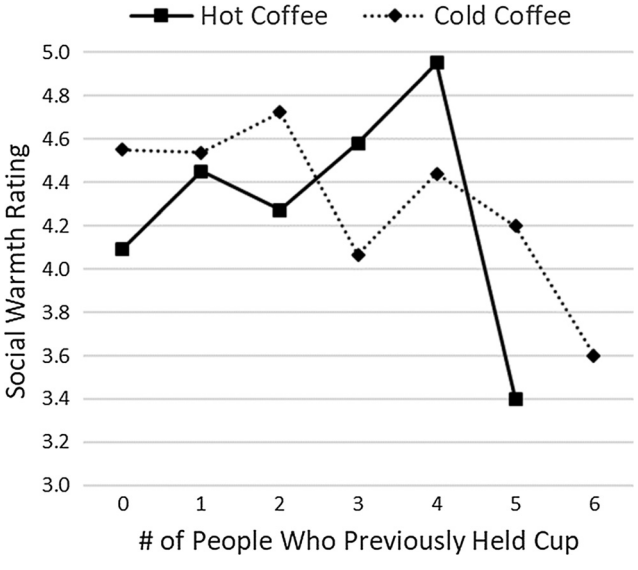

Figure 1. Ratings of social warmth as a function of condition (Hot Coffee vs. Cold Coffee) and the number of people who previously held the (hot or cold) coffee cup. The hot cup was always replaced after the 5th participant, so there are no data for level 6 on the *x*-axis.

physical-to-social-warmth effect emerges. However, among the 4th and 5th participants to hold a cup (3 and 4 on the *x*-axis), those who held the hot coffee rated the social target as warmer compared to participants who held the cold coffee (this effect is not statistically significant, but close: $p = .08$). The effect vanishes again among the final two participants to hold the hot or cold cup. These data are consistent with the idea that, as long as the hot coffee was in the pleasantly warm range (3 and 4 on the *x*-axis), as it was in the Williams and Bargh (2008) study, it activated the concept of social warmth and influenced social judgments accordingly (replicating Williams & Bargh, 2008). But if the coffee was piping hot (0, 1, and 2 on the *x*-axis) or room temperature (5 on the *x*-axis), no such effect emerged. Of course, this is a post hoc story that requires further testing. To this end, we are discussing a pre-registered, collaborative study with Chabris and colleagues to directly test this alternative explanation.

In conclusion, the question of the reliability of the coffee study paradigm bears on – but is not equivalent to – the reliability of the physical-to-social warmth effect, for which there are now several other lines of supporting evidence. Moreover, there are plausible (and theoretically interesting) explanations for Chabris et al.'s (2019) findings that are consistent with Williams and Bargh's (2008) original results – explanations that we hope to test with the help of Chabris and colleagues in line with the current best practices for reproducible science.

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