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INTRODUCTION



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Research Article

# The temperature premium: Warm temperatures increase product valuation☆

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**Abstract**

A series of five field and laboratory studies reveal a *temperature-premium* effect: warm temperatures increase individuals' valuation of products. We demonstrate the effect across a variety of products using different approaches to measure or manipulate physical warmth and different assessments of product valuation. The studies suggest that exposure to physical warmth activates the concept of emotional warmth, eliciting positive reactions and increasing product valuation. Further supporting the causal role of emotional warmth, and following prior research relating greater positive feelings to reduced distance, we find that warm temperatures also reduce individuals' perceived distance from the target products.


*Keywords:* Environmental effects; Sensory marketing; Embodied cognition; Product valuation; Emotions

## Introduction

Consider a consumer who enters a mall. He shops and cruises among the different retail stores, immersing himself in the shopping environment. While he examines and evaluates the various products on display, to what extent might the ambient temperature affect his buying decisions?

Consumers experience a myriad of sensorial stimuli in their shopping environment that may cloud their judgments and bias their decisions (Krishna, 2012; Turley & Milliman, 2000). Despite burgeoning research on the effects of temperature (Bargh & Shalev, 2012; Williams & Bargh, 2008), temperature's impact on individuals' perception and evaluation of products has received less attention. In five studies involving both laboratory experiments and the analysis of field data from an actual shopping website, we show that individuals exposed to warm temperatures express higher valuations for a variety of products ("temperature premium"). Our work highlights the close link between bodily sensations and consumer behavior while offering a plausible theory to explain this effect.

## Warmth and affective reactions

As the metaphor "affection is warmth" suggests (Lakoff & Johnson, 1999), the notion of warmth is often conceived as an affective state (Coke, Batson, & McDavis, 1978; Davitz, 1969). Consistent with embodiment theories, we suggest that physical warmth can produce a similar affective state as emotional warmth. This association stems from the argument that many abstract psychological concepts are metaphorically grounded in concrete physical experiences (Barsalou, 1999; Lakoff & Johnson, 1980), and that objects and events that produce the same affective reactions are associated together in memory (Barsalou, Simmons, Barbey, & Wilson, 2003). The physical warmth one experiences

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when holding a warm object or sitting in a warm room consequently activates the abstract concept of emotional warmth (e.g., intimacy, belonging). This emotional-warmth activation, in turn, generates positive affect and increases valuation of the product. This is akin to the "intraconceptual mechanism" of the effects of bodily responses on abstract concepts (Landau, Meier, & Keefer, 2010): physical experiences are a part of the representation of abstract concepts, and abstract concepts can correspondingly stimulate associated bodily responses (Zhang & Li, 2012).

To test the conjecture that exposure to physical warmth activates the concept of emotional warmth and its associated positive feelings, we conducted a preliminary online study (all studies were conducted in Hebrew). Forty-four students living in Israel (50% female; mean age = 29.5) participated in this study in exchange for NIS4 (equivalent to US$1.12). Participants were randomly assigned to either a warm or a cool condition. We manipulated temperature by asking participants to place their palms on either their computer's warmest spot or their desk's coolest spot for 10 s and to estimate its temperature in the guise of testing temperature-estimation abilities. Subsequently, in a purportedly unrelated task, participants viewed a product (chocolate cake) and rated their feelings along eight dimensions, half pertaining to feelings of emotional warmth (e.g., close, intimacy) whereas the other half pertaining to other positive attitudes unrelated to emotional warmth (e.g., innovative, fascinating) (1 = not at all; 7 = very much). Participants in the *warm* condition reported feeling greater emotional warmth ($M = 3.90$, SD = 1.50) than participants in the *cool* condition ($M = 2.97$, SD = 1.51; $t(42) = 2.06$, $p = .046$). However, participants' emotional-warmth unrelated assessments did not differ across conditions (all $p > .58$).

## Warmth and product valuations

Environmental factors (e.g., music and lighting), despite being product-irrelevant, often shape consumers' response to external products and purchase decisions (Belk, 1975; Krishna, 2012). We posit that the incidental positive affect, which exposure to physical warmth triggers by invoking the abstract concept of emotional warmth, has a spillover effect that engenders congruent (positive) product valuations.

Our temperature-premium hypothesis is conceptually consistent with the implications of two separate streams of research. First, temperature has recently been found to influence interpersonal relationships and individuals' judgment of others (Bargh & Shalev, 2012; Vess, 2012; Zhong & Leonardelli, 2008). Physical warmth, for instance, promotes social warmth (Bargh & Shalev, 2012), fosters interpersonal trust (Kang, Williams, Clark, Gray, & Bargh, 2011), and enhances one's positive assessment of others (Williams & Bargh, 2008). Second, individuals tend to anthropomorphosize inanimate objects around them (Aggarwal & McGill, 2007), and often develop and maintain strong personal relationships with brands (Albert, 2010; Fournier, 1998). Considering these findings, we expect physical warmth to also positively influence individuals' evaluation of inanimate objects. Consistent with this prediction, thinking of the color of one's car in "warm" (vs. "cold") terms positively influenced evaluations of the car (Chandler & Schwarz, 2010). However, while physical warmth induces emotional warmth that influences *subjective* valuations of target products (e.g., willingness-to-pay), it may have lower impact on *objective* assessments (e.g., retail price) of these products.

We examine how physical warmth influences product valuation in five field and lab studies. Study 1 analyzes real behavior on a popular online-shopping website, revealing that warm temperatures increase product-purchase intention. In studies 2A and 2B, we replicated the basic effect of temperature on product valuation in a controlled lab setting. We then examined in studies 3 and 4 the underlying process of this effect using mediation analysis and testing whether warmth influences distance perception. We examined the impact of temperature by recording actual temperature over a 24-month period (Study 1), manipulating ambient temperature (Study 2B), or exposing participants to objects of different temperatures in an unrelated task (Studies 2A, 3, and 4). We operationalized product valuation by measuring intention-to-purchase (Study 1), willingness-to-pay for target products (Studies 2A, 2B, and 4), or likelihood of choosing a target product over cash (Study 3).

## Study 1: Field study

We first examined whether temperature effects on product valuation are observable in a noisy real-world environment, using data from a large price-comparison shopping portal (see Appendix for details). Product information on this portal is organized into various broad product domains, each containing a number of product categories and sub-categories. Through navigating the hierarchy of categories or searching for specific products, visitors can compare the details (e.g., prices) of multiple external sellers for the same product. By clicking on a "To-Purchase" button for a particular seller, they can then access the seller's website directly from the portal to purchase the product. The number of "To-Purchase" clicks for a product category thus provides a measure for shoppers' purchase intention of products in that category.

We focus on this intention-to-purchase measure, analyzing 24 months of available data (September 2010–August 2012; $n$ = 6,364,239 clicks) from eight product categories (e.g., watches). Specifically, we examined how daily temperatures affected purchase intention within these categories. We calculated the average temperature for each day ($M$ = 20.4 °C, SD = 6.0 °C, range = 6.3 °C to 31.6 °C) and conducted three regressions to examine whether physical warmth increases purchase intention (see Appendix). Model 1 tests the basic temperature-premium effect, regressing intention-to-purchase on temperature and dummy variables to control for day of the week and product category. In Model 2, we added a quadratic term for temperature to investigate a potential nonlinear effect: we expect the temperature-premium effect to attenuate as temperature reaches higher levels. Finally, to rule out an alternative explanation that vacation times or specific seasons drive the effect, Model 3 incorporates additional seasonality-related dummy variables.

*Results*

Table 1 presents the estimation results for the three models. As expected, there was a significant positive effect of temperature on intention-to-purchase ($\beta = .026$, $p \leq .001$). The squared-temperature predictor added in Model 2 is negative and marginally significant ($\beta = -.039$, $p = .099$), suggesting that the temperature-premium effect is nonlinear: as the temperature increased, its effect on purchase intention diminished (see Fig. 1).

Finally, Model 3 does not qualitatively alter the main results, indicating that the effect persists even after controlling for holidays and seasons. To further isolate the effect of temperature beyond seasonality, we ran an additional analysis involving dyads of the same day of the year across the two years (e.g., March 1 in Year 1 with March 1 in Year 2; see Appendix). Results remained significant with a larger effect size ($\beta = .067$, $p \leq .001$).

An interesting question is whether these empirical results are driven by the temperature of the day or by day-to-day shifts in temperature. Although the regression results imply that the positive effect of temperature on purchase intention pertains to the former, we conducted further analyses to examine this question. First, regressing intention-to-purchase on the difference between the day's average temperature and the previous day's average temperature yielded a marginally significant effect in the opposite direction ($\beta = -.005$, $p = .075$). Second, regressing intention-to-purchase on the difference between the day's average temperature and a moving average 30-day (±15 days) temperature did not yield a significant effect either ($\beta = -.002$, $p = .61$), although, in a separate regression, the moving average 30-day temperature itself did yield a significant positive effect ($\beta = .028$, $p \leq .001$). Taken together, these results suggest that the observed effect is more likely to pertain to the temperature of the day (vs. day-to-day temperature shifts).

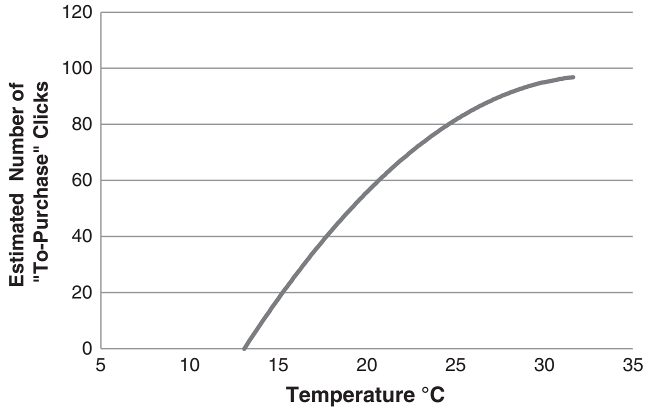


Fig. 1. Pattern of the non-linear relationship between temperature and purchase intention (Study 1).

## Study 2A: Warm versus cool therapeutic pad and willingness-to-pay

This study tests the impact of physical warmth on willingness-to-pay as a measure of product valuation within a controlled

Table 1
Regression analysis of purchase intention and daily temperature (Study 1).

| Independent variable | Model 1 | | | Model 2 | | | Model 3 | | |
|---|---|---|---|---|---|---|---|---|---|
| | *B* | *SE B* | *β* | *B* | *SE B* | *β* | *B* | *SE B* | *β* |
| Average daily temperature | 6.486 | .776 | .026 *** | 16.223 | 5.960 | .064 ** | 18.312 | 7.284 | .072 ** |
| Square of average daily temperature | | | | −.246 | .149 | −.039 * | −.301 | .183 | −.047 * |
| Sunday | 171.383 | 14.636 | .045 *** | 170.652 | 14.640 | .044 *** | 173.350 | 14.655 | .045 *** |
| Monday | 74.358 | 14.792 | .019 *** | 73.100 | 14.809 | .019 *** | 77.331 | 14.866 | .020 *** |
| Tuesday | 56.903 | 14.638 | .015 * | 55.144 | 14.674 | .014 *** | 57.600 | 14.699 | .015 *** |
| Wednesday | 25.958 | 14.601 | .007 * | 25.230 | 14.605 | .007 * | 26.989 | 14.606 | .007 * |
| Product-category 1 (cameras) | 4521.096 | 18.693 | .976 *** | 4521.096 | 18.689 | .976 *** | 4521.096 | 18.668 | .976 *** |
| Product-category 2 (cell-phone accessories) | 72.285 | 18.693 | .016 *** | 72.285 | 18.689 | .016 *** | 72.285 | 18.668 | .016 *** |
| Product-category 3 (living rooms) | 627.446 | 18.693 | .135 *** | 627.446 | 18.689 | .135 *** | 627.446 | 18.668 | .135 *** |
| Product-category 4 (books) | −23.115 | 18.693 | −.005 | −23.115 | 18.689 | −.005 | −23.115 | 18.668 | −.005 |
| Product-category 5 (hand watches) | 1768.854 | 18.693 | .382 *** | 1768.854 | 18.689 | .382 *** | 1768.854 | 18.668 | .382 *** |
| Product-category 6 (logic games) | −26.690 | 18.693 | −.006 | −26.690 | 18.689 | −.006 | −26.690 | 18.668 | −.006 |
| Product-category 7 (recordable CD's) | −32.561 | 18.693 | −.007 * | −32.561 | 18.689 | −.007 * | −32/561 | 18.668 | −.007 * |
| Holidays 1 | | | | | | | 46.533 | 17.934 | .009 ** |
| Holidays 2 | | | | | | | 59.258 | 21.423 | .009 ** |
| Holidays 3 | | | | | | | 24.927 | 23.018 | .004 |
| Summer | | | | | | | 9.104 | 18.158 | .003 |
| Fall | | | | | | | −22.805 | 15.812 | −.006 |
| Winter | | | | | | | 8.518 | 19.910 | .002 |
| Adjusted $R^2$ | | | .961 | | | .961 | | | .961 |

*Notes*. The table presents unstandardized regression coefficients (*B*), their standard errors (*SE B*), and standardized coefficients (*β*).
* $p < .10$, two-tailed.
** $p < .05$, two-tailed.
*** $p \leq .001$, two-tailed.

laboratory setting. Forty-six students from a large University in Israel (41% female; mean age = 24.5) participated in this study in exchange for either course credit or 7 NIS. Participants were told that they would participate in several unrelated studies. First, using a previously employed temperature manipulation (Kang et al., 2011; Williams & Bargh, 2008), we randomly assigned participants to hold and examine either a warm (average 45 °C) or a cool (average 12 °C) therapeutic pad for 10 s under the guise of a product-evaluation task. They were told that the therapeutic pad was designed to relieve aches. While holding the pad in one hand, participants then completed a questionnaire in which they (i) rated the pad's effectiveness (1 = not effective; 7 = very effective); (ii) indicated whether they would recommend it to their friends (1 = will not recommend; 7 = will highly recommend); (iii) suggested a commercial name for the pad, and; (iv) estimated the pad's temperature (Williams & Bargh, 2008). The first three items helped bolster the cover story, while the final item served as a manipulation check. Participants estimated the temperature of the cool pad ($M$ = 7 °C) to be lower than that of the warm pad ($M$ = 40 °C), $t(44) = 10.3$, $p \leq .001$.

Subsequently, in a purportedly unrelated study, participants were shown two products (order counterbalanced; no effect was found for order) which they were told were offered for sale—a hedonic item (a slice of chocolate cake) and a utilitarian item (a six-pack of batteries); we used different types of products to test the robustness of the effect. Participants were asked to indicate the maximum price they were willing to pay for each product. They also estimated each product's retail price and guessed the purpose of the study.

### *Results*

Participants' were willing to pay significantly more for both products in the warm condition (standardized $M$ = .33, SD = .75) than in the cool condition (standardized $M = -.35$, SD = .59, $t(44) = 3.39$, $p \leq .001$, $d = 1.01$; see Table 2), translating to an average temperature premium of 36.1% in the warm condition. In contrast, although participants' retail-price estimates of the products were correlated with their willingness-to-pay ($r = .56$, $p \leq .001$), their retail-price estimates did not differ significantly across conditions (standardized $M_{warm} = .17$, SD = .85; standardized $M_{cool} = -.22$, SD = .77), $t(44) = 1.61$, $p = .12$.

Similar to Williams and Bargh (2008) and Kang et al. (2011), participants rated the warm pad ($M$ = 4.7) to be more effective than the cool pad ($M$ = 3.6), $t(44) = 2.9$, $p = 0.06$, and were more likely to recommend the former to their friends ($M$ = 4.3 vs. 3.2), $t(43) = 2.40$, $p = 0.02$. However, these ratings did not predict willingness-to-pay for either product (cake: $r_{pad\text{-}effectiveness,\ WTP} = .18$, $p = .15$; $r_{recommend\text{-}pad,\ WTP} = .17$, $p = .19$; batteries: $r_{pad\text{-}effectiveness,\ WTP} = .18$, $p = .16$; $r_{recommend\text{-}pad,\ WTP} = 0.9$, $p = .48$).

## Study 2B: Room temperature and willingness-to-pay

In Study 2B, we sought to replicate Study 2A while extending the range of products to examine the generalizability of the temperature-premium effect. Additionally, we used a more subtle approach to manipulate physical warmth in order to rule out the possibility that other non-temperature-related idiosyncratic differences between the pads (e.g., perceived pad effectiveness) had produced the earlier results. Specifically, we manipulated the temperature in the room where we conducted the study (while keeping room pleasantness constant) by adjusting the room's air conditioning one hour before the study's commencement. Using Anderson, Deuser, and DeNeve's (1995) comfortable indoor temperature (22 °C) as the reference point, we set the temperature in the warm (cool) condition to be approximately 4 °C above (below) 22 °C.

We randomly assigned 109 students from a large University in Israel (48% female; mean age = 23.7) to one of the two conditions. Participants received either course credit or 7 NIS. Upon arrival at the temperature-controlled room, participants first completed a registration form for approximately 3–4 min, allowing them to adjust to the room's temperature before the main study. Next, participants were told that they would be presented with a number of products that were available for purchase. They perused 11 color images of different target products that college students typically consume, displayed in a random sequence, and indicated their willingness-to-pay for each product (see Table 3). Finally, participants were probed for suspicion, estimated the room temperature, indicated whether they had spent the hour before arrival outdoors or inside the university buildings, and rated the room's pleasantness (1 = not at all; 7 = very much). Since we conducted this study

Table 2
Comparison of willingness-to-pay (WTP) by therapeutic-pad temperature (Study 2A).

| | WTP in cool condition (NIS) | | WTP in warm condition (NIS) | | | Temperature premium (%) |
|---|---|---|---|---|---|---|
| Product | *M* | *SD* | *M* | *SD* | *t*(44) | |
| Product 1: Slice of cake | 11.41 | 5.41 | 16.42 | 6.55 | 2.81 ** | 43.9 |
| Product 2: Batteries | 12.30 | 5.61 | 15.83 | 5.72 | 2.12 ** | 28.7 |
| Average of Standardized means (across products) | −.35 | .59 | .33 | .75 | 3.39 *** | 36.1 |

*Note.*
** $p < .05$, two-tailed.
*** $p \leq .001$, two-tailed.

Table 3
Comparison of willingness-to-pay (WTP) by room temperature (Study 2B).

| | WTP in cool condition (NIS) | | WTP in warm condition (NIS) | | | Temperature premium (%) |
|---|---|---|---|---|---|---|
| Product | *M* | *SD* | *M* | *SD* | *t*(96) | |
| Milk | 8.64 | 2.74 | 9.97 | 2.88 | 2.33 ** | 15.4 |
| Cup of coffee | 8.22 | 3.39 | 9.98 | 3.44 | 2.54 ** | 21.4 |
| Dove bath gel | 15.07 | 4.64 | 18.78 | 5.86 | 3.5 *** | 24.6 |
| Coca Cola can | 4.98 | 1.39 | 5.44 | 1.24 | 1.70 * | 9.2 |
| Duracell batteries | 18.69 | 10.96 | 21.09 | 8.48 | 1.20 | 12.8 |
| Massage | 127.88 | 65.23 | 125.87 | 61.99 | −.16 | −1.5 |
| Music CD (from a well-known singer) | 39.42 | 24.27 | 46.26 | 27.96 | 1.30 † | 17.4 |
| M&M | 8.12 | 8.27 | 9.28 | 5.47 | .81 | 14.3 |
| Mouse | 70.01 | 78.79 | 72.61 | 46.80 | .13 | 3.7 |
| Pop corn | 11.23 | 4.91 | 11.70 | 5.63 | .44 | 4.2 |
| Gap T shirt | 45.08 | 26.91 | 41.63 | 25.34 | −.65 | −7.7 |
| Average of Standardized means (across products) | −.11 | .53 | .13 | .50 | 2.26 ** | 10.35 |

*Note.*
* $p < .10$, two-tailed.
** $p < .05$, two-tailed.
*** $p \leq .001$, two-tailed.
† $p < .10$, one-tailed.

over two waves (in November and May–June respectively; results did not differ across waves) with different weather conditions, we recorded outdoor temperatures in the university area. Eleven participants were suspicious of the manipulation and were hence excluded from the sample, leaving 98 valid observations.

### *Results*

Consistent with the results of Study 2A, participants in the warm room were willing to pay more (standardized $M = .13$, SD = .49) on average for the 11 products than participants in the cool room ($M = -.11$, SD = .53), $t(96) = 2.26$, $p = .03$, $d = .47$ (Table 3). A comparison-by-product analysis revealed that participants were willing to pay more for nine of the 11 products when assessing them in a warm room. For example, willingness-to-pay for a container of bath gel was on average 18.78 NIS (equivalent to US$ 5.34) in the warm condition but only 15.07 NIS in the cool condition. Overall, ambient warm temperature increased product valuation over cool temperature by 10.4%. Neither outdoor temperature nor participants' location before the study affected willingness-to-pay (both $p > .42$). Importantly, participants' rated room-pleasantness did not differ between conditions ($M_{warm} = 3.44$, SD = 1.81; $M_{cool} = 3.37$, SD = 1.77), $t(96) = .19$, $p = .85$, indicating that the increase in willingness-to-pay cannot be explained by differential levels of experienced (dis)comfort that the different temperatures in the room across conditions directly induced.

## Study 3: Temperature and affective reactions

We tested the hypothesized mechanism underlying the temperature-premium effect in the remaining studies. In Study 3, we measured individuals' affective reactions after exposure to different temperatures, and expected these responses to mediate the effect. Further, we examined the effect with a different, consequential measure of product valuation: real choice between a target product and money.

We used the same temperature manipulation as in Study 2A. Sixty-four students from a large University in Israel (41% female; mean age = 23.4) participated in the study in exchange for course credit and were told that they would be participating in several unrelated studies. First, as in Study 2A, participants touched and evaluated either a warm or a cool pad under the guise of a product-evaluation study. Next, in an ostensibly unrelated task, they were asked to examine a pen placed 40 cm in front of them on the desk, and instructed not to touch the pen. Using a scale developed by Derbaix (1995) (see also Peck & Shu, 2009; Peck & Wiggins, 2006), we asked participants to rate the extent to which they experienced each of seven emotional reactions while evaluating the pen (interested, moved, captivated, delighted, enthusiastic, appealed, and amused) (1 = not at all; 7 = a lot); the average of these ratings ($\alpha = .85$) serves as our mediator measure for the temperature-premium effect. Finally, participants were thanked for their participation and were told that they were entitled to receive a reward in addition to course credit. Specifically, they were asked to choose between receiving the pen and receiving money (3 NIS; equivalent to US$ 0.80) as their reward—our main dependent measure. One participant was suspicious of the manipulation and was hence excluded from the sample, leaving 63 valid observations.

### *Results*

Participants reported experiencing greater positive reactions after touching the warm pad ($M = 3.23$, SD = .97) than the cool pad ($M = 2.44$, SD = .93), $t(61) = 3.30$, $p = .002$, $d = .83$. Participants who touched the warm pad were also more likely to choose the pen over money than those who touched the cool pad (74.2% vs. 46.9%), $\chi^2 = 4.91$, $p = .027$, $\varnothing = .28$.

We ran a series of regressions to further examine the relationships among these variables. Temperature condition (1 = warm; 0 = cool) significantly predicted product choice ($\beta = 1.18$, $p = .029$) and positive reaction ($\beta = .79$, $p = .002$). Additionally, positive reaction significantly predicted product choice ($\beta = .79$, $p = .009$). However, regressing product choice on both temperature and positive reaction revealed that positive reaction, but not temperature, predicted product choice ($\beta_{temperature} = .76$, $p = .197$; $\beta_{positive\ \ reaction} = .65$, $p = .040$). Together, these regression results indicate that positive reaction mediated the effect of temperature on product choice. A bootstrap analysis using the INDIRECT SPSS macro (Preacher & Hayes, 2008) confirmed a significant mediating pathway from physical warmth to product choice through positive reaction (95% CI: .04, 1.37).

Participants estimated the temperature of the warm pad to be higher ($M = 37.77$ °C) than that of the cool pad ($M = 10.28$ °C), $t(61) = 13.51$, $p \leq .001$. As in Study 2A, participants rated the warm pad ($M = 4.74$) to be significantly more effective than the cool pad ($M = 3.25$), $t(61) = 4.49$, $p \leq .001$, and were more likely to recommend it to their friends ($M_{warm} = 4.48$ vs. $M_{cool} = 2.69$; $t(61) = 4.95$, $p \leq .001$). Both ratings were also positively correlated with product choice ($r_{pad\text{-}effectiveness,\ product\ choice} = .32$, $p = .01$; $r_{recommend\text{-}pad,\ product\ choice} = .32$, $p = .01$), and positive reaction ($r_{pad\text{-}effectiveness,\ positive\text{-}reaction} = .38$, $p = .002$; $r_{recommend\text{-}pad,\ positive\text{-}reaction} = .34$, $p = .007$). However, they did not mediate the effect of temperature on product choice (95% CI: −.15, 1.37 for pad-effectiveness and 95% CI: −.19, 1.43 for pad-recommendation).

## Study 4: Temperature and distance perception

The results of Study 3 suggest that differential degrees of positive reaction underlie the effect of temperature on product valuation. We posit that this positive reaction was generated by the activation of emotional warmth due to physical-warmth exposure. To seek further evidence for this proposed mechanism, we draw upon an association between emotional warmth and distance perception that some recent work has suggested: emotional intensity reduces psychological distance (Van Boven, Kane, McGraw, & Dale, 2010). The more positive people feel about a location or object, the closer they perceive it to be (Alter & Balcetis, 2011). Therefore, if physical warmth indeed increases product valuation by generating greater emotional warmth and positive reaction, then physical warmth should also reduce individuals' perceived distance from the product (c.f., Fay & Maner, 2012).

We tested this hypothesis in Study 4, randomly assigning 71 participants from a large University in Israel (52% female; mean age = 24.1) to evaluate either a warm or a cool pad as in studies 2A and 3. The students received either course credit or 10 NIS for their participation. Next, in an ostensibly unrelated task designed presumably to examine distance-estimation abilities, the experimenter placed a pen exactly 40 cm away from the edge of the desk and instructed participants to estimate its distance from them as accurately as possible without touching it. Participants were also asked to indicate their willingness-to-pay for the pen. Five participants were suspicious of the manipulation and were thus excluded from the sample, leaving 66 valid observations.

### Results

As before, participants estimated the temperature of the cool pad ($M = -1$ °C, SD = 8.89 °C) to be lower than that of the warm pad ($M = 46$ °C, SD = 15.86 °C), $t(64) = 15.28$, $p \leq .001$. No significant difference, however, was found in rated pad effectiveness or pad-recommendation likelihood.

Participants in the warm condition were again willing to pay more for the pen ($M = 8.72$, SD = 2.96) than those in the cool condition ($M = 7.20$, SD = 2.68), $t(64) = 2.19$, $p = .033$, $d = .54$, suggesting a temperature premium of 21.1%. Importantly, we found that exposure to physical warmth reduces distance perception: participants who had touched the warm pad estimated the pen to be closer to them ($M = 29.81$ cm, SD = 13.39 cm) than participants who had touched the cool pad ($M = 38.03$ cm, SD = 14.75 cm), $t(64) = -2.36$, $p = .021$, $d = .58$, providing convergent support for our hypothesized process. Notably, these findings also correspond to the direct metaphorical link between warmth and closeness (Ijzerman & Semin, 2009).

## General discussion

Across five studies involving both field data from a shopping website and laboratory experiments, and using a variety of products and temperature manipulations, we consistently found that exposure to physical warmth increases product valuation. Importantly, we found that this temperature-premium effect is mediated by the positive reactions that emotional warmth—which physical warmth activates—induces. This warmth-affect link was evident in both participants' self-reported affective reactions as well as their reduced distance perception due to warmth.

Although temperature effects have received much attention in social psychology, whether temperature influences product valuation has been relatively less explored (see Cheema & Patrick, 2012; Hong & Sun, 2012 for recent exceptions). By demonstrating the existence of a *temperature-premium* for a wide variety of products and examining its underlying mechanism, this work offers new insights into the ease with which incidental environmental factors influence people's decisions in a product-evaluation context. Additionally, the (emotional-warmth) affect-based process which mediates the phenomenon potentially enhances our understanding of the psychology underlying many recently reported temperature-triggered embodiment phenomena (Kang et al., 2011; Williams & Bargh, 2008). In particular, our results suggest that a combination of metaphorical activation and affect is instrumental in temperature's influence on various aspects of interpersonal behavior such as trust and generosity.

While we have provided some initial evidence for our hypothesized account for the temperature-premium effect, the effect may also have been simultaneously driven by a more direct feelings-as-information account (Pham, 1998; Schwarz

& Clore, 1983): people misattribute the positive feelings they experience from physical warmth and comfort to their responses toward the focal products. The fact that self-reported room comfort did not differ significantly in Study 3 suggests that this account may be insufficient.

To further examine how much of the phenomenon is explained by a direct temperature effect (i.e., physical warmth induces positive feelings) versus an indirect effect (i.e., physical warmth induces emotional warmth, which generates greater positive reactions), we conducted a preliminary study in which we compared whether priming the abstract concept of emotional warmth would generate the same degree of positive response as exposure to physical warmth. Eighty-six students in Israel (51% female; mean age = 27.0) were randomly assigned to one of three conditions, receiving 4 NIS each for their participation. In the *physical-warmth* condition, participants first completed a task purportedly designed to test their temperature-estimation ability: they were instructed to place their palms on the warmest spot of their computers and estimate its temperature. In the *emotional-warmth* condition, participants instead completed a word-scrambling task in which they were given 8 sets of words and had to rearrange four of the five words in each set to form a sentence (DeWall & Bushman, 2009; Vess, 2012); the sets contained words related to emotional warmth (e.g., "belong") that prime the concept of emotional warmth. Finally, in the *control* condition, participants completed a similar word-scrambling task but none of the words were related to emotional warmth. Subsequently, all participants viewed a product (chocolate cake) and were asked to indicate their affective reactions using the same scale as in Study 3 ($\alpha = .89$). Participants reported greater positive reactions in both the physical-warmth ($M = 3.81$, SD = 1.47; $t(54) = 1.95$, $p = .056$) and the emotional-warmth condition ($M = 3.92$, SD = 1.54; $t(56) = 2.21$, $p = .031$) than participants in the control condition ($M = 3.11$, SD = 1.23), while the two former conditions did not differ significantly ($t(56) = .27$, $p = .79$). While these results suggest that the activated emotional-warmth concept is sufficient to engender the effect, lending support to our hypothesized mechanism, the use of path analysis and other methodologies would be necessary to further investigate the relative strengths of the two effects.

Two other potential alternative explanations for the observed effect are that higher temperatures trigger greater impulsivity or resource depletion, hence increasing product valuation. However, as evident in participants' own temperature estimates, the warm temperatures to which we exposed participants in the studies were mild (vs. extremely hot) and were therefore unlikely to invoke greater impulsiveness or resource depletion. Additionally, there was no indication in any of the lab experiments that participants in the warm condition took less or more time to evaluate the products, which would otherwise have suggested greater impulsivity (Buss & Plomin, 1975) or resource depletion (Schmeichel, Vohs, & Baumeister, 2003). Nonetheless, future research could further examine the role of these potential mechanisms.

Our results also raise other questions which offer additional opportunities for future research. First, would a temperature premium exist for all products? We think not, considering products or brands for which people have strong preferences, or products typically consumed in cold weather (e.g., gloves) or hot weather (beachwear) (Bahng, Kincade, & Tech, 2009). Second, whether physical warmth induces greater "liking" versus "wanting" (Berridge, Robinson, & Aldridge, 2009) can be further examined. Third, at what temperature does the effect reach its peak, and what are the factors that influence this temperature level? The nonlinear relationship between temperature and intention-to-purchase (Study 1) has potential practical importance and deserves further enquiry.

## Appendix A. Supplementary information on data and regression models (Study 1)

Additional information for Study 1:

a. Country: Study 1 was conducted using data from a large price-comparison shopping portal (Zap Price Comparison) in Israel. The vast majority of the visitors to this website live in Israel.
b. Choice of four cities: We averaged the daily temperatures of four main cities in Israel, using data from a weather-forecast website. The cities Haifa, Beer Sheva, Tel Aviv, and Jerusalem, were chosen to, respectively, correspond to the largest city of the four climate regions in Israel: north, south, shore, and mountains.
c. Temperature range: The data we obtained and analyzed were for a period of 24 months beginning September 2010 and ending August 2012 (weekdays only). Since the website is busiest during 1100-1900 h and 2100-2300 h, we averaged the day and night temperatures ($r = .96$, $p \leq .001$) to create a temperature value for each day. Table A.1 contains the weekday's averages and ranges of temperatures for these 24 months, in the four cities which we analyzed.
d. Product categories: We analyzed data from eight product categories (e.g., watches), each randomly selected from one of the primary domains (e.g., gifts). We ignored seasonal products (e.g., sandals) as well as products that are driven by technological launches (e.g., cellular phones).

**Table A.1** Weekdays and weeknight's averages and ranges of temperatures from September 2010 to August 2012 across 4 cities (Study 1).

| All temperatures in °C | | Mean temperature | Range of temperature | Minimum temperature | Maximum temperature |
|---|---|---|---|---|---|
| Jerusalem | Day | 22.68 | 34 | 5 | 39 |
| | Night | 13.56 | 27 | 0 | 27 |
| Tel-Aviv | Day | 25.01 | 27 | 11 | 38 |
| | Night | 17.56 | 24 | 5 | 29 |
| Haifa | Day | 25.18 | 28 | 10 | 38 |
| | Night | 16.81 | 23 | 4 | 27 |
| Beer-Sheva | Day | 27.02 | 31 | 11 | 42 |
| | Night | 15.25 | 26 | 2 | 28 |
| Average of all four cities | Day | 24.97 | 29 | 9 | 38 |
| | Night | 15.79 | 24 | 3 | 27 |
| Average of all four cities (day and night) | | 20.38 | 25 | 6 | 32 |

## A.1. Models analyzed in Study 1

Four regressions examined whether physical warmth increases purchase intention:

*Model 1* tests the basic temperature-premium effect, regressing purchase intention on temperature and dummy variables to control for day of the week (only Sunday through Thursday, as these are the business days in Israel) and product category (eight product categories).

*Model 2* investigates the potential nonlinear effect of temperature on purchase intention; we added a quadratic term for temperature and expected the temperature-premium effect to attenuate as temperature reaches higher levels. See Fig. 1 for the pattern of the non-linear relationship: as the temperature increased, its effect on purchase intention diminished. Given the range of temperatures in our data (6 °C to 32 °C), we do not know whether the effect levels off after 32 °C or peaks at 32 °C.

*Model 3* incorporates additional dummy variables to control for seasonality and major holidays. Specifically we controlled for four seasons: Summer (June 22nd–September 21st), Fall (September 22nd–December 21st), Winter (December 22nd–March 21st) and Spring (March 22nd–June 21st). In the case of the holidays, we included the days of the Passover holiday, the Hanukah holiday, and the first month of the Jewish calendar which is crowded with holidays. As our goal was to control for major holidays which include both long vacations and periods involving gift purchases, we included also the week before each holiday, which is typically the time for buying gifts.

*Dyad Model.* Since Jewish holidays are based on the lunar calendar year, a particular day may be a holiday in one year but not in another. To control for this seasonality factor, since our data cover a 24-month period of transactions, we tested the effect of temperature on intention-to-purchase by forming dyads, each dyad comprising data from the same date of the calendar year across the years (e.g., September 15, 2010, and September 15, 2011). We computed the difference in temperature between these two data points in the dyad (for the same calendar day), and the difference in the number of clicks between these two data points, and regressed the latter on the former, adding dummy variables to control for product category.

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