



# ASSOCIATION FOR CONSUMER RESEARCH

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## **Influence of Warm (Versus Cool) Temperatures on Consumer Choice: a Resource Depletion Account**

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Across four studies, we find that extended exposure to warm (versus cool) temperatures is depleting, hampering performance on complex choice tasks. Speaking to the process, we demonstrate that warm temperatures lead to poor performance on complex tasks because of an increased reliance on System 1 (heuristic) processing.

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# The Effects of Temperature on Consumers Cognitive and Affective Decisions

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## **Paper #1: Warmer or Cooler: Exploring the Influence of Ambient Temperature on Cognitive Task Performance**

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## **Paper #2: Influence of Warm (versus Cool) Temperatures on Consumer Choice: A Resource Depletion Account**

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## **Paper #3: Mental Thermoregulation: Affective and Cognitive Pathways for Non-physical Temperature Regulation**

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## **Paper #4: Physical Warmth and Following the Crowd: The Effect of Ambient Temperature on Preference for Popularity**

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### **SESSION OVERVIEW**

Consumers are continuously exposed to fluctuations in temperature. Some fluctuations happen gradually (e.g. changing seasons), while others happen more suddenly (e.g. stepping inside an air-conditioned store). While previous research documents that consumers' physical surroundings significantly affect their decisions (Belk 1975), temperature remains an understudied atmospheric variable. Despite widespread agreement that temperature influences consumer behavior, the literature is rife with mixed results, partly driven by a lack of consensus on the theoretical mechanism by which temperature exerts its effects. This session addresses the gap in our understanding and reconciles mixed findings by examining in more detail why, when, and how temperature impacts consumer decision-making.

We bring together four papers that explore the impact of ambient temperature on different outcome variables and behaviors: task performance, complex decision-making, social conformity, and processing strategy. Importantly, each paper relies on diverse theoretical bases to investigate the temperature conundrum. Tong and colleagues explore the impact of ambient temperature on task performance using a thermal stress account. While previous literature reported mixed findings regarding the effect of temperature on cognitive task performance, they reconcile the inconsistent findings by showing that the nature of the task interacts with temperature to jointly determine performance level.

Building on the thermal stress paradigm, Cheema and Patrick narrow the theoretical underpinnings by proposing a resource-depletion explanation: warm temperatures increase thermal load, resulting in resource depletion. The authors extend the effects to a different behavioral domain: complex decisions; and postulate

boundary conditions under which warm (vs. cool) temperatures lead to System 1 vs. System 2 processing. The next paper continues exploring the effects of warmer/cooler temperatures on processing style by introducing the notion of "mental thermoregulation." Using a regulatory lens, Hadi, Block and King examine the effect of experienced temperature on individuals' use of cognitive versus affective processing. They find that reliance on emotions/cognitions can function as warming/cooling mechanisms, and thus individuals may alter their decision-making style according to their thermoregulatory objectives. Finally, Huang and colleagues complete the session by exploring the social consequences of ambient temperature independent of affect. Applying a social distance paradigm to the study of ambient temperature, Huang and colleagues explore the effect of ambient temperature on consumers' preferences for popularity (vs. uniqueness). All the papers in this session are in advanced stages of completion, with multiple studies and full papers available.

All these papers explore the impact of temperature on consumer behavior. However, consistent with the conference's theme of appreciating diversity, they draw from various theoretical underpinnings and come to results that may seem conflicting on the surface. We plan to discuss the systematic differences across papers to reconcile these findings. Due to this interesting juxtaposition and general interest in the burgeoning area of temperature, we expect this symposium to stimulate much discussion and appeal to a large group of conference attendees.

## **Warmer or Cooler: Exploring the Influence of Ambient Temperature on Cognitive Task Performance**

### **EXTENDED ABSTRACT**

Although both practitioners and academics agree that temperature affects human cognition in important ways (Hancock, Ross, and Szalma 2007; Williams and Bargh 2008), there is no consensus in terms of how temperature exerts its effect. In fact, mixed results have been observed in the literature (Hancock and Vasmatazidis 1998). While some research suggests that warmer temperatures enhance cognitive task performance (Ramsey 1995; Wyon, Anderson, and Lundqvist 1979), other studies suggest just the opposite (Givoni and Rim 1962; Hancock 1981). We aim to reconcile this discrepancy in the literature by suggesting that task complexity moderates the impact of temperature on task performance. While for simple tasks, cool (vs. warm) temperatures help, the opposite is true for complex tasks. Support for our hypothesis comes from three lines of research.

First, prior research on temperature suggests that heat, which can induce thermal stress, competes for cognitive resource and consequently hurts task performance (Hancock and Warm 1989). Thus, compared to individuals in a cool temperature condition, those in a warm temperature condition should have limited cognitive resource towards the focal task (Ramsey et al. 1983).

Second, a separate line of research suggests that different levels of cognitive resources can prompt alternative information processing modes. When individuals have limited cognitive resource for the focal task, they are likely to engage in less systematic and more heuristic processing (Todorov et al. 2002). Thus, we expect that those in the warm (cool) temperature condition, due to their limited (abundant) cognitive resources, are likely to engage in primarily heuristic (systematic) processing (Cheema and Patrick 2011).

Finally, past research has shown that while systematic processing benefits simple tasks (Frisch and Clemen 1994), heuristic processing is more beneficial for complex tasks (Rieskamp and Hoffrage 1999). Systematic processing is extensive and compensatory, whereas heuristic processing involves limited and selective information processing. The comprehensive nature of systematic processing makes it particularly suited to simple tasks (i.e., tasks that require individuals to process a small amount of information). However, a different pattern of results is expected for complex tasks. Decision makers have limited information-processing capacity. Thus, as task complexity increases (i.e., as the task requires individuals to process a larger amount of information), systematic processing suffers from computational errors and limited memory capacity (Bettman, Luce, and Payne 1998), leading to worse decisions. Heuristic processing, because it relies on less information and is less subject to computational errors, does not lead to worse decisions as task complexity increases. Relatively speaking, then, heuristic (vs. systematic) processing should lead to better performance on complex tasks. Summarizing our theorizing so far, we hypothesize that cool (vs. warm) temperature should prompt greater systematic processing, and consequently lead to better performance on simple tasks; and that, in contrast, warm (vs. cool) temperature activates primarily heuristic processing, and thus leads to better performance on complex tasks.

Our first two studies (1A & 1B) test the above hypothesis. Study 1A used 3 (temperature: warm vs. moderate vs. cool) \* 2 (task complexity: simple vs. complex) between-subject design. The focal task was a classic choice task, which requires participants to select their preferred lottery from four different options (Payne et al., 2008). Options were defined by payoffs for 12 equiprobable events defined by drawing 1 of 4 numbered balls (simple condition) or 1 of 12 numbered balls (complex condition) from a bingo cage. Among the four options, one option had the highest expected value, which represents the correct answer. The study was run with no more than four people per session. The same lab was used, but the temperature was set to be warm (25-26 Celsius), moderate (21-22 Celsius), or cool (16-17 Celsius). Results confirmed our hypothesis, such that when the task was complex, a significantly higher percentage of individuals in the warm temperature condition chose the correct option than that in the cool or moderate temperature condition. However, when the task was simple, participants in the cool (vs. warm) temperature performed better. Study 1B was a theoretical replication of study 1A by using a different task.

Study 2 aims to shed light on the underlying mechanism. If, as we argue, heuristic processing underlies the beneficial effects of warm temperature on complex task performance, then we should observe equally good performance from those in the cool temperature condition if we prompt them to engage in heuristic processing. To induce heuristic processing, we manipulated participants' available cognitive resource by having them remember either a 2-digit or an 8-digit number (Gilbert and Hixon 1991). In line with prior research, we expect that those being asked to remember the short (long) number would have ample (limited) cognitive resources for the focal task, and thus engage in primarily systematic (heuristic) processing (Chen and Chaiken 1999). The study employed a 2 (temperature: warm vs. cool) \* 2 (available resources: high vs. low) between-subject design. The focal task was always the complex lottery task as used in study 1A. As anticipated, when participants had ample resources for the focal task, we replicated prior result such that those in the warm (vs. cool) temperature performed better on the complex lottery task. However, for those with low available resources, they performed equally well regardless of whether they were in the warm or cool temperature condition, presumably.

Study 3 extends our theorizing to the domain of creative cognition. We theorize that warm temperatures, due to its activation of heuristic processing, can enhance creativity. Prior research suggests that the carefree nature of heuristic processing prompts individuals to think freely and thus facilitate creative cognition (Friedman and Förster 2000). In three separate tasks (studies 3A, 3B, and 3C), we found support to this hypothesis.

## **Influence of Warm (versus Cool) Temperatures on Consumer Choice: A Resource Depletion Account**

### **EXTENDED ABSTRACT**

Across four studies, we find that relative to people who are cool, people who are warm are (1) less likely to gamble, especially for difficult gambles, (2) less likely to purchase an innovative product, (3) more likely to rely on System 1 processing, and, (4) more likely to perform poorly on complex cognitive tasks.

### **OVERVIEW OF STUDIES**

#### **Pilot Study**

This study provided preliminary evidence that warm temperatures can impact lottery sales, but only for difficult lotteries. We used daily lottery sales over a one-year period from a large metropolitan county in the USA. Pre-tests revealed that multiple-option lotteries were judged to be more complex relative to single-option lotteries. We find that temperature has a significant negative effect on lottery sales, but only for complex (difficult) lotteries.

#### **Study 1**

replicate in the laboratory the basic effect found in the pilot study. We manipulate the temperature to be either warm (77 degrees Fahrenheit) or cool (67 degrees). Participants are asked how likely they will be to make a series of gambles. We manipulate gamble difficulty by either providing (easy) or not providing (difficult) the expected values of gambles. We find that for difficult gambles, warm (versus cool) individuals are less likely to gamble. However, temperature does not affect likelihood of making easy gambles.

#### **Study 2**

This study implicates resource depletion as the process underlying the effect of temperature. We manipulate temperature to be warm or cool. We manipulate depletion with a procedure used by Baumeister et al. (1998). Participants see a silent video clip of a woman being interviewed. The video also includes common words that appear on one side of the screen. Participants in the depleted condition are told to ignore the words and, if their attention is drawn to the words, to consciously focus it back on the interviewee. Participants in the non-depleted condition are not provided these instructions. The dependent measure is participants' proof-reading performance. We find that for non-depleted individuals, warm participants have lower cognitive performance (the number of correctly identified typos) than cool participants. However, temperature doesn't affect depleted individuals' performance.

#### **Study 3**

This study has two objectives. First, it shows that warm (versus cool) temperatures are depleting. Second, it demonstrates the moderating role of task complexity: warm temperatures lower willingness to adopt an innovative new product, but don't influence adoption of an established product. As before, we manipulate temperature to be warm or cool. We use a complex estimation task to measure performance. The cognitive estimation task requires participants to provide

10 estimates that are typically difficult to generate (for example, one item asks participants to estimate the height of the empire state building, in feet). Each estimate is scored in terms of its variation from a norm determined on the basis of typical responses. More extreme estimates, that are too high or too low, get a higher score (1 or 2) while estimates within the norm are scored as a zero. A higher score on this task has previously been used as evidence of decreased System 2 processing, being inhibited by depletion (Schmeichel et al. 2003). We find that warm participants perform worse (score higher) relative to cool participants. As a control, performance on a 10-item general knowledge task (such as asking people about the capital of a country) is not affected by temperature. As general knowledge responses are likely retrieved from memory rather than constructed, System 2 inhibition doesn't affect performance on this task.

Following the cognitive estimation and general knowledge tasks, participants see a product purchase opportunity. All participants read that they have been looking for an affordable voice recorder to take notes. Half the participants saw an established product (a box-shaped voice recorder) while the remaining saw a new, innovative product (a voice recorder in a pen). We find that among participants who saw the innovative recorder, cool (versus warm) participants were more likely to buy. However, among participants who saw the regular voice recorder, warm (versus cool) participants were more likely to buy.

#### Study 4

This study juxtaposes the effects of depletion and temperature to show that warm temperatures hamper performance on complex tasks because of an increased reliance on System 1 (heuristic) processing. We manipulate temperature to be warm or cool. We manipulate depletion using the video attention task from study 2 (Baumeister 1998). We use the complex estimation task from study 3 to test for the effects of depletion on cognitive performance. We find that for non-depleted participants, warm (vs. cool) temperatures lead to poorer performance with more varied answers. However, the effect of temperature is attenuated for depleted participants. Similar to study 3, neither temperature nor depletion affects performance on the general knowledge task.

We measure propensity for System 1 processing using a task from Mishra et al. (2007), with participants choosing between two cell phone plans (A and B). A cursory examination of the charges associated with above-plan usage suggests Plan A (which is actually the more expensive plan) is superior to Plan B (the frugal plan). However, closer examination reveals that Plan B is more frugal because it gives the user more free in-plan minutes. Mishra et al. (2007) demonstrate that individuals using System 1 are more likely to choose the expensive plan compared to individuals using System 2. We find that among non-depleted participants, warm (versus cool) participants are more likely to choose the expensive plan. By contrast, temperature doesn't affect plan choice among depleted participants.

### **Mental Thermoregulation: Affective and Cognitive Pathways for Non-physical Temperature Regulation**

#### **EXTENDED ABSTRACT**

In the behavioral sciences, the term "cool" processing typically refers to those processes which involve cognitions and critical analysis, while "warm" processing alludes to those systems involving feelings, desires, and emotions (Metcalf & Mischel 1999). This terminology suggests that at least semantically, each of these processes encompasses a distinct thermoregulatory tone. However, if

reliance on emotions can indeed function as a psychologically warming process and reliance on cognitions functions as a psychologically cooling process, individuals may alter their decision-making style according to their thermoregulatory objectives, without conscious awareness. It is precisely this notion that we address in the current research.

The mammalian tendency to physically thermoregulate is well documented in the biological sciences (Kirkes 1899, Alberts & Brunjes 1978). Mammals seek warm stimuli when their body temperature drops below normal, and seek cooling stimuli when their body temperature rises above normal. For humans, however, physical thermoregulation may not be the only way in which regulation can occur. Thermoregulation might be possible via non-physical mechanisms. For example, some research suggests individuals may consume stimulating products and partake in interpersonal activities in response to physical cold (Parker & Tavassoli 2000, Tavassoli 2000, Zhang & Risen 2010). Collectively, such research seems to imply that humans can engage in thermoregulation through non-physical and largely mental means, a process we term "mental thermoregulation." We assume this is indeed the case, and further propose that the use of a particular decision-making style (using either an affective or cognitive pathway) can also serve as a thermoregulatory mechanism.

Thus, we propose that an individual may embody a particular decision-making process that is metaphorically consistent with his or her thermoregulatory *objective* (and thus inconsistent with his or her thermoregulatory *state*), whenever the current state is non-optimal. Our specific hypotheses are as follows:

*Hypothesis 1a: Cooler temperatures lead individuals to rely more on emotions when making decisions.*

*Hypothesis 1b: Warmer temperatures lead individuals to rely less on emotions when making decisions.*

In study 1, participants were assigned to either a cold or warm temperature condition, and were given a binary choice task in which one alternative, chocolate cake, was superior on the affective dimension but inferior on the cognitive dimension compared to the other alternative, fruit salad (procedure borrowed from Shiv & Fedorikhin 1999). Results confirmed a significant main effect of temperature on choice in the hypothesized direction: the cake was chosen more often in the cold temperature condition than in the warm temperature condition. A 4-item decision basis scale ( $\alpha = .84$ ) measured whether decisions across different conditions were based on respondents' affective reactions or cognitions. Specifying a confidence interval of 98%, with 5000 bootstrap resamples, the indirect effect of temperature on choice through decision basis was significant, with a confidence interval excluding zero, suggesting that reliance on emotions mediated the relationship of temperature on choice of cake.

Study 2 was a 2 (temperature: cold vs. warm) x 2 (object description: low sentiment vs. high sentiment) between-subjects design, and examined the degree to which individuals were relying on affect by measuring their WTP for insurance for an object (an antique clock). Presumably, if one is not relying on emotions, there should be no difference between WTP under the two object descriptions. However, if one *is* relying on emotions, we expect WTP to be higher for the object with a high sentiment description. Results revealed a significant temperature by object description interaction. In the cold temperature condition, the difference between the low sentiment and high sentiment conditions was indeed significant, with individuals' WTP higher in the high sentiment condition than in the low sentiment condition. In the warm temperature condition how-

ever, the difference between the two object description conditions was not significantly different.

The third study was a 2 (temperature simulation: cold vs. warm) x 2 (number of pandas: one vs. four) between subjects design. We adapted our procedure from Hsee and Rottenstreich (2004), who argue that when individuals rely on affect in making decisions, they become insensitive to scale. Thus, individuals relying on their emotions are willing to donate as much money to save one panda as to save four pandas, but those using cognitive processing are willing to donate more to save more pandas. Results revealed a significant temperature x number of pandas interaction. In the warm condition, the difference between the one-panda and four-pandas conditions was indeed significant- participants were more likely to donate when there were four pandas in the scenario than when there was only one panda in the scenario). In the cold temperature condition however, subjects appeared to indeed be insensitive to scale- the difference between the one-panda and four-pandas conditions was not significant.

The purpose of our fourth study was to support the thermoregulation explanation by suggesting that the mere use of cognitive versus affective pathways can indeed alter an individual's perception of physical temperature. After the temperature manipulation, participants were given explicit instructions to use either their feelings or evaluative thoughts in assessing a series of scenarios (adapted from Pham 2001), and then asked to indicate how cold/warm they felt, as well as how comfortable they felt temperature-wise. Results indicated that participants in the affective pathway condition felt warmer than those individuals in the cognitive pathway condition, regardless of their initial temperature condition. Further, results produced a significant temperature x processing interaction on comfort: in the cold condition, affective respondents were more comfortable than cognitive respondents, but the reverse was true in the warm condition, supporting our mental thermoregulation account.

Our research suggests that instead of merely reacting to the physical temperature in a metaphorically consistent manner, physical sensations might instead activate a thermoregulatory goal, thus motivating individuals to embody a process with a metaphorically-opposite thermoregulatory tone. This research encourages more research to explore instances in which physical sensations may lead to goal-driven behavior in a pattern that is metaphorically inconsistent with one's current physical state.

### **Physical Warmth and Following the Crowd: The Effect of Ambient Temperature on Preference for Popularity**

#### **EXTENDED ABSTRACT**

The effect of ambient temperature on consumer behavior has seldom been investigated. Furthermore, most prior research has focused on the adverse effects of uncomfortable (very hot or very cold) temperatures (e.g., Anderson et al., 2000). We argue, however, that temperatures within a comfortable range can influence consumers' preferences and behaviors independently of the affect that the temperatures elicit. This possibility is especially relevant to marketing, as most retail stores set the ambient temperature within this range (Baker and Cameron 1996).

We propose that warm ambient temperatures increase consumers' preferences for choice alternatives that are preferred by others. Other research indicates that ambient warmth increases perceptions of social proximity (IJzerman and Semin 2009). We show that these perceptions influence the propensity to follow others' decisions in two different ways.

First, people who experience warm temperatures tend to perceive others as friendlier (Williams and Bargh 2008). When people

view themselves as close to others, they experience a sense of "witness." As a consequence, they may consider conformity to others' decisions to be more socially desirable independently of the validity of these decisions (Gardner, Gabriel and Hochschild 2002). Such social approval-based conformity may facilitate people's fulfillment of their need for affiliation (Baumeister and Leary 1995, Martin, Hewstone and Martin 2003). This motive generally holds for decisions that reflect primarily the decision maker's personal values and lifestyle.

Second, relative to socially distant others, socially close others are also believed to hold more reliable and accurate opinions (Naylor, Lamberton and Norton 2011). To this extent, the adoption of others' views and decisions may occur not only when individuals' primary goal is to gain social approval but also when their financial well-being is at stake (Cialdini 2001, Castelli, Vanzetto, Sherman and Arcuri 2001, Quinn and Schlenker 2002).

We tested the above predictions in four laboratory experiments and a field study of the betting behavior at the racetrack. In the laboratory experiments, participants were seated in a room in which the temperature was either warm (75-77°F) or cool (61-63°F), but in each case was within the comfortable range (Anderson et al. 2000; Baker & Cameron, 1996; Baron & Bell, 1976; IJzerman & Semin, 2009). Experiment 1 examined conformity when decisions were a matter of personal taste. Participants were shown an ad for a museum and asked to report their attitude towards it. In some cases, the ad emphasized popularity ("Visited by Over a Million People Each Year") and in other cases, it stressed uniqueness ("Stand Out from the Crowd"). Participants evaluated the first ad more favorably, but evaluated the second ad less favorably, when they were in a warm room than when they were in a cool room.

Experiment 2 replicated these findings and, in addition, confirmed that the effects were mediated by the impact of ambient temperature on perceptions of social closeness. However, participants' affective reactions did not differ as a function of temperature, indicating that differences in affect were not a contributor to the effects we observed.

The next three studies extended our findings to decisions in which the primary consideration was financial. In Experiment 3, participants were given six graphs, each depicting changes in the price of a stock, and were asked in each case whether they would buy the stock or sell it. In some conditions, participants were shown the predictions that the majority of previous participants in the experiment had made. In control conditions, this information was not provided. Participants who received information about others' predictions were more likely to conform to them when the temperature was high than when it was low. In the control conditions, participants' choices did not depend on temperature.

Experiment 4 further examined the mediation of perceived social closeness in the domain of financial decisions. Participants in both warm and cool temperature conditions were told to imagine they were at the race track and had an opportunity to place bets on each of seven races. For each race, the distribution of "winning odds" (a function of the amount of money that was bet on each horse) was provided. Participants were more likely to bet on the favorite (i.e. the horse with lowest odds) when the temperature was warm than when it was cool. These effects were mediated by the effects of ambient temperature on participants' perceptions of their social closeness to other betters. However, the positive and negative affect that participants reported experiencing, their risk propensity, involvement, arousal, relaxation and tiredness, did not depend on temperature.

A field study was then conducted in the context of horse racing data in Hong Kong over a period of three consecutive years

(2007 - 2009). Horse races are only held in seasons during which the temperature is comfortable. The extent to which bets on each race converged on the favorite over the hour before each race was averaged over the races run on each day and correlated with the average temperature on that day. This correlation was significantly positive ( $r = .20$ ;  $n = 204$ ). Furthermore the mean standard deviation of the odds associated with the horses in each race (a second indication of the convergence of bets on the favorite) was also significantly correlated with temperature ( $r = .11$ ,  $n = 224$ ). Thus, these data confirm the effects we observed in the laboratory and indicate that the impact of ambient temperature on the adoption of others' opinions is motivated by a desire to make money and is not restricted to conditions in which conformity is motivated by social desirability concerns.

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