Mental Thermoregulation: Affective and Cognitive Pathways For Non-Physical Temperature Regulation

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Reliance on emotions (cognitions) can function as a warming (cooling) process and hence individuals are nonconsciously induced into altering their decision-making style according to their thermoregulatory objectives. The mere use of cognitive versus affective pathways alters not just an individual’s perceived temperature, but leads to changes in actual temperature.

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Turning up the Heat on Haptics: Temperature and Consumer Decision Making
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Paper #1: Mental Thermoregulation: Affective and Cognitive Pathways for Non-Physical Temperature Regulation
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Paper #2: Warmer or Cooler: Exploring the Influence of Ambient Temperature on Cognitive Task Performance
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Paper #3: Red in the Eye, Blue in the Mouth: The Influence of Visual cues on Temperature Perceptions
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SESSION OVERVIEW
Whether choosing what clothing items to wear, while heating or chilling a food item, or when adjusting the thermostat at home, the office or in the car, consumers are extremely conscious of temperature (Cheema and Patrick 2012). Temperature is one aspect of haptics, along with texture, weight and hardness, all of which are primarily perceived via the sense of touch (Klatzky and Lederman 2002). Despite the imminent influence of ambient, body and product temperature in consumers’ daily lives, relatively little attention has been devoted to temperature and its implications for behavioral research. While sensory marketing has emerged as an important area in recent years, most studies have focused on visual and auditory aspects with relatively less attention devoted to olfactory, gustatory and haptic aspects (Krishna 2012). In fact, of the five senses, the sense of touch has possibly received the least amount of attention from marketing researchers (Peck and Childers 2008). In this regard, this special session focuses on temperature and our main objective is to present a set of studies touching upon not only how temperature influences consumer decision making, but also on factors that influence temperature perception.

This session will encourage discussion on temperature as well as the broader theme of the influence of haptics on consumer decision making, and aims to attract researchers with an interest in different aspects of sensory marketing. With three papers, we hope to encourage interactive discussions between the presenters, the discussion leaders and the attendees.

The limited studies in the consumer literature which examine temperature show that incidental exposure to specific ambient and product temperatures influences product preferences (Hong and Sun 2012), that semantic congruence between product temperature and scent influences product evaluations (Krishna, Elder and Caldera 2010), and that interacting with objects that have different temperatures influences interpersonal warmth (Williams and Bargh 2008). However, little is known about how temperature influences consumer decision making processes and the factors that influence temperature perception. To that end, the first paper in this special session (by Hadi, King, and Block) focus on the influence of perceived body temperature on the decision making process. This paper examines how consumers mentally thermoregulate their decision-making process based on the current (vs. desired) body temperature. The second paper (by Tong, Zhu, Zheng, and Zhao) also investigates the influence of temperature on the decision-making process. This research specifically examines how ambient temperature influences heuristic decision making, and ultimately performance on simple (vs. complex) cognitive tasks. Finally, the third paper (by Szocs and Biswas) investigates the influence of visual cues on product temperature perceptions. This paper focuses on how incidental exposure to red versus blue visual cues might influence perceptions about the temperature of the focal product.

Collectively, the three papers in this special session all focus on temperature in the context of consumer decision making. However, each paper takes a different perspective with Tong, Zhu, Zheng, and Zhao focusing on ambient temperature, Hadi, King, and Block focusing on body temperature, and Szocs and Biswas focusing on product temperature. In addition to the variety of perspectives, the papers by Tong, Zhu, Zheng, and Zhao, and Hadi, King, and Block examine temperature as an independent variable while Szocs and Biswas examine temperature as a dependent variable. Given these varied perspectives and the nascent state of this topic domain, this special session is likely to lead to discussions for future research ideas.

Mental Thermoregulation: Affective and Cognitive Pathways for Non-Physical Temperature Regulation

EXTENDED ABSTRACT
In the behavioral sciences, the term “cool” processing typically refers to processes which involve cognitions and critical analysis, while “warm” processing alludes to systems involving feelings, desires, and emotions (Metcalfe and Mischel 1999). This terminology suggests that at least semantically, each process encompasses a distinct thermoregulatory tone. However, if reliance on emotions can indeed function as a warming process and reliance on cognitions functions as a 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 and 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 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 and Tavassoli 2000, Tavassoli 2000, Zhang and 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.
Study 1 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 however, the difference between the two object description conditions was not significant. A 4-item Decision Basis scale measured whether decisions across different conditions were based on respondents’ affective reactions or cognitions. A bootstrap procedure (Hayes, 2012) confirmed the conditional indirect effect of temperature on WTP through Decision Basis was significant, suggesting that reliance on emotions mediated the relationship of temperature x object description on WTP.

The second 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 third 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 equipped with wireless thermometers to measure their temperature while they used 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 fourth study was a 2 level (instructions: affective vs. cognitive) between subjects design to demonstrate physical temperature fluctuations as a result of affective vs. cognitive pathways. Subjects were equipped with wireless thermometers to measure their temperature while they used either their feelings or evaluative thoughts in assessing a series of scenarios (same manipulation as in study 3). Before starting the task, there was no significant difference between physical temperatures of participants in the two conditions. After completing the task, however, participants in the affective condition produced a significantly higher temperature than individuals in the cognitive condition. In the cognitive condition, individuals’ temperatures were significantly lower after the task, as compared to before the task, and in the affective condition, participants’ temperatures were significantly higher after the task, as compared to before the task. Hence, this suggests the mere use of cognitive versus affective pathways can alter an individual’s physical temperature via a physiological warming (vs. cooling) process.

Thus, we contribute to literature on thermoregulation, embodiment, and the role of affect in decision-making by suggesting that reliance on emotions (cognitions) can function as a warming (cooling) process, and individuals may accordingly alter their decision-making style to fulfill thermoregulatory objectives in response to experienced physical temperatures that are cooler or warmer than homeostatic levels in their internal milieu.

**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 Vasmatizidis 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) pro-
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) X 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.

Red in the Eye, Blue in the Mouth: The Influence of Visual Cues on Temperature Perceptions

EXTENDED ABSTRACT

Temperature is one of four haptic properties that individuals rely on when evaluating objects (Klatzky and Lederman 2002), and is an especially important factor for food and beverage evaluations. In fact, research shows that temperature plays an influential role in food product acceptability (Rozin and Tourila 1993) and even taste evaluations (Zellner, Stewart, Rozin and Brown 1988). However, despite the importance of temperature perception in food/beverage evaluations, there has been very limited research examining factors that might influence consumer perceptions of product temperature. The limited number of studies which examine factors influencing temperature perceptions focus on such issues as how feelings of social exclusion influence ambient temperature perception (Zhong and Leonardelli 2008), how interacting with warm or cold objects influences interpersonal warmth (Williams and Bargh 2008), and how semantic congruence between product temperature and olfactory cues influences haptic perceptions and product evaluations (Krishna, Elder, and Caldara 2010). Along these lines, hardly any research has examined cross-modal sensory effects on temperature perceptions; that is, the role of other sensory inputs on product temperature perceptions. In that context, in this research, we examine the effects of visual cues on haptic temperature perceptions. More specifically, we examine how incidental exposure to red or blue peripheral color cues might influence a consumer’s perceptions of the temperature of a focal product. That is, would a consumer rate a focal product as having a higher (lower) temperature after seeing a red (blue) peripheral color cue? Equally importantly, would there be conditions which can lead to an opposite pattern of results? For example, can under certain conditions, exposure to red (blue) peripheral cues lead to lower (higher) temperature perceptions? We address these questions and more broadly we examine the influence of visual (i.e., color) cues on haptic (i.e., temperature) perceptions. The focus on red and blue colors is driven by ecological factors. Specifically, red and blue are often used to denote hot and cold temperatures on items such as faucets, air-conditioning systems, weather maps, and thermometers. In addition, the focus on the effects of visual cues on temperature perceptions makes practical sense since it is very unlikely, and often impossible, to obtain temperature perceptions through any of the other sensory inputs/cues (e.g., from taste, olfactory, or auditory).

We build on theories of visual dominance and intersensory integration and propose that visual cues can play a more influential role in determining temperature perceptions because visual inputs are available prior to haptic inputs, since visual cues can be obtained with a greater degree of non-proximity than haptic cues. Along the same lines, in most real-world scenarios, visual cues would be obtained sequentially earlier than haptic cues. The relative ease and earlier availability of visual cues relative to haptic cues leads to visual cues receiving more weight in temperature evaluations relative to haptic cues.

In study 1 we demonstrate the basic effect of color cues on temperature perceptions (i.e., the color-temperature effect) using a one factor experiment with two conditions (visual cue: red vs. blue). We find that when asked to sample a clear, room-temperature beverage from a red or blue cup consumers who sample from a red (blue) cup perceive the beverage as having a higher (lower) temperature.

In studies 2 and 3 we provide evidence that the color-temperature effect is a function of the ease of obtaining visual (vs. haptic) cues to temperature which leads to visual cues receiving more weight in temperature evaluations. Specifically, in study 2 we manipulate the ease of obtaining visual cues to temperature by manipulating the salience of the color cue using a 2 (visual cue: red vs. blue) x 2 (cue salience: high vs. low) between subjects design. In this study, the color cue is a beverage napkin and visual salience is manipulated by placing a white cup in such a way that it occludes (i.e., low cue salience) or does not occlude the napkin (i.e., high cue salience). We find that when visual inputs are easy to encode relative to haptic inputs (i.e., high cue salience) the color-temperature effect persists,
however when ease of encoding is reduced by minimizing visual cue salience the color-temperature effect is diminished.

In study 3 we manipulate the order sequence in which visual (vs. haptic) information is available using a 2(visual cue: red vs. blue) x 2(sensory cue sequence: visual-haptic vs. haptic-visual) between subjects experiment. In this study we manipulate the color of the beverage and have participants view the color of the beverage before sampling the beverage (i.e., visual-haptic) or after sampling the beverage (i.e., haptic-visual). In support of our theorization we find that when visual information is available before haptic information (i.e., visual-haptics), and hence is easier to obtain, the color-temperature effect persists. However, when haptic information is available before visual information (i.e., haptics-visual) the effect is diminished.

Finally, in study 4 we examine the robustness of the color-temperature effect to unambiguous product temperatures. Employing a 2(visual cue: red vs. blue) x 3(beverage temperature: room vs. cold vs. warm) between subjects design we have participants sample a cold, room or warm temperature beverage from a red or blue cup and evaluate the temperature. We find that the color-temperature effect persists for room temperature beverages, gets diminished for warm beverages and gets reversed for cold beverages.

In conclusion, across four studies we show that visual color cues influence haptic temperature perceptions. The influence of incidental visual cues on focal product temperature perceptions remains largely unexplored in the consumer behavior literature. As a result, the findings of our research can potentially shed insights into cross-modal sensory effects on temperature perceptions. In addition to these conceptual implications, understanding the role of visual cues in temperature evaluations also has managerial implications, especially since the temperature of a food/beverage influences the items’ overall product evaluation.