Influence of Warm versus Cool Temperatures on Consumer Choice:

A Resource Depletion Account

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Across five studies, the authors demonstrate that warm (versus cool) temperatures deplete resources, increase System 1 processing, and influence performance on complex choice tasks. Real-world lottery data (Pilot Study) and a lab experiment (Study 1) demonstrate the effect of temperature on complex choice: individuals are less likely to make difficult gambles in warmer temperatures. Study 2 implicates resource depletion as the underlying process; warm temperatures lower cognitive performance for non-depleted individuals, but don't affect the performance of depleted individuals. Study 3 illustrates the moderating role of task complexity to show that warm temperatures are depleting and decrease willingness to make a difficult product choice. Study 4 juxtaposes the effects of depletion and temperature to reveal that warm temperatures hamper performance on complex tasks because of the participants' increased reliance on System 1 (heuristic) processing.

Keywords: ambient temperature, resource depletion, heuristic processing, task complexity

Ambient temperature matters, but little research exists to explain its effects. People talk incessantly about how warm or cool the temperature is. According to Judith Bowman, a workplace etiquette expert and author of *Don't Take the Last Donut,* the temperature setting of the office thermostat is one of the touchiest subjects in a work environment. Reflecting our sensitivity to ambient temperature, our cars, homes and even airplane seats offer sophisticated temperature controls designed to suit our individual comfort. However, as conscious as we are about temperature, extant research reveals very little about the effect of a modest range of ambient temperatures (67-77°F) on consumer decisions. This is the focus of the current research.

Consumers' physical surroundings significantly affect their decisions (Belk 1975). Characteristics of surroundings that have received attention in the consumer decision-making and marketing literature include weather (Schwarz and Clore 1983), ceiling height (Meyers-Levy & Zhu 2007), flooring (Meyers-Levy, Zhu, and Jiang 2010), fixtures (Zhu and Meyers-Levy 2009), and ambient scents (Morrin and Ratneshwar 2003). In the present research, we focus on one variable that is always present but is almost never researched in the domain of consumer decisions: the ambient temperature. Specifically, we study the effect of a modest range of ambient temperatures (67-77°F) on consumer choice and decision-making.

Prior research provides evidence that heat stress has a greater influence than cold stress on the performance of cognitive tasks (see Hancock and Vasmatzidis 2003 for a review). However, such thermal load does not hamper performance to as great an extent for over-learned and automatically performed tasks (Hancock 1986), nor on relatively simple tasks (Grether 1973). Drawing on recent research that illustrates how resource depletion enhances the role of System 1 processing (Pocheptsova et al. 2009), we theorize that warm (versus cool) temperatures increase thermal load and deplete available resources, thereby increasing System 1 processing and hampering performance on complex choice tasks. This process explanation is consistent with the proposition forwarded (but not tested) by Hancock and Vasmatzidis (2003), who argue that heat stress decreases the resources brought to bear on cognitive tasks.

In the current research we investigate three aspects of the effect of temperature on consumer choice. We manipulate temperatures to be warm (77°F) versus cool (67°F), between subjects. First, we show that warm (versus cool) temperatures are depleting. We demonstrate this using both cognitive performance tests (like proof-reading tasks; Study 2) as well as standard resource depletion tests (Studies 3 and 4). Second, we demonstrate the moderating role of task complexity. Specifically, warm temperatures decrease individuals' performance on complex tasks like making difficult (versus easy) gambles (Study 1) or choosing to buy innovative (versus established) products (Study 3). Third, from a processing standpoint we show that warm temperatures deplete resources and result in a greater reliance on System 1 (heuristic) processing (Pocheptsova et al. 2009) which in turn influences consumer choice (Study 4). In sum, across five 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 cognitive tasks that require processing resources.

This research strives to make some key contributions to the decision making literature. We show the effect of a modest range of ambient temperatures (67-77°F) on consumer decision-making. This represents a fairly typical range of everyday ambient temperatures. Consequently, the drain of thermal load on resources has significant implications. For firms, employee productivity and learning may decrease under warm temperatures (Van De Vliert and Van Yperen 1988). For consumers, the effort required to buy increases under warm temperatures, which may lead to fewer purchases. From a processing standpoint, we present evidence for why thermal load influences decisions. We find that people who are warm are more likely to process information heuristically than people who are cool. These results suggest that under thermal load, consumers may avoid complex decisions like the evaluation of innovative products. Consequently, adoption of innovative products may be slower when it is warm (versus cool; Tellis, Stremersch, and Yin 2003).

THEORETICAL BACKGROUND

Physiological Responses to Temperature Stress

The human body strives to keep its internal temperature between 95-106°F and has developed specialized physiological responses to manage thermal stress. The body has greater tolerance for cold than for heat. In general, we can tolerate over-cooling and are able to recover from hypothermia where body temperatures drop as low as 20°F below normal. However, we have little tolerance for even slight overheating. The human brain malfunctions with six or seven degrees of fever. A body temperature of 110°F, a dozen degrees above normal, is often cited as the upper limit compatible with life. Consequently, humans have developed physiological responses to manage body heat. When the body experiences a shift from thermal neutrality it strives to control temperature through physiological responses to decrease (sweating, increasing skin blood flow) or increase (shivering, decreasing skin blood flow) the internal temperature (see Hammel 1968 for a review).

Behavioral Responses to Temperature Stress

Prior studies show that an ambient temperature of 72°F, one at which most people appear to be comfortable, may be most conducive for automatic tasks. For instance, Allen and Fischer (1978) find that performance on paired-association memory tasks peaks at 72°F. However, some evidence suggests a difference between temperatures that are optimal for comfort and those that are optimal for performance on cognitive tasks. Specifically, Pepler and Warner (1968) show that people perform office work best at 68°F, although they report being cold. By contrast, people work the least at 80°F, the temperature at which they report being the most comfortable.

In the present research, we experimentally manipulate ambient indoor temperature to be either 67 or 77°F. We study the effect of temperature on gambling propensity (Study 1), cognitive tasks (Study 2, 3, 4), and consumer choice (purchase of an innovative product in Study 3; choice of a cell phone plan in Study 4). We do not experimentally investigate a wider range of temperatures (below 67 and above 77°F) because excessively cold or warm environments have limited applicability to purchase decisions (in stores and shopping malls) and organizations (in schools and offices). Given the limited range of temperatures and the cognitive nature of the tasks, we find no differences in mood across conditions (see also Watson 2000).

Our focus on the effect of temperature on effortful cognitive tasks is also different from prior studies that investigate consequences of atmospheric variables on mood (Schwarz and Clore 1983) and on spontaneous behavior (Anderson 1989). For instance, reviewing the positive relationship between temperature and aggression, Anderson (1989, p. 79) focuses on spontaneous aggression and notes that the positive relationship doesn’t hold for “planful, politically instigated acts” such as revolts or wars.

IMPACT OF WARM VERSUS COOL TEMPERATURES ON INFORMATION PROCESSING: A RESOURCE DEPLETION ACCOUNT

Dual process models propose two systems of information processing: System 1 and System 2 (Evans 2008). System 1 is characterized by quick, heuristic-based processing that is relatively effortless and requires few resources. System 2 is characterized by systematic rule-based processing that is more effortful and resource dependent. We theorize that heat depletes resources, resulting in greater System 1 processing (Pocheptsova et al. 2009).

Previous findings of heat impairing cognitive performance suggest that warm (versus cool) temperatures are resource depleting. For instance, Witterseh et al. (2004) show that compared to an ambient temperature of 72°F, performance on cognitive tasks (text typing, adding, proofreading) suffers at moderately warm temperatures (79-86°F). This decline in performance is accompanied by reported difficulty in concentrating and decreased performance estimates. As these authors note, thermal load (warm temperatures) may cause the body to lower internal heat production. This may slow work rate and negatively affect performance on complex tasks. In a review of productivity studies, Seppänen, Fisk, and Lei (2006) identify peak performance at 72°F and consistent declines above 75°F.

Prior research suggests that in contrast to warm temperatures, cool temperatures (in the range studied here) may not hurt performance of complex tasks. Data from internal body temperature studies also suggest that increasing internal body temperatures (in the range of 99-102°F) hurt performance, but decreasing body temperatures in the same range do not affect performance (Allan, Gibson, and Green 1979). Thus, the direction of the change in internal body temperature influences performance. As discussed previously, Pepler and Warner (1968) find optimal performance on cognitive tasks at 68°F, which is close to the lower limit of temperatures investigated in the present research. Seppänen, Fisk, and Lei (2006) also do not find significant performance declines in office tasks until temperatures drop below 68-70°F.

Evidence for the detrimental effect of warm (versus cool) temperatures also comes from anecdotal observations in studies of economic development, which indicate that tropical climates lead to apathy and decrease the inclination to work relative to cold climates (Bandyopadhyaya 1978). Finally, studies of office productivity across different countries find a negative effect of warm versus cool temperatures on worker output (Van De Vliert and Van Yperen 1996).

The observed effect of warm versus cool temperatures suggests that cognitive performance suffers when it is warm. We expect that the effect of thermal load on performance may be similar to the effect of resource depletion (Pocheptsova et al. 2009). Hancock (1986) argues that heat stress taxes resources, significantly decreasing performance on cognitive tasks. Furthermore, Hancock and Warm (1989) propose that heat hinders performance by draining the limited pool of attentional resources. Discussing this proposition in light of subsequent research, Hancock and Vasmatzidis (2003) suggest that while minor decreases in attention may be offset by increased focus and other adaptive strategies, higher levels of heat stress may lead to a progressive decline in performance. Consistent with this process, we argue that thermal load decreases the resources available for cognitive tasks. Based on the extant literature, we expect that the thermal load imposed by warm temperatures results in resource depletion and consequently increases the reliance on System 1 processing. Formally, we hypothesize:

H1: Warm temperatures result in greater resource depletion compared to cool temperatures. Consequently, warm individuals will exhibit greater evidence of System 1 or heuristic processing relative to individuals who are cool.

If thermal load depletes resources, then warm temperatures are likely to result in attenuation in task performance and an increased reliance on heuristic processing compared to cool temperatures where individuals have ample processing resources.

EFFECT OF TEMPERATURE ON CHOICE: THE MODERATING ROLE OF COMPLEXITY

Hypothesis 1 proposes that thermal load depletes individuals and increases reliance on heuristic System 1 style processing. Consequently, we expect a greater impact of temperature on the performance of complex tasks (i.e., tasks that require extensive processing resources). Performance on complex tasks such as making difficult gambles or adopting innovative products might thus be most susceptible to the influence of temperature. A gamble usually involves an evaluation of risk via the multiplication of the probability of winning with the magnitude of the reward to arrive at an expected value. Similarly, adopting an innovative product requires a calculation of risks versus benefits. Since these tasks require processing resources, we expect the effect of warm (versus cool) temperatures to manifest for these types of complex decisions but not for easier decisions (simple gambles, established products).

Some recent research demonstrates a link between resource depletion and complex task performance. Danzinger, Levav, and Avnaim-Pesso (2011) find that in complex decisions such as ruling on releasing a prisoner from jail, hungry (depleted) judges were more likely to choose the status quo. Other research illustrates a similar link between System 1 (heuristic) processing and risk-taking (Slovic et al. 2004), especially for unfamiliar or difficult gambles. In a standard probability experiment of choosing red jellybeans from an urn, Denes-Raj and Epstein (1994) find that individuals relying on System 1 processing are more likely to choose the safer option that feels good (choosing from a bowl containing a greater absolute number, but a smaller proportion, of red beans; e.g. 7 in 100) than one which increases the chance of winning (a bowl with fewer red beans but a better probability of winning; e.g. 1 in 10). Furthermore, in the domain of temperature, prior research suggests that thermal load might hamper performance on complex cognitive tasks, but not on over-learned and automatically performed tasks (Hancock 1986), nor on tasks that are relatively simple and low in attentional demands (Grether 1973).

These varied streams of research suggest that individuals require processing resources to execute complex tasks and since thermal load depletes individuals we expect that temperature influences cognitive performance, but only for complex tasks. Thus:

H2: Warm temperatures influence cognitive performance, but only for complex tasks (difficult gambles or adopting an innovative new product), not for simple tasks (easy gambles or adopting an established product).

OVERVIEW OF THE EMPIRICAL INVESTIGATION

We begin our empirical investigation with a Pilot Study using real-world lottery data to demonstrate the link between warm temperatures and gambling propensity. Lottery sales are lower under warm temperatures, but this pattern is observed only for complex lotteries. Study 1 replicates this basic effect to show that individuals are less likely to make complex gambles in warm versus cool temperatures. Study 2 implicates resource depletion as the underlying process by manipulating both temperature and resource depletion to illustrate that thermal load lowers cognitive performance for non-depleted individuals, but does not affect the performance of depleted individuals. Study 3 has two objectives. First, it uses a standard resource depletion task to show that warm (vs. 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 the decision to purchase an established product. Study 4 juxtaposes the effects of depletion and temperature to show that warm temperatures hamper performance on complex tasks due to an individual's increased reliance on System 1 (heuristic) processing.

PILOT STUDY: LOTTERY SALES ARE LOWER UNDER WARM TEMPERATURES

Data Description and Pretest

These data are for daily lottery sales in St. Louis County from July 1, 2006 - June 30, 2007. The lotteries can be classified as: (1) scratchers (six types of paper tickets where buyers scratch out hidden numbers to see if they won; average daily sales $235,737); (2) electronic (three games dispensed from automated terminals, with daily drawings and fixed rewards; $128,625); and (3) power ball and lotto (single-option lotteries with weekly drawings and a variable jackpot size; power ball: $74,567, lotto: $17,554).

A pretest with 120 individuals (M_{age} = 35 years, 62% women) verified that the decision to gamble is perceived to be more difficult for multiple option lotteries than for single option lotteries. Participants read a scenario where they were asked to consider buying a lottery ticket. Participants saw one of three lottery tickets (multiple option scratcher, multiple option electronic, or single option lotto), and read the lottery rules, possible prizes and probabilities (see Web Appendix A for details). All participants completed three items about the difficulty in (a) making a decision about buying, (b) learning the expected value, and (c) judging the risk associated with buying the lottery ticket (1 = not at all, 7 = very difficult), that were averaged for a difficulty measure (α = .77). The two multiple-option lotteries did not differ in perceived difficulty ($M_{scratchers}$ = 2.89 vs. $M_{electronic}$ = 2.98), F (1, 117) = .13, NS. As expected, multiple-option lotteries (scratchers & electronic) were judged to be more difficult than the single-option lottery ($M_{multiple\ options}$ = 2.94 vs. $M_{single\ option}$ = 2.32), F (1, 118) = 9.80, $p < .005$.

Following hypothesis 2, we expected that multiple-option lottery sales would be lower under warm versus cool temperatures. The daily temperatures were retrieved from the National Climactic Data Center. We analyzed the daily lottery sales (365 observations) separately for each lottery type as a function of the average daily temperature (°F) and the day of the week (Monday – Sunday). We also controlled for the linear trend of increasing lottery sales (using a counter for the month, starting in July 2006, 1-12) and the day of the month (counter from 1-31).

Results and Discussion

Scratchers (6 options, 52% of sales). A significant negative effect of temperature on scratcher sales shows that sales decrease by $594 for every 1°F increase in temperature (b = -593.85, F (1, 355) = 74.84, $p < .0001$; Figure 1, panel A).

Electronic (3 options, 28% of sales). A significant negative effect of temperature on electronic sales reveals that sales decrease by $113 for every 1°F increase in temperature (b = -113.15, F (1, 355) = 17.74, $p < .0001$; Figure 1, panel B).

< Insert Figure 1 about here >

Power ball (single option, 16% of sales). A significant negative effect of temperature on power ball sales reveals that sales decrease by $143 for every 1°F increase in temperature (b = -142.58, F (1, 354) = 6.16, p = .01. This analysis also controls for the size of the jackpot: people buy more power ball tickets as the jackpot increases, b = .0005, F (1, 354) = 594.45, p < .0001.

Lotto (single option, 4% of sales). The effect of temperature on lotto sales is not significant (b = -10.20, F (1, 354) = 1.99, NS. This analysis also controls for jackpot size: lotto ticket sales increase with jackpot size, b = .002, F (1, 354) = 562.73, p < .0001.

Moderating role of difficulty. To test whether the effect of temperature was stronger for difficult (multiple-option) lotteries than for easy (single-option) lotteries, we first controlled for the effects of the covariates for each lottery type. We used the residuals as multiple dependent variables in a repeated measures analysis (difficult: scratchers & electronic, easy: power ball & lotto), controlling for the payday effect (last working day of the month) and the percentage of unemployment (as a proxy for economic conditions). The main effect of temperature remains significant and negative, F (1, 361) = 25.43, p < .0001. The effect of payday is not significant, F (1, 361) = 1.02, NS. Higher unemployment rates are associated with lower lottery sales, F (1, 361) = 6.23, p < .05. Importantly, the difficulty x temperature interaction shows that the effect of temperature is stronger for the difficult (vs. easy) lotteries, F (1, 361) = 13.78, p < .0005.

Discussion. Results from the Pilot Study reveal that the decline in sales under warmer temperatures is greater for difficult (vs. simple) lotteries, supporting hypothesis 2. As the range of temperatures in the data is quite extreme (from 12°F to 91°F), we also investigate lottery sales across narrower ranges of temperatures around 72°F (see Web Appendix B). We find that the effect of temperature is greater in magnitude across narrower ranges, being strongest in magnitude in the 67-77°F range. This may be because with more extreme temperatures, people consciously counteract the effects of temperature (change their clothing, control exposure, etc.).

Indeed, we find a significant non-linear effect of temperature for difficult lotteries (see Web Appendix C, panel 1). The effect of temperature also appears to be asymmetric around 72°F. In particular, the negative effect of temperature is more pronounced for temperatures above 72°F than for temperatures below 72°F (see Web Appendix C, panel 2). This is consistent with the human body being better able to deal with cold than with hot temperatures.

We note that, rather than be exposed to the actual ambient temperature for extended periods of time, exposure may be fleeting (e.g., as people go from their car in to the store to buy the lottery tickets, including electronic tickets, which are only sold in designated stores in the studied county). Alternatively, the ambient temperature may affect the indoor temperature (being elevated in the summer and depressed in the winter).

Next, we present respondents with gambles of varying difficulty to examine whether temperature influences gambling propensity more for difficult versus easy gambles in the lab.

STUDY 1: THE EFFECT OF TEMPERATURE ON PROPENSITY TO GAMBLE

Participants, Design, and Procedure

We recruited 46 undergraduates to complete this lab study in return for research credit (M_{age} = 20 years, 48% women). Participants completed a computer survey that included a series of unrelated scenarios, ending with individual-difference measures. We manipulated the ambient temperature, between subjects, to be either cool (67°F) or warm (77°F). A manipulation check at the end of the survey shows that participants in the warm condition feel hotter (1= very cold, 9 =

very hot; $M_{cool} = 3.87$ vs. $M_{warm} = 5.39$; $F(1, 44) = 25.42$, $p < .0001$). Participants also completed a mood inventory (happy, excited, hopeful, joyful, wishful, relaxed, good mood; 1 = not at all, 9 = very; $\alpha = .84$). Importantly, the temperature manipulation did not affect mood ($M_{cool} = 5.67$ vs. $M_{warm} = 5.47$; $F(1, 44) = 0.34$, NS).

We manipulated the difficulty of gambles, between subjects (see Web Appendix D). Participants in the easy condition were provided calculations about the expected values of the gambles. Participants in the difficult condition were not provided this information, nor were they told the expected values. As a manipulation check, we asked a separate set of participants to evaluate a set of gambles. Sixty-one participants saw the gambles with expected value calculations while the remaining 59 saw no expected values. All participants reported how hard it was for them to (a) make a decision about gambling, (b) learn the expected value, and (c) judge the risk associated with the gamble (1 = not at all, 7 = very difficult). We averaged these items to form an aggregate difficulty measure ($\alpha = .85$). Supporting the manipulation, participants judged the gambles with no expected values to be more difficult ($M_{no\ expected\ values} = 3.47$ vs. $M_{with\ expected\ values} = 2.57$), $F(1, 118) = 16.14$, $p = .0001$. In summary, the study employed a 2 (temperature: cool, warm) x 2 (gamble: difficult, easy) between-subjects design.

Results and Discussion

Participants in the warm (versus cool) condition were significantly less likely to gamble ($M_{cool} = 5.13$ vs. $M_{warm} = 4.13$; $F(1, 42) = 5.96$, $p < .05$). This main effect was qualified by a temperature x difficulty interaction, $F(1, 42) = 6.15$, $p < .05$ (Figure 2). Supporting hypothesis 2, temperature affected difficult gambles ($M_{cool} = 5.31$ vs. $M_{warm} = 3.35$; $F(1, 42) = 12.11$, $p <$

.005) but did not affect easy gambles (M_{cool} = 4.97 vs. M_{warm} = 4.98; $F(1, 42) = 0.001$, NS). Planned contrasts revealed that in the warm condition, participants were significantly less likely to undertake difficult (versus easy) gambles, $F(1, 42) = 8.41$, $p < .01$.

< Insert Figure 2 about here >

The Pilot Study showed that lottery sales declined under warmer temperatures, especially in the case of difficult (multiple-option) lotteries. Replicating the effect in the lab, Study 1 revealed that participants were less likely to make difficult gambles under warm versus cold conditions. In the study that follows we focus on illuminating the proposed process underlying this effect – namely that of resource depletion accompanying warm temperatures.

IMPACT OF WARM VERSUS COOL TEMPERATURES ON INFORMATION PROCESSING: IMPLICATING RESOURCE DEPLETION AS THE UNDERLYING PROCESS

We theorize that heat depletes available resources, resulting in System 1 processing. Thus, we expect that if thermal load depletes resources (hypothesis 1), then consumers will process information in a System 1 processing style. To test this proposition, in Study 2 we manipulate both the temperature and the availability of resources using a standard resource depletion mechanism. We expect that the effect of thermal load will be attenuated when resources are depleted, thereby implicating resource depletion as the underlying mechanism.

In this study we implicate resource depletion using a proofreading task. We expect that people will process information with less effort in warm (versus cool) conditions. This effect of warm temperature on effort reduction may manifest itself in poorer performance. Specifically, we expect that people who exert less effort are less likely to identify proof-reading errors than those who think more deliberately. Processing difficulty may also lead to longer completion times in warm (versus cool) conditions. We expect this effect of temperature to be significant when individuals are not depleted. For depleted individuals, however, we expect the effect of temperature to be attenuated.

STUDY 2: WARM TEMPERATURES HAMPER COGNITIVE PERFORMANCE: ATTENUATING ROLE OF DEPLETION

Participants, Design, and Procedure

We recruited 88 students to complete this lab study in return for research credit (M_{age} = 23 years, 55% women). Participants completed a computer survey that included a series of unrelated scenarios, ending with individual-difference measures. We manipulated the ambient temperature, between subjects, to be cool (67°F) or warm (77°F). A manipulation check at the end of the study finds that people in the warm condition feel hotter (1= very cold, 9 = very hot; $M_{cool} = 3.86$ vs. $M_{warm} = 4.53$; $F(1, 86) = 8.99$, $p < .005$). We also manipulated the depletion level of participants, between subjects. The depletion manipulation was adapted from the procedure used by Baumeister et al. (1998) where participants are shown a silent video clip of a woman being interviewed. Participants are told that they will be making person-perception judgments of the interviewee. The video 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. Further details about the manipulation are provided in Web Appendix E. In summary, the study used a 2 (temperature: cool, warm) x 2 (depletion level: depleted, not depleted) full-factorial between-subjects design.

The cognitive task of interest was a proofreading exercise. For this task, participants read a three-paragraph article that included 20 typos (spelling and grammatical errors). Participants were instructed to click on the words that they thought were spelling or grammatical errors; doing so highlighted the text on the screen (clicking on it again removed the highlight). We use the number of typos correctly identified by a participant as an objective measure of task performance. Participants also completed a mood inventory (happy, excited, hopeful, joyful, wishful, relaxed, aroused, good mood; 1 = not at all, 9 = very; $\alpha = .86$). Mood was not affected by temperature ($M_{cool} = 4.55$ vs. $M_{warm} = 4.38$; $F(1, 84) = 0.56$, NS) or by depletion ($M_{depleted} = 4.52$ vs. $M_{not\ depleted} = 4.42$; $F(1, 84) = 0.21$, NS).

Results and Discussion

Our dependent measure was the number of typos correctly identified by a participant. An ANOVA with temperature and depletion levels as predictors reveals a significant temperature x depletion interaction, $F(1, 84) = 13.42$, $p < .0005$ (Figure 3). Among non-depleted participants, those in the cool condition correctly identify significantly more typos ($M_{cool} = 14.95$ vs. $M_{warm} = 10.41$), $F(1, 84) = 12.18$, $p < .001$. Among depleted participants, however, participants in the cool condition identify marginally fewer typos, ($M_{cool} = 10.17$ vs. $M_{warm} = 12.38$), $F(1, 84) = 2.86$, $p < .10$. The main effects of temperature and depletion are not significant. Planned comparisons reveal that the effect of the depletion manipulation is significant for cool participants ($M_{depleted}$ = 10.17 vs. $M_{not\ depleted}$ = 14.95; $F(1, 84) = 13.76$, $p < .0005$) but not for warm participants ($M_{depleted}$ = 12.38 vs. $M_{not\ depleted}$ = 10.41; $F(1, 84) = 2.24$, NS). Repeating the analysis with all (correctly as well as incorrectly) identified typos reveals similar results.

< Insert Figure 3 about here >

Warm (versus cool) participants took longer and did worse on the proofreading task. The effect of temperature on the cognitive performance of non-depleted participants was consistent with the expectation that thermal load would deplete resources. This pattern of results is similar to that reported by Schmeichel, Vohs, and Baumeister (2003), who find that depletion leads to poorer cognitive performance and longer completion times.

Furthermore, the effect of temperature on cognitive performance was attenuated for depleted participants. Unexpectedly, we find that among depleted participants, warmer people do marginally better. Process measures (for 85 people) suggest that the former take greater care while completing the proofreading task ("I completed the proofreading task carefully," 1 = disagree, 7 = agree; $M_{depleted\text{-}warm}$ = 5.14 vs. $M_{depleted\text{-}cool}$ = 4.14; $F(1, 81) = 5.48$, $p < .05$). We speculate that participants in the depleted-warm condition may have realized they were situationally and environmentally challenged and therefore exerted extra effort to compensate.

In the next study, we use a measure of performance that is sensitive to resource depletion (from Schmeichel, Vohs, and Baumeister 2003), to show that warm temperatures are depleting. Further, we assess consumers' propensity to make complex choices in the consumption domain when asked to choose between an established product and an innovative product.

STUDY 3: TEMPERATURE AFFECTS EFFORTFUL ESTIMATION & PRODUCT ADOPTION

Participants, Design, and Procedure

One hundred and seventeen undergraduates (M_{age} = 21 years, 46% women) completed the study in a computer lab where the temperature was manipulated to be cool (67°F) or warm (77°F). As a manipulation check (how cold or hot are you feeling right now; 1 = very cold, 7 = very hot), participants in the warm condition reported feeling significantly more hot (M_{cool} = 3.42 vs. M_{warm} = 4.23), $F(1, 115) = 38.11$, $p < .0001$.

The first task required participants to read through a recent Consumer Reports article on TV attributes. This filler exercise took approximately nine minutes and, in addition to the wait and pre-study briefing, helped participants get acclimated to the lab temperature. Participants subsequently rated the importance of five attributes (large screen size, 3D, web access, 240Hz refresh rate, and a 1080p resolution; 1 = not at all important, 7 = important).

The order of the next pair of tasks – cognitive estimation and general knowledge – was counterbalanced. The cognitive estimation task required participants to provide measures that are typically difficult to generate (see Web Appendix F). Each estimate is scored in terms of its variation from a norm determined by typical responses. Extreme (i.e., too high or too low) estimates get a higher score (1 or 2, based on the absolute deviation) versus estimates within the norm (0). Summed across the 10 estimates, each participant can have a score between zero and 20. A higher score on this task has previously been used as evidence of System 2 processing being inhibited by depletion (Schmeichel, Vohs, and Baumeister 2003).

In contrast to the cognitive estimation, the second task was a simpler test of general knowledge (see Web Appendix F). Responses to this task are retrieved from memory rather than constructed. Consequently, System 2 inhibition is unlikely to affect performance on this general knowledge task (Schmeichel, Vohs, and Baumeister 2003). Responses to the 10 general knowledge items are scored as either correct (1) or incorrect (0). Across 10 questions, each participant can therefore score between zero and 10 points.

After the two counterbalanced tasks, participants completed a purchase scenario where they evaluated a voice recorder. All participants read that they were in the market for a voice recorder (to take voice notes, record lectures, etc.). We manipulated the innovativeness of the product, between subjects, with half the participants seeing the picture and description of an innovative voice recorder that was pen-shaped, and the remaining seeing a regular voice recorder (see Web Appendix G). Manipulation checks in a pretest confirmed that the pen recorder was perceived to be more innovative ("How innovative is this product?" 1 = not at all, 7 = very innovative; $M_{\text{pen recorder}} = 5.11$ vs. $M_{\text{regular recorder}} = 3.23$), $F(1, 84) = 37.38$, $p < .0001$. Product innovativeness did not vary with manipulated temperature, ($M_{\text{cool}} = 4.00$ vs. $M_{\text{warm}} = 4.35$), $F(1, 84) = .99$, NS. The product x temperature interaction effect on innovativeness was also not significant, $F(1, 84) = .40$, NS. In summary, the design for the purchase task was a 2 (temperature: cool, warm) x 2 (product: innovative, regular) between subjects design. Our primary dependent measure for the purchase task is the participants' purchase likelihood (1 = not at all, 7 = very likely). Consistent with the procedure described for Study 2, we also measured participants' mood. Mood was not affected by the temperature manipulation and is therefore omitted from the discussion.

Results and Discussion

Cognitive estimation versus general knowledge tasks. Participants in the warm condition provided more widely varying (i.e., poorer) estimates, as evidenced by larger overall scores ($M_{cool} = 3.95$ vs. $M_{warm} = 4.93$), $F(1, 115) = 6.07$, $p < .05$. Warm participants took longer to provide these estimates relative to cool participants ($M_{cool} = 166$ vs. $M_{warm} = 195$ seconds), $F(1, 115) = 4.07$, $p < .05$. By contrast, temperature did not affect the number of general knowledge questions correctly answered by participants ($M_{cool} = 5.46$ vs. $M_{warm} = 5.47$), $F(1, 115) = 0.00$, NS nor did it affect the time taken to answer the general knowledge questions ($M_{cool} = 131$ vs. $M_{warm} = 120$ seconds), $F(1, 115) = 1.52$, NS.

We conducted a repeated measures analysis with performance on the two tasks (cognitive estimation and general knowledge) as the two dependent measures, and the manipulated temperature (cool, warm) as the predictor. For this analysis, we reverse scored the cognitive estimation score so that higher scores reflect better performance, as they do for the general knowledge score. Consistent with the preceding pattern of results, we find a significant task type x temperature interaction, $F(1, 115) = 6.36$, $p = .01$; warm temperatures hamper performance on the complex cognitive estimation task, but do not affect general knowledge scores.

Innovative versus regular products. An ANOVA with temperature (cool, warm) and product type (innovative, regular) as predictors and purchase likelihood as the dependent measure revealed a significant temperature x product type interaction, $F(1, 113) = 20.44$, $p < .0001$. See Figure 4. Among cool participants, those who saw the innovative voice recorder were more likely to buy than those who saw the regular voice recorder ($M_{innovative} = 3.59$ vs. $M_{regular} = 2.27$), $F(1, 113) = 15.06$, $p < .0005$. By contrast, among participants who were warm, those who saw the regular voice recorder were more likely to buy ($M_{innovative} = 2.14$ vs. $M_{regular} = 3.00$), $F(1, 113) = 6.35$, $p = .01$. Planned contrasts revealed that among participants who saw the innovative recorder, those who were cool were more likely to buy than those who were warm; $F(1, 113) = 18.23$, $p < .0001$. However, among participants who saw the regular voice recorder, warm participants were more likely to buy; $F(1, 113) = 4.67$, $p <.05$.

< Insert Figure 4 about here >

Discussion. This study revealed two effects of the temperature manipulation. First, warm temperatures hampered effortful cognitive estimation but did not affect performance on general knowledge questions. Second, warm (vs. cool) temperatures decreased purchase likelihood of innovative new products. Supporting evidence for the second effect was revealed in participants' responses to the filler task at the beginning of the study. Recall that participants read an article about TV attributes and rated the importance of different attributes (1 = not at all, 7 = very important). Temperature did not affect importance ratings of typical attributes such as large screen size ($M_{cool} = 5.76$ vs. $M_{warm} = 5.83$; $F(1, 115) = .13$, NS) or 1080p resolution ($M_{cool} = 5.31$ vs. $M_{warm} = 5.40$; $F(1, 115) = .11$, NS). Relatively innovative attributes, however, were rated less important by warm (vs. cool) participants. These attributes included 3D capability ($M_{cool} = 2.44$ vs. $M_{warm} = 1.95$; $F(1, 115) = 4.31$, $p < .05$), web access through the TV ($M_{cool} = 4.15$ vs. $M_{warm} = 3.45$; $F(1, 115) = 4.97$, $p < .05$), and a 240 Hz refresh rate ($M_{cool} = 4.00$ vs. $M_{warm} = 3.36$; $F(1, 115) = 4.70$, $p < .05$). These differences suggest that warm participants were less willing to think carefully and process the novel attributes, relative to cool participants.

We conducted an additional manipulation check for the voice recorder stimuli used in Study 3 to investigate the financial and performance risk (Grewal, Gotlieb, and Marmorstein 1994) as well as the social risk (Stone and Grønhaug 1993) associated with the innovative pen recorder and the regular voice recorder. We asked 165 participants from the Amazon MTurk panel (M_{age} = 31 years, 34% women) to evaluate the innovative pen recorder or the regular recorder, between subjects. Consistent with pretest results, the pen recorder was rated as being more innovative ($M_{pen\ recorder}$ = 5.00 vs. $M_{regular\ recorder}$ = 3.86), $F(1, 161) = 23.11$, $p < .0001$.

In addition, the pen recorder was judged to be a greater financial risk (average of two questions: Considering the price, how risky will it be for you to buy the voice recorder? 1= not risky at all, 7 = very risky; Given the price of the voice recorder, how much financial risk is associated with buying the voice recorder? 1 = very little risk, 7 = substantial risk; $r = .66$, $p < .0001$) relative to the regular recorder ($M_{pen\ recorder}$ = 3.76 vs. $M_{regular\ recorder}$ = 3.36), $F(1, 161) = 4.10$, $p < .05$. The pen recorder was also judged to be a greater performance risk (average of two reverse-scaled questions: How confident are you that the voice recorder will perform as described? 1 = not confident at all, 7 = very confident; How certain are you that the voice recorder will work satisfactorily? 1 = not certain at all, 7 = very certain; $r = .72$, $p < .0001$) relative to the regular recorder ($M_{pen\ recorder}$ = 3.41 vs. $M_{regular\ recorder}$ = 2.99), $F(1, 161) = 7.04$, $p < .01$.

In terms of social risk (average of two questions: If I bought the voice recorder, I think I would be held in high esteem by my friends. 1 = Disagree, 7 = Agree (reverse scaled); If I bought the voice recorder, some people whose opinion I value will think of me as being foolish. 1 = Disagree, 7 = Agree; $r = .29$, $p = .0001$), however, the two products were evaluated no differently ($M_{pen\ recorder}$ = 4.29 vs. $M_{regular\ recorder}$ = 4.19), $F(1, 161) = .31$, NS.

The present manipulation check for the voice recorder stimuli was conducted online and therefore did not experimentally vary temperature. We did, however, ask participants how cold or hot they were feeling at the time they completed the survey. This self-reported felt temperature measure affected participants' purchase likelihood in a manner similar to the temperature manipulation in Study 3. Specifically, among participants who saw the innovative pen recorder, those who reported feeling hotter were less likely to buy, b = - .77, F (1, 80) = 14.48, $p < .0005$. By contrast, among participants who saw the regular recorder, those who felt hotter were more likely to buy, b = .48, F (1, 81) = 7.51, $p < .01$. This pattern resulted in a significant product x temperature interaction, F (1, 161) = 21.74, $p < .0001$, suggesting that the felt temperature measure was a viable proxy for manipulated temperature in the present context. Importantly, the main effects of temperature and the product x temperature interaction effects on perceptions of innovativeness, financial risk, performance risk, and social risk were not significant, all F (1, 161) < .5, NS. Thus, risk perceptions for the pen recorder and the regular recorder did not vary with temperature.

In the final study we juxtapose the effects of temperature with the effects of depletion in order to conclusively implicate resource depletion as the process mechanism and to illustrate an increase in System 1 processing. The former is achieved by replicating the resource depletion task from Study 2. The latter is based on recent work by Mishra, Mishra, and Nayakankuppam (2007) that highlights how environmental and situational factors can interfere with System 2 processing, especially for complex decisions that require comparing and contrasting of information across two or more alternatives.

STUDY 4: WARM TEMPERATURES (AND DEPLETION) HAMPER PERFORMANCE ON COMPLEX TASKS

Participants, Design, and Procedure

One hundred and twenty-eight students (M_{age} = 24 years, 55% women) completed the study in a computer lab where the temperature was manipulated to be cool (67°F) or warm (77°F) for each session. As a manipulation check (how cold or hot are you feeling right now; 1 = very cold, 7 = very hot), participants in the warm condition reported feeling significantly more hot (M_{cool} = 3.15 vs. M_{warm} = 4.59; $F(1, 124) = 62.43$, $p < .0001$). We also manipulated participants' depletion, between subjects, using the same procedure as Study 2. Confirming the effectiveness of the depletion manipulation, participants in the depletion condition reported greater difficulty in paying attention to the video (1 = very easy, 7 = very difficult; $M_{not\ depleted}$ = 3.95 vs. $M_{depleted}$ = 4.84, $F(1, 124) = 11.25$, $p < .005$). In summary, the study employed a 2 (temperature: cool, warm) x 2 (depletion: no, yes) between-subjects design. The order of the next pair of tasks, identical to that used in Study 3 – cognitive estimation and general knowledge – was counterbalanced. After completing these two tasks, participants read a complex choice scenario adapted from Mishra, Mishra, and Nayakankuppam (2007).

In this complex choice scenario, participants are asked to choose between two cell phone plans in order to demonstrate System 1 processing (see Web Appendix H). 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,

Mishra, and Nayakankuppam (2007) demonstrate that individuals using System 1 are more likely to choose the expensive plan compared to individuals using System 2.

We expect warmer temperatures to increase System 1 processing and affect choice in a similar manner. In other words, we expect that when choosing between these complex phone plans, warm (vs. cool) people will be less likely to calculate the cost of plans, and will therefore be more likely to choose the expensive cell phone plan. At the end of the study we also asked participants to complete a mood inventory (described in Study 2). Mood was not affected by the temperature manipulation and is therefore omitted from the discussion of results.

Results and Discussion

Cognitive estimation versus general knowledge tasks. An ANOVA with estimation performance as the dependent measure and depletion and temperature as predictors revealed a significant depletion x temperature interaction, $F(1, 124) = 5.39$, $p < .05$. See Figure 5. Among participants who were not depleted, those in the warm condition provided more widely varying (i.e., poorer) estimates, as evidenced by larger overall scores ($M_{cool} = 7.12$ vs. $M_{warm} = 9.27$), $F(1, 124) = 7.90$, $p < .01$. This pattern is similar to that observed in Study 3. Depletion attenuated the effect of temperature; among depleted participants, temperature did not affect performance on the estimation task ($M_{cool} = 9.43$ vs. $M_{warm} = 9.06$; $F(1, 124) = .23$, NS). Planned contrasts reveal that among cool participants, depleted participants performed worse (scored higher) than non-depleted participants, $F(1, 124) = 8.78$, $p < .005$. By contrast, depletion did not affect warm participants' performance, $F(1, 124) = .08$, NS.

In the non-depleted conditions, warm participants took longer to provide estimates relative to cool participants ($M_{cool} = 137$ vs. $M_{warm} = 205$ seconds; $F(1, 124) = 8.07$, $p < .01$). The depleted conditions showed a similar pattern, with warm (vs. cool) participants taking marginally longer to estimate ($M_{cool} = 135$ vs. $M_{warm} = 183$ seconds; $F(1, 124) = 4.05$, $p = .05$).

Temperature did not affect the number of general knowledge questions correctly answered by non-depleted participants ($M_{cool} = 3.53$ vs. $M_{warm} = 3.57$), $F(1, 124) = 0.01$, NS) nor by depleted participants ($M_{cool} = 3.61$ vs. $M_{warm} = 3.72$), $F(1, 124) = 0.06$, NS). Furthermore, the time taken to answer general knowledge questions was not affected by temperature or by depletion (F's < 1).

< Insert Figure 5 about here >

We conducted a repeated measures analysis with performance on the two tasks (cognitive estimation and general knowledge) as the two dependent measures, and depletion and temperature as the predictors. We reverse scored the cognitive estimation score so that higher scores reflect better performance, as they do for the general knowledge score. Consistent with the preceding univariate results, we find a significant task type x depletion x temperature interaction, $F(1, 124) = 5.59$, $p < .05$. The depletion x temperature interaction is significant for the cognitive estimation task, indicating that depletion attenuates the effect of warm temperatures on the cognitive estimation task. For the general knowledge task, however, the depletion x temperature interaction is not significant.

Choice of cell phone plans. A logistic regression with temperature (cool, warm) and depletion (no, yes) as predictors and plan choice the dependent measure revealed a temperature x depletion interaction, Wald χ^2 (1) = 3.58, *p* = .058 (see Figure 5, panel B). We note this χ^2 statistic translates to *w* = .17 (Sawyer and Ball 1981), falling between the small (.10) and medium (.30) effect sizes values as defined by Cohen (1977).

In non-depleted conditions, cool participants were more likely to correctly choose the inexpensive plan (X_{cool} = 59% vs. X_{warm} = 27%), χ^2 (1) = 6.70, $p < .01$. By contrast, temperature did not affect plan choice among depleted participants (X_{cool} = 23% vs. X_{warm} = 31%), χ^2 (1) = .03, NS. Planned contrasts revealed that among cool participants, those who were depleted were significantly less likely to correctly choose in the inexpensive plan, χ^2 (1) = 5.67, $p < .05$. However, depletion did not affect choice of warm participants, χ^2 (1) = .12, NS.

Discussion. Study 4 highlighted the process through which temperature affects performance on complex cognitive tasks. We find that non-depleted participants are affected by temperature in the manner observed in Study 3, where temperature hampers performance on a complex cognitive estimation task, but not on a memory-based general knowledge task. However, depletion attenuates this effect of temperature. In particular, depleted, cool participants perform like (depleted or not depleted) participants who are warm. We also study the effect of temperature on a complex choice between cell phone plans, which has previously been used by Mishra, Mishra, and Nayakankuppam (2007) as a measure of System 2 processing. We find that warm temperatures increase reliance on System 1 processing for warm participants and for depleted participants, but not for cool non-depleted participants. Specifically, depleted cool participants exhibit significantly worse performance than non-depleted cool participants.

GENERAL DISCUSSION

Summary of Results

Across five studies, we show that warm versus cool temperatures differentially affect consumers' behavior. Consistent with our theorizing, we find thermal load decreases resources, increases reliance on System 1 (heuristic) processing and influences performance on complex tasks. Specifically, sales of relatively complex lotteries (Pilot Study) and individuals' propensity to undertake difficult gambles (Study 1) are lower under warm temperatures. Illustrating the underlying processing differences, subsequent studies reveal that individuals in warm conditions show evidence of heat-induced resource depletion. We demonstrate in a series of tasks that warm temperatures hamper performance on complex tasks (Study 2-4).

Underlying Process

We find that warm versus cool temperatures influence information processing by depleting individuals' available resources, resulting in greater System 1 (heuristic) processing. We present evidence of the effect of warm temperatures on the propensity to gamble, willingness to adopt an innovative new product and the ability to choose between complex cell phone plans.

Thus, warm temperatures are depleting and this lowers performance on complex tasks. But how does depletion work? Does it decrease the motivation to perform complex tasks or decrease the ability to perform these tasks? The exact process underlying how depletion operates is under active investigation (Muraven 2011). Support for the motivation account comes from research showing that one's belief that resources are limited affects subsequent effort (Job, Dweck and Walton 2010; Martijn et al. 2002). In other words, this camp argues that failure on regulatory tasks occurs because individuals expect to fail. On the other hand, there are arguments that depletion is biologically based and hence decreases ability of the individual to perform certain tasks. Galliot et al. (2007) demonstrate that depletion lowers blood glucose levels, hampering cognitive performance. In the current research, whether warm individuals were less motivated or less able to perform the complex tasks relative to cool individuals remains a viable area for further investigation.

Alternative Effects of Temperature

Prior research on the effects of temperature, focusing on more extreme ranges than the ones studied here, finds that extreme temperatures may affect arousal and improve performance on vigilance tasks for short periods of time (Poulton 1976). While arousal within a small range can improve performance (and then decrease performance for higher levels; Easterbrook 1959), one still needs a resource explanation to understand the non-linear relationship (Hancock 1986). Furthermore, the procedures employed in the present studies had participants acclimate to the room temperature for at least fifteen minutes before they completed the cognitive tasks, which may have ruled out short-term effects.

Another broad stream of research has studied the effect of extreme temperatures on spontaneous acts of affect-based aggression (Anderson 1989). In the present research, however, warm versus cool temperatures do not affect arousal and mood. This could be for several possible reasons. First, we study a narrow range of temperatures (67-77°F) that is suitable for indoor offices and retail environments. In this range, we find no differences in mood measures. Second, the tasks that we study are cognitive in nature (gambling, adopting a new product, choosing between cell phone plans) that differ from spontaneous actions for which the effect of warm temperatures has been previously shown. Indeed, Studies 2-4 show that heat stress depletes resources. Consequently, warm temperatures increase heuristic processing and hamper performance on complex cognitive tasks.

Implications

The demonstrated effect of moderate heat stress on resource depletion has significant implications for firms and for consumers, given the narrow range of studied temperatures (67-77°F), which represents a typical range of ambient temperatures in which consumers make decisions. For firms and educational institutions, implications include decreased productivity and slower learning under warm temperatures (Seppänen, Fisk, and Lei 2006). For consumers, the effort exerted when making a purchase decision may decrease under warm temperatures. This detrimental effect of warm temperatures is more likely to manifest itself for purchases of new products than for habitual, repeat purchases. Indeed, Tellis, Stremersch, and Yin (2003) show that new product adoption is slower in nations that are close to the equator (and warmer) than in nations farther away from the equator. Thus, new products may fare better in cool retail settings. By contrast, market leaders in an established category may want warmer ambient temperatures. Furthermore, stores may want people to carefully process deep discounts, but only superficially notice shallow discounts as a promotion signal (Inman, McAlister, and Hoyer 1990).

Retailers could therefore manipulate ambient temperature within a reasonable range (67-

77°F) to influence the amount of resources consumers have available at the point of sale. However, anecdotal evidence suggests that retailers are unaware of the potential influence of temperature: a survey of 32 local stores revealed in-store temperatures of 72-80°F, with only one store reporting the existence of a temperature guideline. When the managing employees were explicitly asked about warm versus cool temperatures, only one store reported negative effects of cool temperatures. By contrast, 34% (11/32) of the stores reported negative effects of warm temperatures, with less time and money spent in store, and more complaints. Finally, the impact of temperature on financial decisions is also significant, as demonstrated by the present research in the domain of gambling, and by Cao and Wei (2005) in the domain of stock market returns.

In conclusion, our physical surroundings provide a variety of cues that affect decisions (Belk 1975). Despite temperature's obvious influence on our daily lives, little systematic research has been done to understand how it influences us as consumers. The current research is a first step in investigating how warm versus cool temperatures, in the range typically experienced by individuals in retail and work settings, influence gambling propensity, new product adoption, and complex choices.

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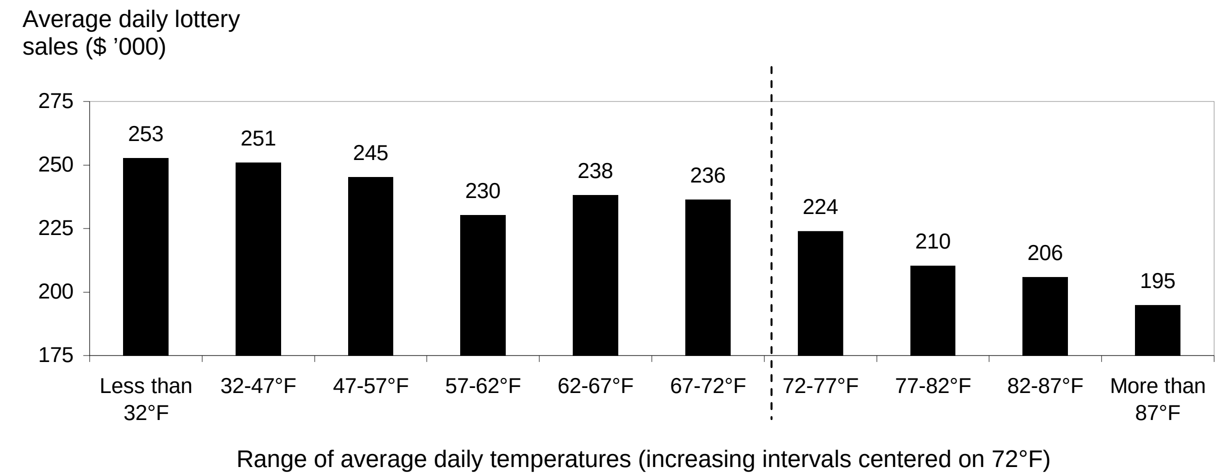
FIGURE 1

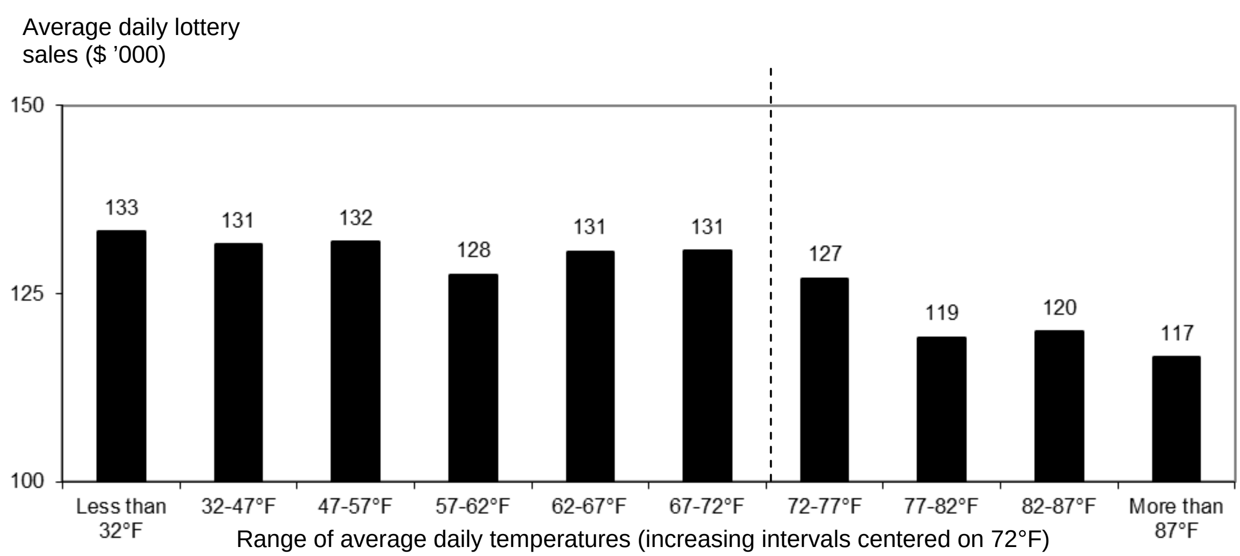
LOTTERY SALES DECREASE IN WARM TEMPERATURES – PILOT STUDY

A. Scratchers



NOTES
1. An effect of day of the week shows sales being lowest on Sun. and highest on Fri., F (6, 355) = 44.03, *p* < .0001
2. A monthly trend shows that scratchers sales increase by about $3,853 per month, F (1, 355) = 106.47, *p* < .0001
3. The effect of date (1-31) is not significant, F (1, 355) = 1.26, *NS*
4. The effect of temperature remains significant in the absence of covariates, b = -756, F (1, 363) = 63.08, *p* < .0001

B. Electronic



NOTES
1. An effect of day of the week shows sales are lowest on Sun. and highest on Fri., F (6, 355) = 158.31, *p* < .0001
2. A monthly trend shows that electronic sales increase by about $1,314 per month, F (1, 355) =80.79, *p* < .0001
3. An effect of date (1-31) shows sales dropping by $243 per day of the month, F (1, 355) = 18.38, *p* < .0001, possibly as a consequence of decreased liquidity.
4. The effect of temperature remains significant in the absence of covariates, b = -182, F (1, 363) = 12.43, *p* < .001

FIGURE 2

WARM TEMPERATURES DECREASE PROPENSITY TO

UNDERTAKE DIFFICULT GAMBLES – STUDY 1

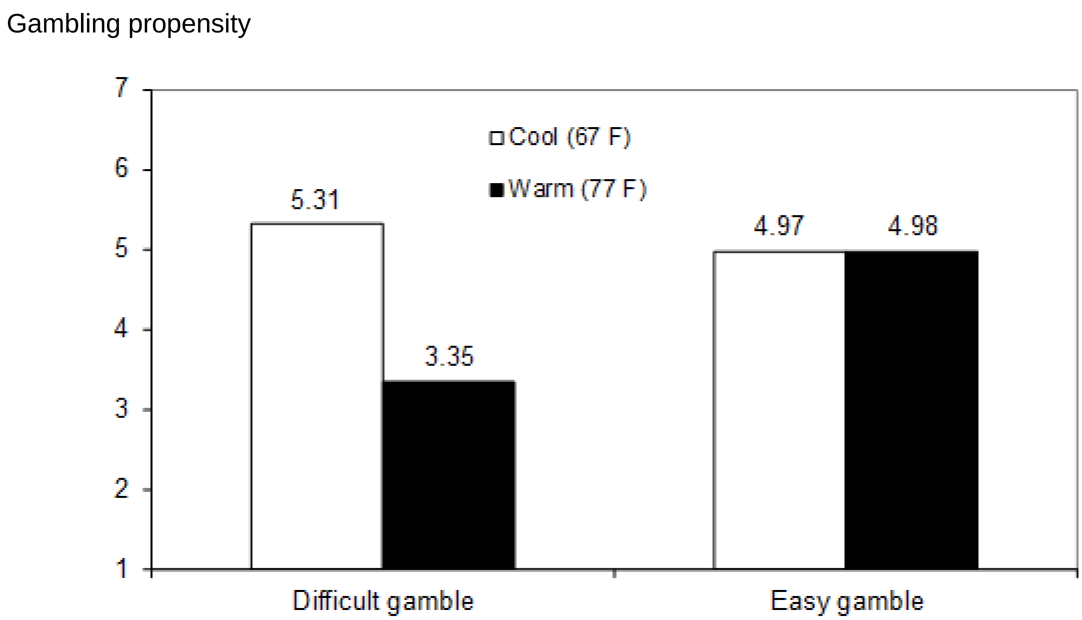


FIGURE 3

WARM TEMPERATURE HAMPERS PROOFREADING PERFORMANCE:

ATTENUATING ROLE OF DEPLETION – STUDY 2

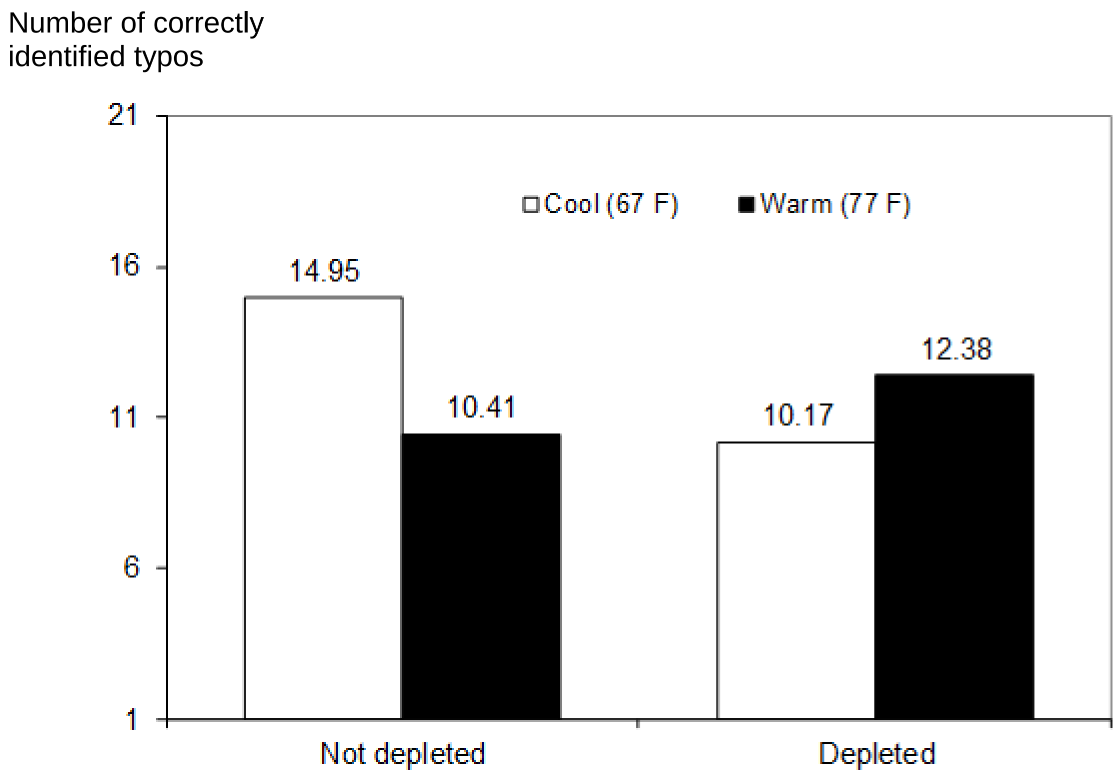


FIGURE 4

WARM TEMPERATURES DECREASE PROPENSITY TO

BUY AN INNOVATIVE NEW PRODUCT – STUDY 3

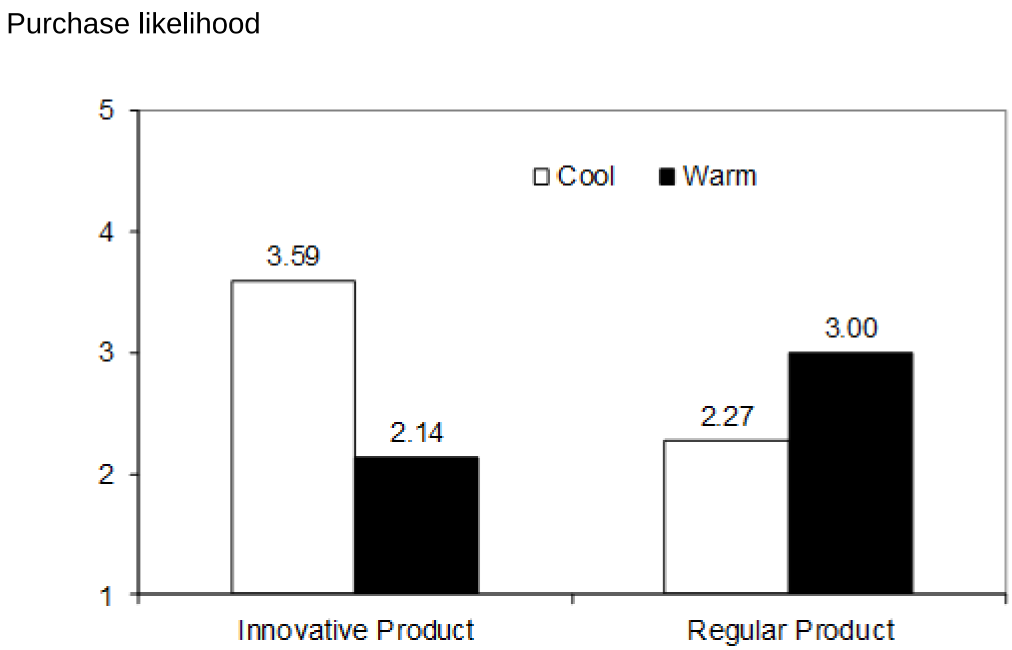
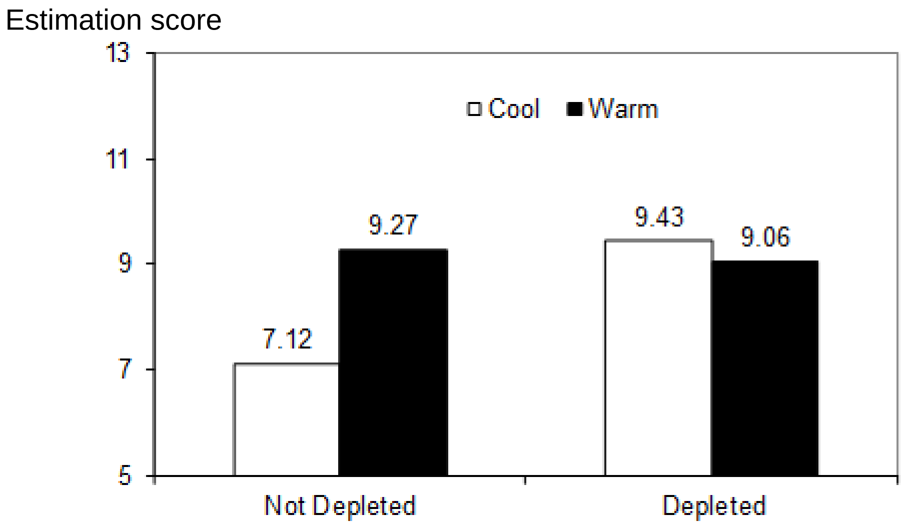


FIGURE 5

DEPLETION AND WARM TEMPERATURES RESULTS IN

DECREASED PERFORMANCE ON COMPLEX TASKS – STUDY 5

A. Depletion Attenuates the Effect of Temperature on Complex Cognitive Estimation



Note: Larger numbers denote higher variability and a poorer performance

B. Depletion Attenuates the Effect of Temperature on System 2 Processing