10-6-2015

Can Non-Haptic Manipulation Of Temperature Influence The Same Emotions As Ostracism?

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AS OSTRACISM?

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68 Pages

I explored the possibility that temperature can alter the same variables affected by ostracism (i.e., being ignored and excluded): belonging, control, meaningful existence, and self-esteem need satisfaction, feelings of ostracism, mood, and loneliness. According to the theory of embodied cognition, individuals can associate physical warmth with social intimacy, as well as cold temperatures with social isolation (Zhong & Leonardelli, 2008; IJzerman et al., 2012). Bargh and Shalev (2012) found that participants holding a cold pack reported higher loneliness than participants holding a neutral or warm pack. My study expands upon Bargh and Shalev's (2012) findings by examining more emotions frequently associated with ostracism. Furthermore, my study uses gum as a non-haptic manipulation of temperature to expand on evidence of cross-modal associations (Barsalou, 2008). With 170 participants at Illinois State University I induced sensations of heat with red, cinnamon-flavored gum, coldness with white, peppermint-flavored gum, and a neutral temperature with purple, mixed-berry flavored gum. I then measured variables typically collected in ostracism research. Results

indicated that although the gum conditions were perceived to be significantly different temperatures, there was no main effect of gum condition on the ostracism related cognitions while controlling for liking of gum and familiarity with gum. I suggest several possible explanations for the inability of gum to induce changes in cognition, including the possibility that the gum causes positive cognitions that impede any negative effect cold temperature may have on cognitions. Future research should explore if the non-haptic nature of the gum manipulation hinders its ability to alter cognitions and emotions.

KEYWORDS: Basic needs, Belonging, Cold, Color, Conceptual Metaphor Theory, Control, Cross-modal Association, Embodied Cognition, Emotion, Gum, Loneliness, Meaningful existence, Mood, Non-haptic, Ostracism, Self-esteem, Taste, Temperature, Warm

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A Thesis Submitted in Partial
Fulfillment of the Requirements
for the Degree of

MASTER OF SCIENCE

Department of Psychology

ILLINOIS STATE UNIVERSITY

2015

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ACKNOWLEDGMENTS

I am truly grateful for all of the opportunities I have been afforded and people who have helped me get to where I am today. I'd first like to thank my thesis chair, Eric Wesselmann, for helping me to mold my varying interests into a discernable thesis; I appreciate all of the advice and support you have given me throughout this entire process. I am also grateful for the help I have received from Matthew Hesson-McInnis, not only on my thesis but in sharing his expertise in all things statistics. I feel like I have truly learned from the best. Thanks to Alexandra Ilie for your helpful comments and suggestions regarding my thesis. I'd also like to thank Sara Brady for the advice on career paths and for instilling in me a love for research.

I have two incredibly close friends who were my saving grace throughout graduate school that I owe way more than just my gratitude: Kamila Gabka and Ellen Klieme. Kamila, it's no wonder we never killed each other after spending so many hours at the table in my apartment. I'm so glad graduate school brought us together, because as we know, we are basically the same person. And to Ellen, I can only strive to be half as brilliant and kind as you; thank you for showing me what it is to harmoniously join intelligence with humanity and reason with beauty. Thanks Ryan for sharing your musical and statistical talents and for putting up with me for two years. Thanks to everyone in the ISU psychology program for not only making graduate school bearable but fun. Thanks to my friends in Texas and around the world for the love and

encouragement you gave me to even attempt graduate school. Thanks to Nina for your continuing friendship and open couch, and of course for dealing with my altered personality around finals week for all those years.

A huge thank you to my family who supported me throughout my life and especially through the turmoil of graduate school. I want to thank my mom for always being there to listen, my dad for the support and encouraging pep talks, Walter for the graduate school wisdom and for being a good friendly competitor in this game of academics, Katie for the joy you give me, and Abby for being lazy with me during breaks when I've needed it. To Meme, my incredibly intelligent grandma and a woman ahead of her time, thank you for inspiring me to become educated and experience everything the world has to offer.

This endeavor to earn a master's degree has challenged and pushed me further than I thought possible. I would never have accomplished this goal without the people in my life who grounded me and kept me relatively sane. My sincerest thanks to you all.

R. A. O

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CHAPTER I

INTRODUCTION

Most people do not interpret the phrase *give the cold shoulder* to mean deliberately showing spitefulness to a visitor by offering him or her a cold shoulder of mutton instead of a hot meal as folk etymology suggests (Hendrickson, 1997); yet this phrase has entered the common vernacular. *Cold shoulder* is a metaphor in which one concept is described in terms of another (Landau, Robinson, & Meier, 2014). Although Sir Walter Scott first used this phrase in print in 1816 (Hendrickson, 1997), somehow individuals have an enduring understanding that this phrase means to ostracize (i.e., ignore and exclude; Williams, 2009) someone simply based on an underlying understanding that social isolation can be adequately described by a sensation of physical coldness.

The common and creative use of language comparing physical warmth and social intimacy signifies the prevalence of the connection. A glare is described as an *icy stare*; oppositely, a warm personality is associated with prosocial characteristics such as being sociable, humorous, popular, and generous (Asch, 1946). Recurrently, coldness is conceptualized as excluding or isolating whereas warmth is conceptualized as bringing closer into union (Asch, 1958). The prevalence of this metaphor has intrigued psychologists who ask the question of whether the lingual connection between warmth

and social intimacy is merely a turn of phrase or somehow more deeply engrained in human understanding. If people understand social isolation based on temperature, could one possibly manipulate the temperature to alter the same psychological effects of ostracism?

CHAPTER II

REVIEW OF RELATED LITERATURE

Embodied Cognition

To begin unraveling the issue one must first determine if the mind and body are separate entities or somehow intimately related. The social cognitive theory hypothesizes that the brain functions like a computer. Information is stored in semantic memory through amodal, or abstract, symbols (Barsalou, 2008). Social information is processed through schemas (i.e., abstract mental representations of similar stimuli that are organized together; Landau, Meier, & Keefer, 2010). The social cognitive theory states that mental representations function independently of bodily sensations and motor function (Landau, Meier, & Keefer, 2010). A growing body of evidence, however, suggests that the mind and body are interconnected. For example, left-handers and right-handers perceive pictures on their respective dominant side as having more positive valence (Casasanto, 2009); injections of Botox (inhibiting the use of the corrugator supercilii, the facial muscle used for frowning) result in slower processing of sad and angry sentences but not happy sentences (Havas et al., 2010) as well as impaired perception of facial emotions (Neal & Chartrand, 2011), and wearing a heavy backpack causes individuals to overestimate the incline of hills and the distances to a target (Proffitt, 2006).

The theory of embodied cognition posits that not just modal representations of physical sensation and motor control affect cognition (Barsalou, 2008). In other words,

"Thinking is influenced by the body and the brain interacting with the environment" (Glenberg, Witt, & Metcalfe, 2013, p. 575). From experience in interacting with the world, the brain stores information about bodily states that occur while experiencing specific abstract concepts (Landau, Meier, & Keefer, 2010). Strack, Martin, and Stepper (1988) tested a simple application of this concept, noting that recurrently when people find something humorous their mouths turn up in a smile. They found that forcing participants' muscles to form a smile by holding a pencil in their mouths caused participants to find cartoons more humorous than participants prevented from physically smiling through the act of holding a pencil in their lips. Another example of the brain's coupling of physical sensations and abstract concepts through repetitive paring of the two is the formation of the concept of social intimacy. One's concept of social intimacy may include tactile representations of the physical warmth felt from being cradled in a nurturer's arms or the heat radiated from a warm hug (Williams & Bargh, 2008). If the feelings of social intimacy and physical warmth occur simultaneously in a reoccurring pattern the physical sensation and abstract concept develop a neuronal connection. Indeed, Inagaki and Eisenberger (2013) found that social intimacy and psychological warmth share neurocognitive processes. Participants in a functional MRI scanner were given socially warm letters to read from their friends and later given a warm pack to hold. These two experiences activated the ventral striatum and middle insula areas of the brain associated with rewarding outcomes and processing warmth (Inagaki & Eisenberger, 2013). Interestingly, this overlap in neural activity was not demonstrated with the merely pleasant task of receiving touch from the brushstroke of a soft brush. This evidence suggests that social intimacy is experienced similarly to the physical sensation of warmth.

Conceptual Metaphor Theory

The connection between physical warmth and social intimacy does not only occur in situations one has previously experienced but can be translated into metaphors. Returning to the phrase *cold shoulder*, one does not have to have previous experience with a cold shoulder while being ostracized to understand the phrase's meaning. The conceptual metaphor theory posits that dissimilar concepts that do not normally occur together can be systematically structured in what is called conceptual mapping (Landau, Meier, & Keefer, 2010). Elements of abstract concepts (i.e., target) can be understood by elements of more concrete concepts (i.e., source; Landau, Robinson, & Meier, 2014). For example, Williams and Bargh (2008) demonstrated the connection between physical warmth and interpersonal warmth by having participants briefly hold either a cold or a warm cup of coffee for the experimenter. Participants who held the warm cup of coffee perceived a target person as having a warmer personality (using the same scale as Asch, 1946). A warm cup is not normally paired with a friendly person; hence, Williams and Bargh (2008) demonstrated a metaphoric mapping between the abstract concept of interpersonal warmth (i.e., target) and the physical sensation of warmth (i.e., source).

Schnall (2014) argues that warmth is likely a core metaphor (i.e., fundamental to human nature) because all humans share the experience of having bodies that give off heat and move at varying distances from objects and other people. Moreover, research shows that we vary distance to others based on our level of intimacy. According to Hall (1969), Americans consider intimate distance to be up to eighteen inches away; at this distance physical contact is highly probable. As the name suggests, intimate distance is reserved for those one feels intimately acquainted with. Personal distance is one and a

half to four feet from one's body; this is the distance that non-contact animals inhabit and could be considered the protective distance people maintain from others they are not intimately associated with. Although the exact distances differ between cultures, people still associate shorter interpersonal distance with more intimacy (Hall, 1969). Furthermore, Mehrabian (1968) found that participants who were asked to imagine talking to someone they like sat closer to this imagined individual; results indicate that a negative linear relation exists between attitude toward a subject and distance. Interestingly, perception of distance may also differ, with accepting individuals viewed as being physically closer than ostracizing individuals (Knowles, Green, & Weidel, 2013). In summation, the connection between social intimacy and warmth is perpetuated because people tend to be physically close to those with whom they are socially intimate, which produces heat.

Social Isolation Causes Cold Sensations

Whereas the concept of social intimacy appears to be grounded in the physical sensation of warmth, the opposite end of the temperature spectrum (i.e., cold temperature) appears to be connected with social isolation. For example, Lee, Rotman, and Perkins (2014) found that participants sitting alone perceived the room temperature to be significantly colder than participants sitting with another person. Much of the literature connecting social isolation and cold temperature, however, concerns ostracism; for this reason I would like to narrow down the topic of social isolation to focus on the connection between temperature and ostracism.

For simplicity I will use the term *ostracism* ubiquitously. This simplification is important to note because some argue that rejection (i.e., explicit messages that one is not

wanted; Wesselmann et al., 2015) and ostracism are fundamentally different experiences and thus affect need satisfaction and mood differently. While acknowledging the disagreement in the field, this simplification is warranted because rejection and ostracism appear to affect the outcomes of interest in the current study in the same way, but to a different degree (Wesselmann et al., 2015). The experience of ostracism involves rejection but is a stronger situation because this rejection occurs without acknowledgement of the ostracized individual (Gerber & Wheeler, 2009). Gerber and Wheeler's (2009) meta-analysis demonstrated no difference between the effects of ostracism and rejection on mood or control. Furthermore, although ostracism manipulations resulted in larger effects sizes than rejection manipulations for belonging, self-esteem, and meaningful existence, most of the effects of both manipulations were statistically significant, and all were in the same hypothesized direction (Gerber & Wheeler, 2009).

Several studies have demonstrated that ostracism causes the sensation of physical coldness. Zhong and Leonardelli (2008) found that when participants were asked to recall a time in which they were ostracized they estimated the room temperature to be colder than participants who recalled a time in which they were socially included. Furthermore, IJzerman et al. (2012) provide biological evidence of the relation between ostracism and cold physiological sensations. When participants were ostracized in an online ball tossing game their internal temperatures, measured through a finger thermometer, were significantly lower than participants who were included. Given the evidence that ostracism is experienced through the sensation of physical coldness, could cold temperature activate the same emotional responses as ostracism?

Ostracism

To understand why cold temperature may produce similar effects as social ostracism one must explore the negative consequences of ostracism. Social ostracism is a powerful tool used by a group to send a warning to the ostracized individual that he or she is not adhering to the norms or contributing to the group (Williams, 2009). If an ostracized individual does not subsequently change to adhere to the group's norm, then he or she will be exiled to conserve group resources, which was historically a death-sentence (Kerr & Levine, 2008; Williams, 2007). Ostracism threatens an individual's personal security through an array of negative outcomes. Firstly, ostracism affects the body, causing heightened cortisol levels (Dickerson & Kemeny, 2004; Gunnar et al., 2003) and cardiovascular difficulties (Moor, Crone, & van der Molen, 2010). Furthermore, ostracism is physically painful; Eisenberger, Lieberman, and Williams (2003) demonstrated that ostracizing individuals in an fMRI activated the region in the brain associated with physical pain (i.e., dorsal anterior cingulated cortex [dACC]). Ostracism also affects psychological health through increasing feelings of dehumanization (Bastian & Haslam, 2010), and impairing self-regulation (Baumeister et al., 2005).

The current study focused on the following commonly researched immediate psychological effects of ostracism: ostracism increases negative affect (i.e., anger and sadness; Chow, Tiedens, & Govan, 2008), increases loneliness (Hawkley et al., 2008), and threatens four fundamental psychological needs. First, ostracism threatens one's need to belong (Baumeister & Leary, 1995); if an individual does not have close social relationships then he or she does not have anyone for support or protection (i.e.,

ostracized individuals lack psychological security; Wesselmann et al., 2015). Second, ostracism threatens one's need for self-esteem. Ostracized individuals do not receive messages that they are respected by others, thus they have a limited ability to navigate a social system successfully (i.e., ostracized individuals lack personal security; Wesselmann et al., 2015). Third, ostracism threatens one's need for perceived control, a quality that is important for psychological well-being (Rothbaum, Weisz, & Snyder, 1982). Ostracized individuals feel that they cannot control others' actions toward them and thus have a lack of agentic security (Wesselmann et al., 2015). Last, ostracism threatens the need for meaningful existence (Greenberg, Pyszczynski, & Solomon, 1986). Because ostracized individuals are not acknowledged they may feel that their existence is not real and their life has no purpose (i.e., ostracized individuals' existential security is threatened; Wesselmann et al., 2015).

Cold Sensations Cause Negative Emotions

Being ostracized is an intensely negative emotional experience. Although no physically painless experience will likely match ostracism in the pain and negativity it evokes, some evidence suggests that cold temperature can induce emotional responses associated with ostracism just as ostracism can induce cold temperature. Bargh and Shalev (2012, study 2) demonstrated the former causal relation by having participants hold a cold pack, warm pack, or neutral pack. Participant primed with the cold pack scored higher on the UCLA loneliness scale than the participants primed with the neutral or warm pack. I would like to expand upon Bargh and Shalev's (2012) study to include more variables associated with ostracism. Much of the previously stated literature connecting temperature with social intimacy is highly related to ostracism literature, but

no one has yet thoroughly examined the connection between temperature and the variables that are commonly researched effects of ostracism (i.e., need satisfaction, feelings of ostracism, mood, and loneliness).

Bargh and Shalev (2012) conducted a subsequent study (study 3) in which they found a main effect of temperature primes (holding a warm, cold, or neutral pack) on desire to affiliate with others (from Park and Maner, 2009) and interest in emotion regulation activities (from Thayer, Newman, and McClain, 1994). Although these measures relate to belonging need satisfaction and mood, respectively, they do not directly measure current feelings but instead desires for future activities. In the current study I measured feelings instead of future desires because measurements of feelings related to mood (e.g., PANAS) and need satisfaction (e.g., self report items developed for ostracism literature such as those found in Zadro, Williams, & Richardson [2004] and Twenge et al., 2007) are often used in ostracism literature and demonstrated to be effects of ostracism (Gerber & Wheeler, 2009). Like the current study, IJzerman et al. (2012) also measured feelings of negative affect (i.e., mood) in response to a temperature manipulation (i.e., participants holding a warm or cold cup for 30-seconds). IJzerman et al. (2012), however, did not find a significant overall effect of temperature. In relating the findings from Bargh and Shalev's (2012) study 3 and IJzerman et al. (2012) to the current study, I must note that these studies also include an ostracism condition in which participants wrote about either a time in which they were ostracized, a time when they were included, or a neutral situation (Bargh & Shalev, 2012, study 3) or participants were included or ostracized in an online ball tossing game called Cyberball (IJzerman et al., 2012). Both studies found no significant effect of temperature in the inclusion condition.

For two reasons these null findings should not be strongly considered when estimating the effects of the current study. First, the current study does not induce ostracism or inclusion; this methodological difference will likely cause participants to be in a different emotional state and hence must be considered accordingly. Second, these studies are likely underpowered, with only 19 participants per temperature condition in Bargh and Shalev (2012) and about 21 per temperature condition in IJzerman et al. (2012). Not enough information was given in Bargh and Shalev (2012) to calculate observed power; however, IJzerman et al.'s (2012) observed power was .80, thus demonstrating the difficulty of finding a main effect of temperature in the inclusion conditions if an effect does indeed exist.

Cross-modal Association

In expanding upon Bargh and Shalev's (2012) study to examine ostracism outcomes affected by temperature, I reason that, in accordance with the theory of embodied cognition, if people fundamentally experience ostracism as a cold sensation, then the emotions resulting from ostracism should, theoretically, also be an effect of the sensation of coldness. To further enhance the understanding of modalities associated with the theory of embodied cognition in the current study, I manipulated temperature using non-haptic modalities. Previous studies have induced heat through heating pads (Bargh & Shalev, 2012), ambient temperature (Lee, Rotman, & Perkins, 2014), holding a warm or cold cup of coffee (Williams & Bargh, 2008), and drinking hot or iced tea (Hong & Sun, 2012). All of these manipulations directly induced the haptic sensation of heat. Research in grounded cognition, however, suggests that warmth can be elicited through

any of the different modalities the brain processes (i.e., visual, olfactory, taste, auditory, and haptic; Barsalou, 2008).

The current study contributes to a multi-trait multi-method approach (Campbell & Fiske, 1959) of understanding the link between heat and social intimacy by manipulating temperature in an alternate way. I chose a gum flavor and color manipulation of temperature primarily because the non-haptic induction of temperature is an interesting and relatively novel means of inducing temperature that perpetuates the idea of multimodal representations. Furthermore, gum is a potentially useful tool for researchers to manipulate temperature. I induced warmth through red cinnamon-flavored gum and induce cold through white peppermint-flavored gum. Gum manipulation of temperature was used in Lewandowski, Ciarocco, and Gately's (2012) study in which participants who experienced gum induced deviation of normal temperature (warm or cold) expressed greater concern exclusively for the threat of global warming (not other social issues) and were also more likely to volunteer for a global warming club on campus than participants who did not chew gum.

To best replicate Lewandowski, Ciarocco, and Gately's (2012) ability to induce temperature with gum I used the same brand of gum the researchers used. The gum manipulation affects two non-haptic senses. First, the gum manipulates the taste modality through cinnamon or peppermint flavor. The gum produces the sensation of warmth or coldness through the chemical compounds in the gum flavors that cause a neurological response, activating internal temperature receptors that would normally only be sensitive to haptic temperatures that deviate from internal body temperatures (Kimbrough, 1997). Second, the gum manipulates the visual modality through red or

white colors. Demonstrating that non-haptic visual stimuli can invoke perceptions of temperature, Choi (2013) found that participants first exposed to pictures of a hot steaming cup of tea judged a man in a neutral colored background as having a warmer personality than participants who first viewed pictures of a chilled glass of iced tea. Specifically relating color to temperature perception, Choi (2013) also found that people in pictures with a warm color background (i.e., red or orange) were perceived as having a warmer personality than people in pictures with a cold color background (i.e., blue or green). Whereas Choi (2013) examined blue and green as colors representing coldness, Madden, Hewett, and Roth (2000) found that white is included in a blue-green-white cluster that fall on the opposite end of the spectrum of meaning associations from red, which was cross culturally found to signify heat. Whereas atypical combinations of color and taste result in incorrect taste response (DuBose, 1980), the current study used conceptually consistent colors to increase the overall non-haptic sensation (i.e., red and cinnamon-flavor represent warmth; white and peppermint-flavor represent cold); this is important because the color is likely to be more impactful for stronger color-flavor associations (Delwiche, 2003) and hence serve as a stronger temperature manipulation.

Taste, color, and temperature may be connected simply due to associative learning (e.g., eating spicy red pepper and sweating from internal heat; Barsalou, 2008). The cognitive simulation perspective, however, suggests that the brain processes multimodal representations (e.g., visual, somatosensory, and olfactory) that can be later recalled together (Barsalou, 2008). This perspective suggests that non-haptic stimuli (e.g., gum flavor and color) can influence one's perception of warmth. Furthermore, the cognitive simulation perspective suggests that remembered experiences are comprised of

multiple sensations including temperature (Barsalou, 2008). If the sensation of temperature is altered perhaps the brain will associate the temperature deviation as a form of social intimacy, thus changing one's emotions. Given the connection between temperature and ostracism I hypothesized that non-haptic induction of temperature would have a direct effect on belonging, control, meaningful existence, and self-esteem need satisfaction, feelings of ostracism, mood, and loneliness.

Hypothesis 1: Participants in the cold condition (i.e., consume white, peppermint-flavored gum) experience lower mood and need satisfaction, as well as higher loneliness and feelings of ostracism than participants in the warm condition (i.e., consume red, cinnamon-flavored gum).

To determine directionality and strength of the warm and cold manipulation I included a neutral temperature manipulation. The neutral temperature manipulation also involved taste and visual modalities. Mixed-berry flavored gum has no obvious flavor-temperature association. The gum is a deep purple color. Because the color purple is cross-culturally found to be approximately equidistant between the blue-green-white cluster and red on the spectrum of color meaning (Madden, Hewett, & Roth, 2000) one can be reasonably confident that the color of the mixed-berry flavored gum will not significantly alter temperature perception.

By using gum as the neutral temperature manipulation I not only ensured that all conditions involved the experience of chewing, taste, and color stimulation, but I also ensured that all participants received what most would perceive as a rewarding stimulus (i.e., gum). By including a neutral temperature condition I can determine the size and direction of the effect of the cold and warm manipulations. Previous studies have

demonstrated that cold manipulations have a considerably larger impact than warm manipulations. IJzerman and Semin (2010) found that priming social isolation caused participants to rate the room temperature as colder with an effect size three times larger than the warming effect of a social intimacy prime. Whereas this evidence suggests a significant difference in emotional responses between the cold manipulation and the neutral manipulation, other studies suggest there will be no difference between the warm and neutral manipulations. Bargh and Shalev (2012, study 2) found that the participants in the neutral and warm pack conditions did not significantly differ in their loneliness scores, suggesting that perhaps "the default state or orientation toward other people is mild warmth" (Bargh and Shalev, 2012, p. 153). Kang et al. (2010) provided biological evidence of this effect, finding that while warm primes did not significantly differ from control condition in the subsequent activation of the left anterior insula, cold primes resulted in significantly greater activation of the this area of the brain associated with physical and psychological warmth. People may have a natural inclination for warmth by engaging or seeking to engage in social intimacy (Bargh & Shalev, 2012). Negative experiences or cold sensations may alter this natural inclination for warmth and thus produce a greater alteration in emotions.

Hypothesis 2: Participants in the sweet, neutral temperature condition (i.e., consume a purple, mixed-berry flavored gum) will express the same mood, need satisfaction, loneliness and feelings of ostracism as participants in the warm condition (i.e., consume red, cinnamon-flavored gum) but not the cold condition (i.e., consume white, peppermint-flavored gum).

CHAPTER III

METHOD

Participants

A total of 170 Illinois State University students (75.3% female; M_{age} = 20.07; SD_{age} = 2.19) participated in the study. Of these participants, 64.7% were Caucasian, 22.9% were African American, 8.2% were Latino, 2.9% were Asian, and 1.2% classified themselves as other. Participants were recruited through Sona Systems, an online recruiting system through the ISU psychology department. Participants were compensated for their participation with extra credit to be used in their psychology courses. To ensure participants were sensitive to the temperature manipulation I excluded the following participants from the analyses: four participants who incorrectly answered the gum flavor manipulation question, three participants who reported trouble seeing colors, nine participants who reported taking painkillers within the last six hours (suppressors such as acetaminophen [DeWall et al., 2010] have been demonstrated to numb the social pain system, which is activated by ostracism [Eisenberger & Leiberman, 2004]), and five participants who reported themselves as smokers (Sato, Endo, and Tomita [2002] demonstrated that smokers are less sensitive to taste). One participant was excluded from the analyses for failing to complete any questions on the loneliness measure. A total of 22 participants were excluded from the analyses, resulting in 59

participants in the peppermint condition, 54 participants in the cinnamon condition, and 57 participants in the mixed-berry condition. The study was adequately powered according to a preliminary power analysis using G*Power (Faul et al., 2007) which previously determined that 135 participants were required to have adequate power to find a main effect of temperature using the following criteria: $\alpha = .05$, $\beta = .05$, and $\eta^2 = .096$. As the estimated effect size I used Bargh and Shalev's (2012) reported effect size of the effect of temperature on loneliness because the current study replicated Bargh and Shalev 's (2012) study by using non-haptic temperature manipulations that are hypothesized to function similarly to their haptic manipulation.

Research Design

I used a one-way design with three levels (Temperature: warm vs. cold vs. sweet, neutral temperature). I conducted a one-way multivariate analysis of covariance (MANCOVA) for the seven specified dependent variables (i.e., belonging, control, meaningful existence, and self-esteem need satisfaction, feelings of ostracism, mood, and loneliness), statistically controlling for familiarity with gum chewing and liking of gum flavor.

Measures

The first four dependent variables of interest originate from Williams, Cheung, and Choi's (2000) S-12 basic needs measure and appear in Williams (2009; see Appendix B). This scale asks participants the degree to which they experience certain feelings to measure need satisfaction for belonging ($\alpha = .67$, e.g., "I feel like an outsider" [reverse coded]), control ($\alpha = .66$, e.g., "I feel powerful"), meaningful existence ($\alpha = .86$, e.g., "I feel meaningless" [reverse coded]), and self-esteem ($\alpha = .72$, e.g., "I feel good about

myself"). Participants answered each question using a five-point likert scale. Higher scores indicate more need satisfaction. Need satisfaction scores consisted of the sum of the four items that correspond to each variable; thus, the scores were out of 20 total points. All of the measures are theory-derived but are not validated diagnostic scales (Williams, 2009); however in the current study the S12 basic needs had a reliability of $\alpha = .69$. Williams (2009) has demonstrated that each item highly corresponds to each specific need; furthermore all four needs are moderately correlated. Importantly, in almost all studies using this measure for need satisfaction all four needs were affected by ostracism (Williams, 2007; Williams, 2009).

The next two dependent variables also originate from Williams, Cheung, and Choi (2000) and are found in Williams (2009). I measured the extent to which participants have feelings of ostracism. Participants were asked the extent to which they agree with the statements "I feel ignored" and "I feel excluded" on a five-point likert scale. The two answers were summed to constitute the feelings of ostracism score out of 10 total points ($\alpha = .67$). Higher scores indicate more feelings of ostracism. Using the measure for mood in Williams (2009) I measured the extent to which participants experienced four positive emotions (e.g., "Friendly" or "Pleasant") and four negative emotions (e.g., "Sad" and "Angry"). Negative emotions were positive scored and all items were summed to generate a composite score with a maximum score of 40 ($\alpha = .48$). Higher mood scores indicate better mood. I also used the individual item indicating anger to determine if cinnamon flavored gum made participants angrier than the peppermint and mixed-berry flavored gum. Although cinnamon is a popular gum flavor,

the possibility remains that cinnamon gum may be perceived as painfully hot; extreme heat is associated with anger (Wilkowski et al., 2009).

I measured loneliness using the Hughes et al.'s (2004) Three-Item Loneliness Scale ("First, how often do you feel that you lack companionship?", "How often do you feel left out?", and "How often do you feel isolated from others?"). Participants answered on a three-point likert scale: Hardly ever, some of the time, or often. The composite loneliness score consisted of the sum of the three items, resulting in a maximum score of 9; higher scores indicate more loneliness. Hughes et al. (2004) demonstrated that the shortened scale demonstrates good reliability ($\alpha = .72$) and is highly correlated with the R-UCLA Loneliness Scale ($r = .82$).

To control for possible covariates I also included several single item questions (see Appendix B). Before the temperature manipulation I asked about participants' liking of gum flavors on a five-point likert scale to control for improved or worse mood and/or need satisfaction because of the participants' individual taste preferences. These scores were compared to a single item question after the temperature manipulation because participants may not have encountered specific gum flavors prior to the study ("To what extent was the gum pleasant?"; see Appendix B). I also controlled for familiarity with chewing gum. Stephens and Tunney (2004) suggest controlling for familiarity with chewing gum because Wilkinson, Scholey, and Wesnes (2002) found that when participants pretended to chew they experienced impaired reaction time, possibly because they had to use more attention to engage in an unfamiliar task. Although reaction time is not necessarily relevant to the current study, if participants are unfamiliar with chewing gum and the act distracts them then this may facilitate a quicker recovery from ostracism

(Wesselmann et al., 2013). Participants were asked to respond to the question "How often do you chew gum of any flavor?" on a 5-point likert scale.

As a temperature manipulation participants reported the flavor of the gum they consumed and the degree to which the gum gave them the sensation of warmth and cold (Lewandowski, Ciarocco, & Gately, 2012) on a 5-point likert scale. As a color manipulation check participants were asked the color of the gum the participants consumed (see Appendix B).

To ensure no differences between physiological responses to the gum flavors I also measured arousal in a single item measure (e.g., "To what extent did the gum make you feel "awake"?). This question addresses the common thinking that peppermint enhances arousal (Raudenbush et al. 2004). Mint odors have been demonstrated to ease marginally the effects of mental stress (Sakai et al., 2011) and increase arousal (Zoladz et al., 2003); these effects, however, are unlikely to occur in the current study because odorants have been found to affect human behavior more when administered orthonasally (i.e., through the nose) than retronasally (i.e., through the mouth; Puttanniah & Halpern, 2001). In fact, Zoladz et al. (2003) found that retronasal administration of peppermint had no effect on arousal.

Another concern is that Roth et al. (1988) found that altering the color of a flavored solution resulted in different sweetness ratings. The presence of aspartame in the peppermint gum may also result in higher sweetness ratings. Although sweetness is a possible mediator in the relation between gum-flavor and the outcomes of interest, sweetness is unlikely to affect activation of belongingness. Troisi and Gabriel (2011) conducted a study examining the types of food people considered comfort food (i.e., food

considered to satiate emotions needs) and found that although comfort food appears to increase mood and belonging need satisfaction, there was no difference in level of sweetness between comfort food and food that is not considered comfort food. To determine if the gum flavors are perceived at different levels of sweetness participants will be asked a one-item question on a five-point likert scale ("To what extent do you think the gum was sweet?"; see Appendix B). Because Troisi and Gabriel's (2011) study suggests that food considered to be comfort food by an individual has the potential to increase mood and belonging need satisfaction in that individual, like Troisi and Gabriel (2011) I will determine individuals' comfort food preference with a single item measure ("To what extent do you consider cinnamon flavored gum to be a comfort food?"; see Appendix B).

Participants were asked if they are smokers, if they have trouble seeing colors, and if they consumed painkillers in the last six hours to determine their likely sensitivity to flavor, color, and social pain, respectively. Lastly, participants answered several demographic questions (see Appendix B).

Procedure

Data collection took place in a laboratory setting. Upon arrival at the study participants were asked to remove large coats or jackets to control for the baseline internal temperature of participants; this procedure was also implemented by Lee, Rotman, and Perkins (2014). Participants then read and signed an informed consent document (see Appendix A). Participants were instructed both verbally and on the informed consent that they may be at risk for having an aversive reaction to ingredients in the gum; they were instructed to examine the ingredient list located on the informed

consent. After signing the informed consent document, participants were placed in separate rooms. Participants completed a Sudoku puzzle for five minutes as a filler task to allow participants to acclimate to the internal room temperature. Participants then completed a product pre-evaluation survey (see Appendix B) to indicate their level of liking of gum flavors, if any of the gum flavors would be considered comfort food, and their familiarity with chewing gum.

Next, participants were randomly assigned to a warm condition, cold condition, or neutral temperature condition. Participants assigned to the warm condition received Dentyne Fire® cinnamon flavored gum, participants assigned to the cold condition received Dentyne Ice® peppermint flavored gum, and participants assigned to the neutral temperature condition received Dentyne Tango® mixed-berry flavored gum. I chose these specific gum flavors and brand because Lewandowski, Ciarocco, and Gately (2012) used this specific cinnamon and peppermint gum to successfully manipulate temperature. Table 1 displays the ingredient and visual properties of the gum. The gum brand, size and majority of ingredients were held constant. One of the differences between the ingredients in the three types of gum, besides the artificial and natural flavorings, was that the cinnamon and mixed berry gums contain the coloring agents blue 2 lake and red 40 lake. These artificial dyes have been demonstrated to cause a small but significant increase in hyperactivity among children (McCann et al., 2007). This effect, however, has not been examined in an adult population (Arnold, Lofthouse, & Hurt, 2012) and should not be relevant to the dependent measures of the current study. The second difference between the gum ingredients is that the peppermint gum contained aspartame. Aspartame contains phenylalanine, an essential amino acid that is safe for most

individuals except those with the rare metabolic disease phenylketonuria (Ehrlich, 2011). The presence of aspartame in only one of the gum flavors should not have an effect on mood for healthy populations (Reid & Hammersley, 1998). Whereas Walton, Hudak, and Green-Waite (1993) found that participants with a history of recurrent major depression may be at an increased risk for mood changes from high doses of aspartame (2.1 g per day for a participant weighing 70 kg), the low level of aspartame in gum (less than .06 g) is unlikely to have a significant impact on any participants who may be at higher risk. The mixed-berry flavored gum also included the sweetener xylitol, which has no significant effects on the body for most people (Mäkinen, 1976), but may result in a sweater taste sensation.

Table 1

Temperature Manipulation Nutritional Details

Ingredients and Characteristics	Gum Flavor		
	Dentyne Ice® Peppermint (Cold)	Dentyne Tango® Mixed Berry (Neutral)	Dentyne Fire® Cinnamon (Warm)
Sorbitol, maltitol, gum base, mannitol, glycerin, acacia, acesulfame potassium, BHT, candelilla wax, soy lecithin, sucralose and titanium dioxide	✓	✓	✓
Artificial and natural flavoring	Peppermint flavors	Mixed-berry flavors	Cinnamon flavors
Color	White	Purple	Red
Size / shape	✓	✓	✓
0g sugar	✓	✓	✓
2g sugar alcohol	✓	✓	✓
0g total fat	✓	✓	✓
0mg sodium	✓	✓	✓
0g protein	✓	✓	✓
2g total carb.	✓	✓	✓
5 calories	✓	✓	✓
Blue 2 lake		✓	✓
Red 40 lake		✓	✓
Aspartame / Phenylalanine	✓	✓	
Xylitol		✓	

Note. The above check marks represent the ingredient and physical properties of the three types of gum participants consumed.

Participants were given two pieces of the assigned gum on a plate, allowing them to see the color of the gum before they place the gum into their mouths. Participants, therefore, were exposed to two modalities: taste and visual. The researchers instructed participants to chew at a natural pace because Clemons et al. (2013) found that chewing at a fast pace can increase one's stress level. After a one minute waiting period in which participants were instructed to focus on the flavor and move the gum around their mouth

to allow the flavor to saturate both sides of their tongue and cheeks, participants were given the f basic needs scale (Williams, Cheung, & Choi [2000]; Williams, 2009) which determine the current level of perceived basic need satisfaction, mood, and feelings of ostracism, as well as the Three Question Loneliness Scale (Hughes et al., 2004; see Appendix B). Measures were counter-balanced to ensure no order effects.

Finally, participants completed a product post-evaluation survey (see Appendix B). This survey included a temperature manipulation check in which the participants indicated if the gum they consumed gave them the sensation of heat or cold, as well as the flavor of gum they chewed. As a visual modality manipulation check participants indicated if they saw the color of the gum, what color the gum was, and if they have trouble seeing colors. Participants also answered question about their arousal level, the perceived sweetness of the gum, how pleasant the gum flavor was (Bargh & Shalev, 2012), if they were a smoker, if they took painkillers, additional questions to perpetuate the cover story, and various demographic questions. Participants then reported what they thought the study was about to determine if participants were suspicious of the study's true intentions. After being thoroughly debriefed (see Appendix C), participants were thanked and compensated for their participation.

CHAPTER IV

RESULTS

For all items used in the following analyses, the average percent of missing data was 0.7%. All items had 1.2% randomly missing data or less except the item "To what extent do you feel disconnected," which had 7.1% missing data because of a systematic error in data collection. Using SPSS Version 22 (IBM Corp., 2013), missing items were replaced with the participants' mean score on the items they completed within each composite score. None of the participants omitted more than one item per composite score. List-wise deletion was not used in this particular case because multivariate analyses require a complete dataset, and the power would have been significantly diminished without replacement of these values because the sample size would be smaller (Brown, Arbour, & Jackson, 2012). I compared the analyses with datasets using both methods and although mean replaced data resulted in more significant results the conclusions and effect sizes did not differ in a meaningful way.

While participants were in the laboratory the internal room temperature ranged from 63°F to 70°F, with an average temperature of 67.41°F (*SD* = 2.12). The external temperature ranged from 1°F to 77°F, with an average external temperature of 44.93°F (*SD* = 18.52). What the external temperature felt like ranged from -9°F to 77°F; the external temperature felt like 40.96°F (*SD* = 21.86) on average. The five-minute waiting

period at the beginning of the lab, however, should have allowed all participants to acclimate to indoor temperature. See Table 2 for the temperature means and standard deviations broken down by gum condition. The following analyses were conducted using SPSS software. I conducted a one-way analysis of variance (ANOVA) that suggested that there was not a significant difference between the three gum conditions in internal temperature [$F(2, 167)= .23$, $p = .79$, $\eta_p^2 < .01$], external temperature [$F(2, 167) = .17$, $p = .85$, $\eta_p^2 < .01$], or what the external temperature felt like [$F(2, 167) = .16$, $p = .85$, $\eta_p^2 < .01$].

Table 2

Descriptive Statistics of Measured Temperature During Experiment

	Gum-flavor condition		
Measure	Peppermint *M* (*SD*)	Mixed-berry *M* (*SD*)	Cinnamon *M* (*SD*)
Internal Temperature	67.25 (2.19)	67.47 (2.05)	67.50 (2.14)
External Temperature	44.22 (19.23)	44.53 (17.68)	46.13 (18.87)
Ext Feels Like Temp	40.34 (22.54)	40.28 (20.84)	42.37 (22.50)

Note. Temperature is measured in Fahrenheit.

The intention of the gum manipulation was to alter only perceived temperature between participants. On average, participants' coldness perception rating of the gum was 3.75 (*SD* = 1.24) in the peppermint condition, 2.07 (*SD* = 1.22) in the mixed-berry condition, and 1.07 (*SD* = .33) in the cinnamon condition. As a manipulation check I conducted a one-way analysis of variance (ANOVA), which revealed a main effect of gum condition on perception of cold temperature, $F(2, 167) = 96.90$, $p < .001$, $\eta_p^2 = .54$. Post hoc tests with Bonferroni adjustments suggested that participants perceived significantly more coldness from the peppermint-flavored gum than the cinnamon-

flavored gum ($p < .001$, $d_{cohen} = 2.95$) and mixed-berry flavored gum ($p < .001$, $d_{cohen} = 1.36$). Furthermore, the mixed-berry gum was perceived as significantly colder than the cinnamon-flavored gum ($p < .001$, $d_{cohen} = 1.12$). Figure 1 displays the differences in perceived cold temperature between the gum conditions.

Figure 1

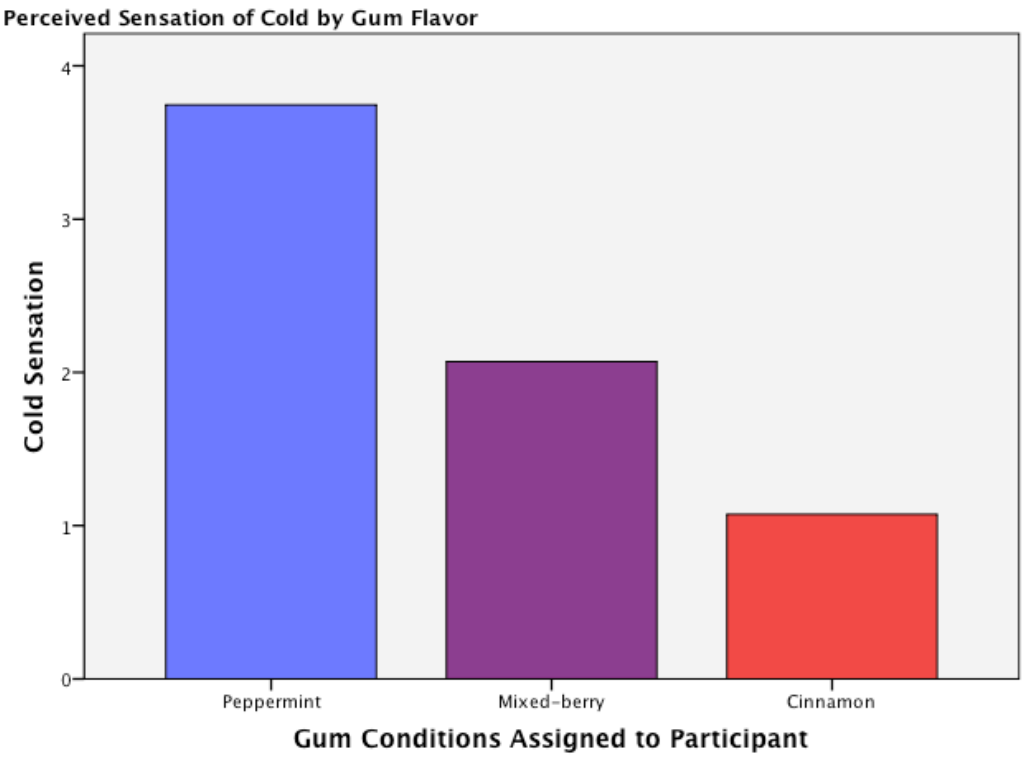

Figure 1. Explanation. Participants perceived peppermint-flavored gum to give them the sensation of coldness to a greater degree than mixed-berry and cinnamon-flavored gum. Participants also perceived mixed-berry flavored gum to give them the sensation of coldness to a greater degree than cinnamon-flavored gum.

I also analyzed the reported sensation of heat from the gum as a manipulation check. On average, participants' heat perception rating from the gum was 2.10 (SD = 1.39) in the peppermint condition, 1.49 (SD = 0.93) in the mixed-berry condition, and 4.15 (SD = 1.11) in the cinnamon condition. A one-way analysis of variance (ANOVA) also revealed a main effect of gum condition on the degree to which the assigned gum

gave the participants the sensation of heat, $F(2, 167) = 79.49$, $p < .001$, $\eta_p^2 = .49$. Post-hoc tests with Bonferroni adjustments suggested that participants perceived significantly more warmth from the cinnamon-flavored gum than the peppermint-flavored gum ($p < .001$, $d_{cohen} = 1.63$) and mixed-berry flavored gum ($p < .001$, $d_{cohen} = 2.61$). Oddly, participants felt significantly more warmth from the peppermint-flavored gum than the mixed-berry flavored gum ($p = .02$, $d_{cohen} = 0.52$). The peppermint gum was perceived as both significantly colder and warmer than the hypothesized neutral mixed-berry gum, suggesting that cold and warm temperature perception may not be mutually exclusive. Figure 2 displays the differences in perceived warm temperature between the gum conditions.

Figure 2

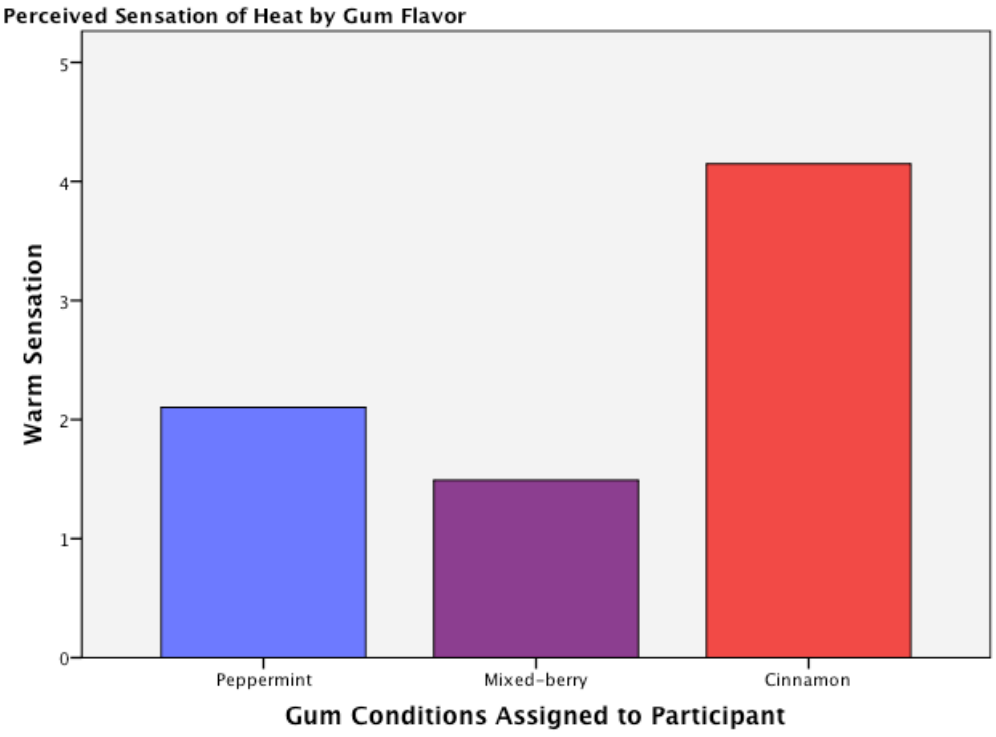

Figure 2. Explanation. Participants perceived cinnamon-flavored gum to give them the sensation of heat to a greater degree than mixed-berry and peppermint-flavored gum. Participants also perceived peppermint-flavored gum to give them the sensation of heat to a greater degree than the mixed-berry flavored gum.

The manipulation of temperature via gum also involved the non-haptic manipulation the visual sensation of color. As a manipulation check I examined the perceived color of each gum type. 100% of participants who received peppermint-flavored gum perceived the gum to be white. 100% of participants who received cinnamon-flavored gum perceived the gum to be red. 66.7% of participants who received mixed-berry flavored gum perceived the gum to be red while 33.3% perceived the color to be purple.

Random assignment was used to assign participants to consume one of the three gum flavors. I conducted the following analyses to determine if participants in the three gum conditions varied in their opinions and experiences with different flavors of gum. Table 3 shows the descriptive statistics for the extent to which participants liked the three gum flavors, considered the three gum flavors a comfort food, and familiarity with chewing gum broken down by assigned gum condition. Prior to receiving the gum participants indicated that they liked peppermint [$F(2, 167) = .12$, $p = .89$, $\eta_p^2 < .01$], mixed-berry [$F(2, 167) = 1.33$, $p = .27$, $\eta_p^2 = .02$], and cinnamon-flavored gum [$F(2, 167) = .56$, $p = .57$, $\eta_p^2 < .01$] to the same degree in all of the three assigned gum conditions. Participants also considered peppermint [$F(2, 167) = .37$, $p = .69$, $\eta_p^2 < .01$], mixed-berry [$F(2, 167) = .51$, $p = .60$, $\eta_p^2 < .01$], and cinnamon-flavored gum [$F(2, 167) = 1.31$, $p = .27$, $\eta_p^2 = .02$] to be a comfort food to the same degree in all of the three assigned gum conditions. Furthermore, through random assignment familiarity with chewing gum was the same for participants in all three assigned gum conditions [$F(2, 167) = .03$, $p = .97$, $\eta_p^2 < .01$].

Table 3

Descriptive Statistics of Liking, Comfort Food, and Familiarity with Gum

	Gum-flavor condition		
Measure	Peppermint *M* (*SD*)	Mixed-berry *M* (*SD*)	Cinnamon *M* (*SD*)
Like Peppermint Gum	4.00 (0.87)	4.00 (0.96)	3.93 (0.93)
Like Mixed-Berry Gum	3.17 (1.18)	3.35 (1.03)	3.50 (1.02)
Like Cinnamon Gum	2.69 (1.32)	2.51 (1.24)	2.76 (1.34)
Peppermint Comfort Food	2.83 (1.33)	2.74 (1.28)	2.94 (1.19)
Mixed-Berry Comfort Food	2.36 (1.19)	2.30 (1.19)	2.52 (1.19)
Cinnamon Comfort Food	1.83 (1.07)	1.84 (1.03)	2.13 (1.20)
Frequency of Gum Chewing	3.54 (1.09)	3.49 (1.05)	3.50 (1.22)

To determine if the gum induced differences in feelings or sensations not pertaining to perceived temperature I first conducted an Exploratory Factor Analysis (EFA) with oblimin rotation using SPSS software. This EFA allowed me to determine empirically which variables could be grouped in factors and hence could be analyzed with a MANOVA to optimize the potential to detect an effect with minimal Type I errors (Field, 2013). Table 4 shows the correlations between the following factors that possibly differ between gum conditions: arousal, feelings of anger, perceived sweetness of the assigned gum, comfort food level of assigned gum, and liking of assigned gum flavor. An Exploratory Factor Analysis with Maximum Likelihood Estimation and oblimin rotation revealed a two factor structure with comfort food level of given gum, liking of gum flavor, and arousal all significantly loading onto factor 1 and gum sweetness and anger significantly loading onto factor 2. See table 5 for the factor loadings. This analysis suggests performing two separate MANOVA analyses. The two factors have a correlation of -.08 (p = .32).

Table 4

Correlations Between Variables in EFA Analysis

Measure	1	2	3	4	5
1. Arousal	—				
2. Anger	-.11	—			
3. Gum Sweetness	-.01	.17*	—		
4. Comfort Food	.27***	-.14	.18*	—	
5. Liking of Gum	.24**	-.16*	.16*	.59***	—

Note. $*p < .05$. $**p < .01$. $***p < .001$.

Table 5

Factor Loadings for EFA

Measure	1	2
Comfort Food	.79	
Liking of Gum	.74	
Arousal	.33	
Gum Sweetness		.61
Anger		.35

Note. Excluded factor loadings under .3 according to recommendations from Tabachnick and Fidell (2001).

In the following analysis I conducted a one-way multivariate analysis of variance (MANOVA) to determine if the gum conditions differed in the factor 1 variables (see Table 6 for descriptive statistics). The MANOVA revealed a significant main effect of gum condition on comfort food level of a given gum, liking of gum flavor, and/or arousal, Wilks' $\Lambda = .74$, $F(6, 330) = 9.10$, $p < .001$, $\eta_p^2 = .14$. The largest difference between the gum conditions occurred for liking of gum flavor ($\eta_p^2 = .18$), followed by arousal ($\eta_p^2 = .12$) and comfort food level ($\eta_p^2 = .06$). Post hoc tests using Bonferroni adjustments revealed that participants liked peppermint-flavored gum significantly more than mixed-berry flavored gum ($p = .005$, $d_{cohen} = .68$) and cinnamon-flavored gum (p

< .001, d_{cohen} = 1.10), and participants liked mixed-berry flavored gum significantly more than cinnamon-flavored gum (p = .01, d_{cohen} = .49). Participants indicated that peppermint-flavored gum was significantly more of a comfort food than cinnamon-flavored gum (p = .01, d_{cohen} = .55), but there was no difference between comfort food levels of peppermint and mixed-berry gum (p = .07, d_{cohen} = .42) or cinnamon and mixed-berry gum (p = 1.00, d_{cohen} = .14). Participants also reported higher arousal (i.e., feeling "awake") in the peppermint condition compared with the mixed-berry flavor gum condition (p < .001, d_{cohen} = .94) but there was no significant difference in arousal between the peppermint and cinnamon conditions (p = .07, d_{cohen} = .45) or the cinnamon and mixed-berry conditions (p = .05, d_{cohen} = .42).

Table 6

Descriptive Statistics of Factor 1 Variables by Gum-Flavor Condition

	Gum-Flavor Condition		
Measure	Peppermint *M* (*SD*)	Mixed-berry *M* (*SD*)	Cinnamon *M* (*SD*)
Comfort Food	2.83 (1.33)	2.30 (1.19)	2.13 (1.20)
Liking of Gum	4.00 (0.87)	3.35 (1.03)	2.76 (1.34)
Arousal	3.92 (.92)	2.91 (1.21)	3.43 (1.25)
Gum Sweetness	2.59 (1.13)	4.42 (0.73)	2.26 (1.23)
Anger	1.25 (0.68)	1.54 (0.89)	1.33 (0.67)

In the following analysis I conducted a one-way MANOVA to determine if the gum conditions differed in the factor 2 variables (see Table 6 for descriptive statistics). The MANOVA revealed a significant main effect of gum condition on perceived sweetness of gum and/or anger, Wilks' Λ = .54, $F(4, 332) = 29.62$, $p < .001$, $\eta_p^2 = .26$. The largest difference between the gum conditions occurred for perceived sweetness of gum (η_p^2 = .45) followed by anger (η_p^2 = .03). Post hoc tests using Bonferroni

adjustments revealed that participants perceived berry-flavored gum to be significantly sweeter than peppermint-flavored gum ($p < .001$, $d_{cohen} = 1.92$) and cinnamon-flavored gum ($p < .001$, $d_{cohen} = 2.14$); there was no significant difference between the sweetness of peppermint and cinnamon-flavored gum ($p = .28$, $d_{cohen} = .28$). Feelings of anger did not differ between peppermint and mixed-berry ($p = .12$, $d_{cohen} = .37$), peppermint and cinnamon ($p = 1.00$, $d_{cohen} = .12$), or mixed-berry and cinnamon gum ($p = .47$, $d_{cohen} = .27$).

Next, I compared questions pertaining to how much participants liked the gum flavor they were given from before and after the gum manipulation to determine if the scores were significantly different. In a paired-samples t-test I determined that the participants' liking of the gum flavor before being given the gum (M=3.39, $SD = 1.20$) was not significantly different from the pleasantness of the gum the participants reported after chewing the gum ($M = 3.49$, $SD = 1.21$), $t(169) = -1.34$, $p = .18$, $d_{cohen} = .08$, hence the originally determined gum liking measurement before the manipulation was used as a covariate in the following analysis.

To address the main hypotheses that participants will experience different feelings related to ostracism as a result of the temperature perception effects of the assigned gum I conducted a one-way multivariate analysis of covariance (MANCOVA) on the seven specified dependent variables (i.e., belonging, control, meaningful existence, and self-esteem need satisfaction, feelings of ostracism, mood, and loneliness), statistically controlling for familiarity with gum chewing and liking of assigned gum flavor. Table 7 presents the descriptive statistics of the dependent variables and control variables by gum condition. The MANCOVA revealed a non-significant main effect of gum condition,

Wilks' $\Lambda = .89$, $F(14, 318) = 1.34$, $p = .18$, $\eta_p^2 = .06$. There was no significant difference in belonging, control, meaningful existence, and self-esteem need satisfaction, feelings of ostracism, mood, or loneliness between the gum conditions; hence, I did not support my hypotheses that temperature induced through the non-haptic senses of color detection and taste can alter cognitions related to ostracism.

Table 7

Descriptive Statistics of Variables in Primary Analysis by Gum-Flavor Condition

	Gum-flavor condition		
Dependent and Control Variables	Peppermint *M* (*SD*)	Mixed-berry *M* (*SD*)	Cinnamon *M* (*SD*)
Belonging	**13.81 (1.72)**	13.54 (2.09)	13.34 (2.01)
Control	9.10 (2.50)	9.19 (2.24)	**9.69 (2.30)**
Meaningful Existence	**14.47 (1.12)**	14.26 (1.84)	14.24 (1.68)
Self-esteem	11.03 (2.13)	11.09 (1.93)	**11.32 (1.96)**
Ostracism	**2.72 (1.27)**	3.02 (1.25)	2.87 (1.18)
Mood	**34.62 (3.14)**	33.81 (4.32)	33.29 (4.27)
Loneliness	**4.25 (1.25)**	4.87 (1.46)	4.39 (1.37)
Gum Familiarity	**3.54 (1.09)**	3.49 (1.05)	3.50 (1.22)
Liking of Gum	**4.00 (.87)**	3.35 (1.03)	2.76 (1.35)

Note. Higher scores indicate better outcomes except for ostracism (higher scores indicate feeling more ostracized) and loneliness (higher scores indicate feeling lonelier). Bold indicates best outcome.

Finally, I examined the possibility of interaction effects. Using custom models in SPSS, I ran a multivariate analysis examining the main effects of gum condition, liking of gum, and gum familiarity, as well as the interaction of liking of gum by gum condition, gum familiarity by gum condition, and a three way interaction of liking of gum by gum condition by gum familiarity on the same dependent variables related to ostracism (belonging, control, meaningful existence, and self-esteem need satisfaction, feelings of ostracism, mood, and loneliness), controlling for liking of gum and gum familiarity. The custom model MANCOVA revealed a non-significant main effect of gum condition

[Wilks' $\Lambda = .95$, $F(14, 304) = 0.59$, $p = .87$, $\eta_p^2 = .03$], a non-significant main effect of liking of gum [Wilks' $\Lambda = .95$, $F(7, 152) = 1.23$, $p = .29$, $\eta_p^2 = .05$], and a non-significant main effect of gum familiarity [Wilks' $\Lambda = .93$, $F(7, 152) = 1.58$, $p = .15$, $\eta_p^2 = .07$]. For interaction effects I found a non-significant interaction of gum condition by liking of gum [Wilks' $\Lambda = .96$, $F(14, 304) = 0.46$, $p = .95$, $\eta_p^2 = .02$], a non-significant interaction of gum condition by gum familiarity [Wilks' $\Lambda = .95$, $F(14, 304) = 0.57$, $p = .89$, $\eta_p^2 = .03$], and a non-significant three-way interaction of liking of gum by gum condition by gum familiarity [Wilks' $\Lambda = .91$, $F(21, 437.01) = 0.68$, $p = .86$, $\eta_p^2 = .03$].

CHAPTER V

DISCUSSION

Outcomes

In the current study I found that gum flavor could induce significantly different perceptions of temperature, thus replicating Lewandowski, Ciarocco, and Gately's (2012) results. Peppermint-flavored gum was perceived as significantly colder than cinnamon-flavored gum, and cinnamon-flavored gum was perceived as significantly warmer than peppermint-flavored gum. Based on the temperature perception differences between the gum conditions, there were theoretical and empirical grounds for predicting that peppermint-flavored gum causes participants to feel lonelier, more ostracized, worse mood, and lower levels of need satisfaction than the cinnamon-flavored gum. The current study, however, found no significant difference between the peppermint and cinnamon-flavored gum conditions on these measures related to ostracism while controlling for liking of gum flavor and familiarity with chewing gum; thus, hypothesis 1 was not supported.

I used mixed-berry flavored gum as a novel neutral temperature condition. As expected, the mixed-berry flavored gum was perceived as significantly less cold than the peppermint-flavored gum condition and significantly colder than the cinnamon-flavored gum. Also as predicted, mixed-berry flavor gum was perceived as significantly less

warm than cinnamon-flavored gum. Unexpectedly, participants perceived peppermint-flavored gum as significantly warmer than mixed-berry flavored gum. This difference inwarmth perception does not necessarily negate the mixed-berry flavored gum as a neutral temperature condition; this evidence suggests that mixed-berry flavored gum induces the least amount of warmth, hence still supporting the suggestion that mixed-berry flavored gum does not induce temperature. Hypothesis 2 was partially supported; as I hypothesized, participants expressed the same mood, need satisfaction, loneliness and feelings of ostracism in the mixed-berry flavored gum condition as participants in the cinnamon-flavored gum condition while controlling for liking of gum flavor and familiarity with chewing gum. The evidence did not support, however, my prediction of a significant difference in measures related to ostracism between the peppermint-flavored gum and mixed-berry flavored gum.

Although non-significant, the descriptive statistics suggest a pattern of more positive feelings related to ostracism for participants who consumed the peppermint-flavored gum and more negative feelings for participants who consumed the cinnamon-flavored gum, the opposite of what I hypothesized. Participants in the peppermint-flavored gum condition reported the most positive outcomes for five out of the seven ostracism-related variables (i.e., highest belonging, meaningful existence, and mood scores and lowest ostracism and loneliness scores). The average control and self-esteem need satisfaction scores, however, were highest in the cinnamon-flavored gum condition, as I had hypothesized. Although the more positive cognitions reported in the peppermint-flavored gum condition may have resulted from random error, this pattern of descriptive

statistics may suggest that consuming peppermint-flavored gum results in more positive cognitions related to ostracism.

The non-significant findings may be attributed to insufficient power. The observed power for the primary analysis was .79, suggesting the likelihood of finding an effect if one exists was good but there was still a risk for making a type II error. The lack of power could be a result of a small sample size; however, I attained a sample of 170 participants, an adequate sample size according to the preliminary power analysis, which suggested a sample of 135 participants. Using G*Power (Faul et al., 2007) I determined that an optimally powered study based on the effect size found in the current study should have a sample of 210. In addition, my study had a larger sample size than Bargh and Shalev's (2012A) study in which they found a significant effect of temperature on loneliness with only 19 participants per condition. The second reason why the current study may have been underpowered is that the gum manipulation produced a small effect size in an unhypothesized direction. In an effort to enhance the effect size I gave participants two pieces of gum to consume at once and used a gum brand previously used in the literature and strong in flavor. Furthermore, participants were verbally instructed to focus on the gum flavor as they chewed it to enhance the potential temperature perception and thus enhance the likelihood of finding a significant effect of gum induced temperature on cognitions related to ostracism. The gum manipulation, however, had an effect size of $\eta_p^2 = .06$ on the ostracism related cognitions. The observed effect was less than the expected effect size of $\eta_p^2 = .096$ found by Bargh and Shalev (2012A). The observed small to medium effect found in the current study suggests that the gum did not

evoke large differences in cognition despite participants expressing significant differences in temperature perception between the gum conditions.

Results from the current study do not support previous evidence of a conceptual metaphor between cold and feelings of social isolation. Sufficient effort was put forth in controlling or measuring variables that could possibly alter physical sensations or cognitions during the experiments. Participants were asked to take off large coats and completed a filler task for five minutes at the beginning of the study to allow them to acclimate to the internal temperature that remained fairly stable between the experiments; furthermore room and outdoor temperature was not likely a factor influencing the results because there was no significant difference between the groups on average internal or external temperature. Random assignment was used to evenly distribute participants in the three gum conditions, which resulted in equivalent groups on the average level of liking of all three gum flavors, comfort food level of all three gum flavors, and familiarity with gum. Furthermore, I statistically controlled for two of these variables (liking of given gum flavor and gum familiarity) in my main analysis in accordance with suggestions from previous literature (Stephens & Tunney, 2004).

Issues with a Gum Manipulation

In the current study I used gum as a novel temperature manipulation in part because gum had the possibility of being a meaningful and convenient way to manipulate temperature in future experiments or possibly manipulate cognitions in an individual's daily life. This study, however, suggests that gum may not be a useful temperature manipulation when examining differences in cognition; in ascertaining why this may be, one can first compare gum flavor manipulation to other temperature manipulations used

in the literature. Researchers have manipulated temperature by having participants hold a hot or cold pack (Bargh & Shalev, 2012), having participant hold a hot or cold cup of coffee (Williams & Bargh, 2008), having participant drink hot or iced tea (Hong & Sun, 2012), and manipulating room temperature (Lee, Rotman, & Perkins, 2014). All of these temperature manipulations produce a strong temperature sensation. For example, in Bargh and Shalev's (2012) study the hot pads were 98°F and the cold packs were frozen (i.e., around 32°F). Although perceived temperature in Fahrenheit was not measured in the current study and the gum conditions were perceived to be significantly different in temperature sensation, it is unlikely that participants would have perceived the gum to give them sensations of temperature that reach the same level of temperature sensation as those measured in Bargh and Shalev's (2012) study. Even the more modest temperatures induced in Lee, Rotman, and Perkin's (2014) study (room temperature of 62 to 64°F in the cold condition and 78 to 80°F in the warm condition) could be perceived as strong because of many individuals' sensitivity to room temperature, particularly over an extended period of time. The gum manipulation may not have produced significant results because it induces less intense temperature perception and differentiation among conditions than other temperature manipulations used in previous literature. I have to speculate as to the extent to which the strength of the temperature manipulations differ because temperature manipulations checks differed between studies and previous research did not report sufficient evidence to calculate effect sizes of the temperature manipulations.

In prior studies participants likely felt some level of discomfort induced from the strength of the temperature manipulations. Discomfort was not measured in any of these

experiments but can be presumed when examining the temperature experienced through the manipulations. Yagloglou and Drinker (1929) found the comfort zone of ambient temperature falls between 66 and 75°F in the summer and between 63 and 71°F in the winter; previous research manipulating room temperature has fallen outside of this comfort zone. Even if the haptic temperature manipulations were at a comfortable level, participants may have associations of discomfort with these manipulations, having previously tasted tea that was too hot or external temperature that was too cold, for example. Although certain individuals with a strong palate or particular taste may perceive the taste of cinnamon-flavored gum to be uncomfortable, most individuals would probably agree that chewing gum induces no discomfort. In particular, peppermint-flavored gum likely induces little discomfort; participants who received peppermint-flavored gum reported liking peppermint-flavored gum the most with a score of 4.00 out of 5.00. Furthermore, individuals do not tend to buy commodities that make them uncomfortable, and mint-flavored gum it is the best selling flavor of gum (Ferdman, 2014). Perhaps the gum manipulation, and particularly the peppermint-flavored gum condition intended to cause coldness and thus negative cognitions, was unsuccessful because manipulations must involve both discomfort and temperature induction to produce changes in cognition related to ostracism; this explanation would make sense because ostracism is an uncomfortable and painful experience (Eisenberger, Lieberman, and Williams, 2003).

Gum may differ from other manipulations of temperature not only because it may lack feelings of discomfort but also because of the enjoyable nature of gum. Related to feeling of enjoyment, pleasantness ratings after the consumption of the gum indicated

that the gum was an enjoyable product, scoring a mean of 3.49 out 5 across all gum conditions. The gum industry is profitable, generating 3.7 billion dollars annually in the United States (Ferdman, 2014). Any product this profitable is sure to be used for enjoyment, as it fulfills no basic dietary needs. The act of chewing, although controlled across all conditions, is also generally seen as an enjoyable act associated with food and may have induced more positive emotions; in fact, Scholey et al. (2009) found that self-reported mood improved after chew chewing gum.

Evidence suggests that gum may not just be enjoyable but may have comforting effects as well. While the sweet taste of the gum (participants indicated a sweetness rating of 3.10 out of 5.00 across all gum conditions) may have contributed to its enjoyable nature sweetness has also been found to be calming (Kassab et al., 2012). Chewing gum, specifically, has been shown to reduce stress levels measured by cortisol stress hormone found in saliva samples (Scholey et al., 2009; Smith, 2012). Another aspect of gum that may be comforting is the positive social association with gum. Gum is often advertised and used to freshen breath before a pleasant social encounter, which may invoke feelings of warmth or comfort. Furthermore, previous evidence suggests chewing gum may facilitate the onset or preservation of social associations; Wilkinson, Scholey, & Wesnes (2002) found that chewing flavored gum facilitates episodic and working memory. The function of gum as a comfort food remains a possible explanation for the inability to alter cognitions via temperature to overcome positive cognitions already associated with gum; however, participants in the current study did not indicate on a single item measure that gum was highly regarded as a comfort food, reporting average comfort food of 2.83, 2.30, and 2.13 out of 5.00 for peppermint, mixed-berry,

and cinnamon-flavored gum respectively. The current study may not have been successful in inducing feelings related to ostracism in the peppermint-flavored gum condition because gum induced pleasant sensations and social associations may overpower any effect cold temperature may have on cognitions.

Another possible reason for the nonsignificant findings of the current study is that the non-haptic nature of the gum manipulation hindered the ability of the perceived temperature to induce changes in cognitions. Theoretical evidence on grounded cognition still suggests that any of the sensing modalities, including the non-haptic senses of sight and taste, can perceive warmth and coldness. Choi (2013) demonstrated that pictures can induce temperature sensations, and in the current study gum significantly altered temperature perception. Unlike Choi (2013), however, I did not find that a non-haptic temperature manipulation altered cognitions. The temperature induction through the non-haptic sense of sight and taste of gum may not produce the same metaphoric mapping between the abstract concept of the physical sensation of temperature and the abstract concept of social intimacy that Williams and Bargh (2008) demonstrated with a haptic temperature manipulation. Perhaps the taste sensation was too different from the heat sensation occurring in nature that would innately bind physical coldness to social isolation. Gum may activate multiple conflicting conceptual maps. The cold sensation from peppermint-flavored gum may act as source for the target, social isolation. The act of chewing gum or the memories attached to gum may act as a source for the targets happiness or social intimacy. As well, the induction of cold temperature with the obscure, non-haptic manipulation of gum flavor may be inherently difficult to associate with feelings of ostracism. Participants may have preconceived notions about the effects of

gum on the body or the mind. Perhaps moreso than with cinnamon or mixed-berry flavored gums, people may associate good smelling breath with a peppermint odor. Participants with the peppermint-flavored gum may have felt more socially confident because the gum alleviated any concerns about having bad breath. If participants experienced increased confidence or positive feelings as a result of their belief in the positive effects of peppermint-flavored gum, perhaps these beliefs may have prevented the cold effect of peppermint-flavored gum on cognitions from overcoming this placebo effect.

Another factor that may have affected the usefulness of gum as a temperature manipulation is the rewarding aspect of the gum. The inclusion of a rewarding stimulus in all conditions was important to the current study because a different embodied effect between rewarding stimuli and the concept of fairness may influence emotions. Fair treatment is intrinsically rewarding; Lieberman (2013) describes a study in which participants individually performed anagram tasks but received pay depending on group performance. The members of the group had to then negotiate how to distribute the money. Regardless of individual monetary compensation, participants expressed more positive emotions if they believed they were fairly compensated. Although Lieberman demonstrates fairness causes emotions associated with rewarding stimuli, biological evidence and the theory of embodied cognition suggests the possibility of a rewarding stimuli activating the concept of fairness because both experiences share neurocognitive processes, activating the ventromedial prefrontal cortex and ventral striatum, areas associated with the brain's reward system (Lieberman, 2013). The emotional effects relating to ostracism analyzed in the current study may be positively affected by the

rewarding qualities of gum more so than other temperature manipulations because the physical reward of the gum may activate the concept of fairness. Fairness is associated with positive emotions (Lieberman, 2013) and directly opposes ostracism, which is frequently perceived as unfair (e.g., not being passed the ball).

Differences Between Gum Conditions

Besides the novel issues with a gum manipulation of temperature, several more factors can be considered that may differ between the specific flavors of gum used in the temperature manipulation that may provide insight into why the study resulted in non-significant results. Despite theoretical reasons to suspect otherwise, the gum conditions were found to be equivalent in measures of arousal and anger. Across all gum conditions participants liked the peppermint-flavored gum most, the next favorite gum was the mixed-berry flavored gum, and cinnamon flavored gum was liked the least. All of these differences in liking of gum flavor were statistically significant. The descriptive pattern of liking of gum flavors corresponds to the observed pattern of cognitions related to ostracism, hence participants both liked the peppermint-flavored gum the most and reported the most positive cognitions in the peppermint-flavored gum condition.

Although exploratory analyses indicated no main effect of liking of given gum flavor on ostracism related cognitions, perhaps liking of the gum induced positive feelings that were as powerful as the effect of temperature on cognitions. Interestingly, peppermint-flavored gum was perceived to induce both heat and cold sensations in relation to the neutral mixed-berry gum condition. Because peppermint-flavored gum was most liked perhaps a competing embodied effect was taking place in which

peppermint-flavored gum was perceived as warm because of the positive cognitions people received from the enjoyment of chewing a flavor of gum they liked.

Exploratory analyses indicated that there was also no main effect of gum familiarity on the ostracism related cognitions and no significant interaction effects of liking of gum flavor by gum flavor, gum familiarity by gum flavor, or a three-way interaction. One explanation for these findings is that competing effects canceled out any effects that could be found. The findings also may have been affected by skewed variables and other method-specific abnormalities.

Experimental Issues

Many considerations went into the initial design of the study; however, I encountered several unforeseen issues. Despite my best efforts to provide gum manipulations that produce similar color and flavor associations, the color manipulation checks indicated that participants perceived the mixed-berry flavored gum to be red more often than they perceived it to be purple. The mixed-berry gum appears to be close to red in color, which likely evokes associations closer to heat than to cold in the temperature spectrum (Madden, Hewett, and Roth, 2000). Although the purple/red tint of the mixed-berry flavored gum suggests the gum may not function well as a neutral temperature manipulation, participants indicated very little temperature association with the mixed-berry flavored gum. Sweetness perception ratings indicated that mixed-berry gum was perceived as significantly sweeter than the peppermint and cinnamon-flavored gum, despite all of the gum flavors containing zero grams of sugar in an attempt to control for the effects of sugar on cognitions. Mixed-berry flavored gum was likely perceived as sweeter because it contains more artificial sweeteners and it has no temperature sensation,

sweetness is the primary sensation participants perceived, which may have enhanced participants' perception of sweetness. The increased sensation of sweetness in mixed-berry flavored gum, however, did not affect cognitions related to ostracism. The fact that the current study did not even show a difference between the warm and cold conditions on ostracism-related cognitions suggests a neutral condition is not needed because the effect of gum induced temperature is not strong enough to detect small differences in temperature; however, this conclusion is based on the results of one study. Future research is needed to determine if a neutral condition can be used to determine the directionality of the effect of the temperature induced gum manipulation.

Another issue in the current study is that all of the dependent variables were skewed, with the majority of participants claiming to experience more positive cognitions. The skew of these variables did not violate the assumptions of the primary analysis because a MANCOVA is robust to violations of normality if the sample size is at least 20 in each cell (Mardia, 1971); however, the skew may indicate that the instruments used were not sensitive enough to detect small differences in cognitions, especially at the positive cognitions. Participants were much more likely to claim feeling positive cognitions (e.g., low levels of loneliness, high levels of belonging) than negative cognitions. Perhaps future studies would benefit from 7 or 9-point likert scales, which would allow more variability in responding and perhaps make small effects more detectable. Future studies could also stress to the participants the importance of honest and thoughtful answers in an effort to decrease social desirability bias. The covariates, liking of given gum flavor and familiarity with chewing gum, were also significantly skewed across all three conditions. Although I controlled for liking of gum flavor and

familiarity with chewing gum, there was a lack of variability in responses and hence a lack of sensitivity for liking to be properly used as a covariate.

In the current study I attempted to maximize the non-haptic perception of temperature by combining both color perception and flavor perception. Because the non-haptic manipulation did not change emotions as I predicted there is little need to conduct subsequent studies to separate the effects of color from effects of flavor. There are ways, however, to perhaps enhance both perceptions for the participants to maximize the non-haptic temperature perception. Participants could receive the gum on plates or napkins with a color of a similar associated temperature (e.g., receive white colored peppermint manipulation on a blue colored plate). Participants could also be shown pictures of cold or warm objects (e.g., sun or ice like Choi [2013]). To enhance the flavor induced temperature perception and control for positive affect from chewing participants could receive several strong mints (e.g., altoid brand peppermint and cinnamon mints).

An ideal future study would compare the effects of nonhaptic to haptic temperature manipulations on ostracism related cognitions to determine if there is a difference between reponses to haptic and nonhaptic manipulations. The haptic conditions are important because no studies have shown that temperature affects cognitions directly related to ostracism besides loneliness (Bargh and Shalev, 2012, study 2). The study would have four conditions with participants holding a cold pack, holding a warm pack, receiving peppermint-flavored mints, or receiving cinnamon-flavored mints. Future research could also explore the effects of modality and temperature via strongly brewed cinnamon and peppermint tea. Participants could drink warm cinnamon tea, warm peppermint tea, iced cinnamon tea, or iced peppermint tea; in this study design all

combinations of haptic and non-haptic taste manipulations are used. An exploration of interaction effects could advise whether haptic or non-haptic manipulation of temperature is effective in altering emotions. The study would be further enhanced if the measures used were sensitive (7 to 9-point likert scales), perceived temperature in Fahrenheit or Celsius was measured and more items were developed for some of the one item measures (i.e., comfort food measure, liking of manipulation) to enhance validity. One limitation in the current study is that the dependent measures, especially the S-12 basic needs and mood measures, exhibited uncharacteristically low reliability in comparison to previous research (Williams, Cheung, & Choi, 2000). The results could reflect the specific population used in the study or perhaps could indicate a deeper problem within the measures. Future research could determine the validity of these measures and possibly analyze negative and positive mood in separate subscales.

Researchers should also measure how much each manipulation is liked, enjoyed, and comfortable in a pilot study; ideally the manipulations should all induce some slight discomfort but to the same extent for every condition. Lastly, future research could benefit from more advanced suspicion checks. Participants in the current study often guessed that the study was about how the gum affected mood or other cognitions but never explained how they perceived the cognitions to be affected. Future researchers could ask how they think the different temperature manipulations affected their cognitions if they indicate initial suspicions.

In conclusion, although the hypotheses of the current study were not significant, important information can be gained from the results. Gum is a practical and theoretically important temperature manipulation to explore, and this study illuminated

some of the major issues that may impede gum-flavor as a useable temperature manipulation. This study successfully replicated Lewandowski, Ciarocco, and Gately's (2012) findings that perceived temperature can be manipulated via gum flavor. The results suggest neutral gum induced temperature conditions are not necessary because no subtle temperature effects are likely to be found. Overall, the current study raises questions about non-haptic manipulation of temperature and how it may affect cognitions differently than haptic manipulations of temperature.

REFERENCES

Arnold, L. E., Lofthouse, N., & Hurt, E. (2012). Artificial food colors and attention-deficit/hyperactivity symptoms: conclusions to dye for. *Neurotherapeutics*, *9*, 599-609.

Asch, S. E. (1946). Forming impressions of personality. *The Journal of Abnormal and Social Psychology*, *41*, 258-290.

Asch, S. E. (1958). The metaphor: A psychological inquiry. In R. Tagiuri & L. Petrullo (Eds.), *Person perception and interpersonal behaviour* (pp. 86-94). Palo Alto, CA: Stanford University Press.

Bargh, J. A., & Shalev, I. (2012). The substitutability of physical and social warmth in daily life. *Emotion*, *12*, 154-162.

Barsalou, L. W. (2008). Grounded cognition. *Annual Review of Psychology*, *59*, 617-645.

Bastian, B., & Haslam, N. (2010). Excluded from humanity: The dehumanizing effects of social ostracism. *Journal of Experimental Social Psychology*, *46*, 107-113.

Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Twenge, J. M. (2005). Social exclusion impairs self-regulation. *Journal of Personality and Social Psychology*, *88*, 589-604.

Baumeister, R. F., & Leary, M. R. (1995). The need to belong: Desire for interpersonal attachments as a fundamental human motivation. *Psychological Bulletin*, *117*, 497-529.

Brown, C. M., Arbour, J. H., & Jackson, D. A. (2012). Testing of the effect of missing data estimation and distribution in morphometric multivariate data analyses. *Systematic Biology*, *61*, 941-954.

Campbell, D. T., & Fiske, D. W. (1959). Convergent and discriminant validation by the multitrait-multimethod matrix. *Psychological Bulletin*, *56*, 81-105.

Casasanto, D. (2009). Embodiment of abstract concepts: Good and bad in right-and left-handers. *Journal of Experimental Psychology: General*, *138*, 351-367.

Choi, J. (2013). Revisiting positive and negative charity appeal effectiveness: Moderation effect of color and victim-type (Master's thesis). Available from ProQuest Dissertations and Theses database. (UMI No. 3559044)

Chow, R. M., Tiedens, L. Z., & Govan, C. L. (2008). Excluded emotions: The role of anger in antisocial responses to ostracism. *Journal of Experimental Social Psychology*, *44*, 896-903.

Clemons, T., Rodgers, M., Rolli, A., & Traeger, M. (2013). Potential psychological stress response while chewing gum at various rates. *Journal of Advanced Student Science, 3,* 1-14. Retrieved from http://jass.neuro.wisc.edu/2013/01/

Delwiche, J. F. (2003). Impact of color on perceived wine flavor. *Foods and Food Ingredients Journal of Japan, 208,* 349-352.

DeWall, C. N., MacDonald, G., Webster, G. D., Masten, C. L., Baumeister, R. F., Powell, C., & Eisenberger, N. I. (2010). Acetaminophen reduces social pain behavioral and neural evidence. *Psychological Science*, *21*, 931-937.

Dickerson, S. S., & Kemeny, M. E. (2004). Acute stressors and cortisol responses: A theoretical integration and synthesis of laboratory research. *Psychological Bulletin*, *130*, 355-391.

DuBose, C. N., Cardello, A. V., & Maller, O. (1980). Effects of colorants and flavorants on identification, perceived flavor intensity, and hedonic quality of fruit-flavored beverages and cake. *Food Science, 45*, 1393-1399.

Eisenberger, N. I., Lieberman, M. D., & Williams, K. D. (2003). Does rejection hurt? An fMRI study of social exclusion. *Science*, *302*, 290-292.

Eisenberger, N. I., & Lieberman, M. D. (2004). Why rejection hurts: A common neural alarm system for physical and social pain. *Trends in Cognitive Sciences*, *8*, 294-300.

Ehrlich, S. D. (2011). Phenylalanine. Retrieved from University of Maryland Medical Center website: http://umm.edu/health/medical/altmed/supplement/phenylalanine

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*, 175-191.

Ferdman, R. A. (2014, March). Which gum americans are chewing on these days. *Quartz*. Retrieved from http://qz.com/190895/which-gum-americans-are-chewing-on-these-days/

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Sage.

Gerber, J., & Wheeler, L. (2009). On being rejected a meta-analysis of experimental research on rejection. *Perspectives on Psychological Science*, *4*, 468-488.

Glenberg, A. M., Witt, J. K., & Metcalfe, J. (2013). From the revolution to embodiment: 25 years of cognitive psychology. *Perspectives on Psychological Science*, *8*, 573-585.

Greenberg, J., Pyszczynski, T., & Solomon, S. (1986). The causes and consequences of a need for self-esteem: A terror management theory. In R. Baumeister (Eds.), *Public self and private self* (pp. 189-212). New York: Springer.

Gunnar, M. R., Sebanc, A. M., Tout, K., Donzella, B., & van Dulmen, M. M. (2003). Peer rejection, temperament, and cortisol activity in preschoolers. *Developmental Psychobiology*, *43*, 346-368.

Hall, E. T. (1969). *The hidden dimension*. New York: Anchor Books.

Havas, D. A., Glenberg, A. M., Gutowski, K. A., Lucarelli, M. J., & Davidson, R. J. (2010). Cosmetic use of botulinum toxin-A affects processing of emotional language. *Psychological Science*, *21*, 895-900.

Hawkley, L. C., Hughes, M. E., Waite, L. J., Masi, C. M., Thisted, R. A., & Cacioppo, J. T. (2008). From social structural factors to perceptions of relationship quality and loneliness: The Chicago health, aging, and social relations study. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, *63*, S375-S384.

Hendrickson, R. (1997). *The facts on file encyclopedia of word and phrase origins.* New York: Facts on File, Inc.

Hong, J., & Sun, Y. (2012). Warm it up with love: The effect of physical coldness on liking of romance movies. *Journal of Consumer Research*, 39, 293-306.

Hughes, M. E., Waite, L. J., Hawkley, L. C., & Cacioppo, J. T. (2004). A short scale for measuring loneliness in large surveys results from two population-based studies. *Research on Aging*, *26*, 655-672.

IBM Corp. Released 2013. IBM SPSS Statistics for Windows, Version 22.0. Armonk, NY: IBM Corp.

IJzerman, H., Gallucci, M., Pouw, W. T., Weiβgerber, S. C., Van Doesum, N. J., & Williams, K. D. (2012). Cold-blooded loneliness: Social exclusion leads to lower skin temperatures. *Acta Psychologica*, *140*, 283-288.

IJzerman, H., & Semin, G. R. (2010). Temperature perceptions as a ground for social proximity. *Journal of Experimental Social Psychology*, *46*, 867-873.

Inagaki, T. K., & Eisenberger, N. I. (2013). Shared neural mechanisms underlying social warmth and physical warmth. *Psychological Science*, *24*, 2272-2280.

Kang, Y., Williams, L., Clark, M., Gray, J., & Bargh, J. (2010). Physical temperature effects on trust behavior: The role of insula. *Social Cognitive and Affective Neuroscience, 6*, 507-515.

Kassab, M., Foster, J. P., Foureur, M., & Fowler, C. (2012). Sweet-tasting solutions for needle-related procedural pain in in-fants one month to one year of age. *Cochrane Database of Systematic Reviews, 12* (2), 1-59.

Kerr, N. L., & Levine, J. M. (2008). The detection of social exclusion: Evolution and beyond. *Group Dynamics: Theory, Research, and Practice*, *12*, 39-52.

Kimbrough D. R. (1997). Hot and spicy vs. cool and minty as an example of organic structure-activity relationships. *Journal of Chemical Education 74*, 861-862.

Knowles, M. L., Green, A., & Weidel, A. (2013). Social rejection biases estimates of interpersonal distance. *Social Psychological and Personality Science*, *5*, 158-167.

Landau, M. J., Meier, B. P., & Keefer, L. A. (2010). A metaphor-enriched social cognition. *Psychological Bulletin*, *136*, 1045-1067.

Landau, M. J., Robinson, M. D., & Meier, B. P. (2014). *The power of metaphor: Examining its influence on social life*. Washington, DC: American Psychological Association.

Lee, S. H. M., Rotman, J. D., & Perkins, A. W. (2014). Embodied cognition and social consumption: Self-regulating temperature through social products and behaviors. *Journal of Consumer Psychology*, *24*, 234-240.

Lieberman, M. D. (2013). *Social: Why our brains are wired to connect*. Oxford University Press.

Lewandowski, G. W., Ciarocco, N. J., & Gately, E. L. (2012). The effect of embodied temperature on perceptions of global warming. *Current Psychology*, *31*, 318-324.

Mäkinen, K. K. (1975). Long-term tolerance of healthy human subjects to high amounts of xylitol and fructose: General and biochemical findings. *Internationale Zeitschrift fur Vitamin-und Ernahrungsforschung. Beiheft*, *15*, 92-104.

Madden, T. J., Hewett, K., & Roth, M. S. (2000). Managing images in different cultures: A cross-national study of color meanings and preferences. *Journal of international marketing*, *8*, 90-107.

Mardia, K. V. (1971). The effect of nonnormality on some multivariate tests and robustness to nonnormality in the linear model. *Biometrika*, *58*, 105-121.

McCann, D., Barrett, A., Cooper, A., Crumpler, D., Dalen, L., Grimshaw, K., … Stevenson, J. (2007). Food additives and hyperactive behaviour in 3-year-old and 8/9-year-old children in the community: A randomised, double-blinded, placebo-controlled trial. *The Lancet*, *370*, 1560-1567.

Mehrabian, A. (1968). Relationship of attitude to seated posture, orientation, and distance. *Journal of personality and social psychology*, *10*, 26-30.

Moor, B. G., Crone, E. A., & van der Molen, M. W. (2010). The heartbrake of social rejection heart rate deceleration in response to unexpected peer rejection. *Psychological Science*, *21*(9), 1326-1333.

Neal, D. T., & Chartrand, T. L. (2011). Embodied emotion perception amplifying and dampening facial feedback modulates emotion perception accuracy. *Social Psychological and Personality Science*, *2*, 673-678.

Park, L. E., & Maner, J. K. (2009). Does self-threat promote social connection? The role of self-esteem and contingencies of self-worth. *Journal of Personality and Social Psychology*, *96*, 203-217.

Proffitt, D. R. (2006). Embodied perception and the economy of action. *Perspectives on Psychological Science*, *1*, 110-122.

Puttanniah, V. G., & Halpern, B. P. (2001). Retronasal and orthonasal identification of odorants: Similarities and differences. *Chemical Senses, 26,* 802.

Raudenbush, B., Koon, J., Meyer, B., Corley, N., & Flower, N. (2004). Effects of odorant administration on pain and psychophysiological measures in humans. *North American Journal of Psychology*, *6*, 361-370.

Reid, M., & Hammersley, R. (1998). The effects of blind substitution of aspartame-sweetened for sugar-sweetened soft drinks on appetite and mood. *British Food Journal*, *100*, 254-259.

Roth, H. A., Radle, L. J., Gifford, S. R., & Clydesdale, F. M. (1988). Psychophysical Relationships Between Perceived Sweetness and Color in Lemon‐and Lime‐Flavored Drinks. *Journal of Food Science*, *53*, 1116-1119.

Rothbaum, F., Weisz, J. R., & Snyder, S. S. (1982). Changing the world and changing the self: A two-process model of perceived control. *Journal of Personality and Social Psychology*, *42*(1), 5-37.

Raudenbush, B., Meyer, B., & Eppich, B. (2002). Effects of odor administration on objective and subjective measures of athletic performance. *International Sports Journal, 6,* 14-27.

Sato, K., Endo, S., & Tomita, H. (2002). Sensitivity of three loci on the tongue and soft palate to four basic tastes in smokers and non-smokers. *Acta Oto-Laryngologica*, *122*, 74-82.

Schnall, S. (2014) Are there basic metaphors? In M. J. Landau, M. D. Robinson, & B. P. Meier (Eds.), *The power of metaphor: Examining its influence on social life* (225-247). Washington, DC: American Psychological Association.

Scholey, A., Haskell, C., Robertson, B., Kennedy, D., Milne, A., & Wetherell, M. (2009). Chewing gum alleviates negative mood and reduces cortisol during acute laboratory psychological stress. *Physiology & Behavior*, *97*, 304-312.

Smith, A. P., Chaplin, K., & Wadsworth, E. (2012). Chewing gum, occupational stress, work performance and wellbeing: An intervention study. *Appetite*, *58*, 1083-1086.

Stephens, R., & Tunney, R. J. (2004). How does chewing gum affect cognitive function? *Appetite*, *43*, 217-218.

Strack, F., Martin, L. L., & Stepper, S. (1988). Inhibiting and facilitating conditions of the human smile: A nonobtrusive test of the facial feedback hypothesis. *Journal of Personality and Social Psychology*, *54*, 768-777.

Tabachnick, B. G., & Fidell, L. S. (2014). Using multivariate statistics (6 ed.). Harlow: Pearson Education Limited.

Thayer, R. E., Newman, J. R., & McClain, T. M. (1994). Self-regulation of mood: strategies for changing a bad mood, raising energy, and reducing tension. *Journal of Personality and Social Psychology*, *67*, 910-925.

Troisi, J. D., & Gabriel, S. (2011). Chicken soup really is good for the soul: "Comfort food" fulfills the need to belong. *Psychological science*, *22*, 747-753.

Twenge, J. M., Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Bartels, J. M. (2007). Social exclusion decreases prosocial behavior. *Journal of Personality and Social Psychology*, *92*, 56-66.

Van Beest, I., & Williams, K. D. (2006). When inclusion costs and ostracism pays, ostracism still hurts. *Journal of Personality and Social Psychology*, *91*, 918-928.

Walton, R. G., Hudak, R., & Green-Waite, R. J. (1993). Adverse reactions to aspartame: Double-blind challenge in patients from a vulnerable population. *Biological Psychiatry*, *34*, 13-17.

Wesselmann, E. D., Hales, A. H., Ren, D., & Williams, K. D. (2015). A Temporal Need Threat Framework. *Handbook of Personal Security*, 191-205.

Wesselmann, E. D., Ren, D., Swim, E., & Williams, K. D. (2013). Rumination hinders recovery from ostracism. *International Journal of Developmental Science*, *7*, 33-39.

Wilkinson, L., Scholey, A., & Wesnes, K. (2002). Chewing gum selectively improves aspects of memory in healthy volunteers. *Appetite*, *38*, 235-236.

Wilkowski, B. M., Meier, B. P., Robinson, M. D., Carter, M. S., & Feltman, R. (2009). "Hot-headed" is more than an expression: The embodied representation of anger in terms of heat. *Emotion*, *9*, 464.

Williams, K. D. (2007). Ostracism: The kiss of social death. *Social and Personality Psychology Compass*, *1*, 236-247.

Williams, K. D. (2009). Ostracism: A temporal need−threat model. *Advances in Experimental Social Psychology*, *41*, 275-314.

Williams, K. D., Cheung, C. K., & Choi, W. (2000). Cyberostracism: Effects of being ignored over the Internet. *Journal of Personality and Social Psychology*, *79*, 748-762.

Williams, L. E. & Bargh, J. A. (2008). Experiencing physical warmth promotes interpersonal warmth. *Science*, *322*, 606-607.

Yagloglou, C. P. and Drinker, P. (1929). The summer comfort zone: Climate and clothing. *Journal of Industrial Hygiene and Toxicology, 10*, 350-363.

Zadro, L., Williams, K. D., & Richardson, R. (2004). How low can you go? Ostracism by a computer is sufficient to lower self-reported levels of belonging, control, self-esteem, and meaningful existence. *Journal of Experimental Social Psychology*, *40*, 560-567.

Zhong, C. B., & Leonardelli, G. J. (2008). Cold and lonely: Does social exclusion literally feel cold? *Psychological Science*, *19*, 838-842.

Zoladz, P.R., Raudenbush, B., Fronckoski, R., & Price, N. (2003). Differential effects of retronasal vs. orthonasal odorant administration on athletic performance, mood, and workload. Paper presented at the Conference of the Association for Chemical Reception Sciences, Sarasota, Florida.

APPENDIX A

RESEARCH PARTICIPANT CONSENT FORM

Research Project Number: **2014-0333**

RESEARCH PARTICIPANT CONSENT FORM
Taste
Dr. Eric D. Wesselmann
Illinois State University
Department of Psychology

Purpose of Research: In this research, we are conducting a product evaluation.

Specific Procedures: You will be asked to chew gum and complete popular measures in psychology.

Duration of Participation: Your participation will take no more than 30 minutes. You will earn experimental credits for your participation.

Requirements: You must be 18 years of age or older to participate.

Benefits to the Individual: You may learn about research in social psychology.

Risks to the Individual: You may potentially be allergic to the gum. Please examine the ingredients list below to ensure you are not allergic to any of the ingredients in the gum. If you are concerned about having an allergic reaction please notify the experimenter at this time. The risks are no greater than those ordinarily encountered in daily life, though you may feel emotionally uncomfortable in various stages of the experiment. As with any laboratory study in which data are collected, there is a potential risk of breach of confidentiality. Safeguards to minimize this risk are discussed in the "Confidentiality" section below.

Ingredients: Sorbitol, maltitol, gum base, mannitol, xylitol, glycerin, acacia, acesulfame potassium, BHT, candelilla wax, soy lecithin, sucralose, titanium dioxide, blue 2 lake, red 40 lake, aspartame, cinnamon, peppermint, or mixed-berry artificial and natural flavoring. **Warning: contains phenylalanine.**

Confidentiality: The project's research records may be reviewed by the Office of Human Research Protections and by departments at Illinois State University responsible for regulatory and research oversight. Your anonymous data will be kept locked up in Dr. Wesselmann's research lab. Only Dr. Wesselmann or his research team will have access to the data. After 5 years following the publication of the data, all hard copies of the data relating to this study will be destroyed.

Voluntary Nature of Participation: You do not have to participate in this research project. If you agree to participate you can withdraw your participation at any time without penalty. Any questions you may find objectionable, you are not required to answer.

Contact Information: If you have any questions about this research project, you can contact Dr. Eric D. Wesselmann (edwesse@ilstu.edu). If you have concerns about the treatment of research participants, you can contact the Research Ethics & Compliance Office at Illinois State University. The email address is rec@ilstu.edu.

Documentation of Informed Consent:

I agree to participate in this study.

Participant's Signature

_____ Date _____

Participant's Name

_____

Researcher's signature

_____ Date _____

APPENDIX B

QUESTIONNAIRE

PRE-1 Participant ID_____

Product Pre-evaluation Survey					
For each question, please circle the number that best represents your feelings toward the following products.	**Not at all**				**Extremely**
To what extent do you like **cinnamon**-flavored gum?	1	2	3	4	5
To what extent do you consider **cinnamon**-flavored gum to be a comfort food?	1	2	3	4	5
To what extent do you like **peppermint**-flavored gum?	1	2	3	4	5
To what extent do you consider **peppermint**-flavored gum to be a comfort food?	1	2	3	4	5
To what extent do you like **mixed-berry**-flavored gum?	1	2	3	4	5
To what extent do you consider **mixed-berry**-flavored gum to be a comfort food?	1	2	3	4	5

Please circle the number that best represents your experience with the following product.	**Not at all**				**All the time**
How often do you chew gum of any flavor?	1	2	3	4	5

*For each question, please circle the number that best represents the **feelings** you are **currently** experiencing.*	**Not at all**				**Extremely**
I feel good about myself	1	2	3	4	5
I feel like an outsider	1	2	3	4	5
I feel superior	1	2	3	4	5
My self-esteem is high	1	2	3	4	5
I feel excluded	1	2	3	4	5
I feel non-existent	1	2	3	4	5
I feel invisible	1	2	3	4	5
I feel ignored	1	2	3	4	5
I feel powerful	1	2	3	4	5
I feel I have control over the course of my interactions	1	2	3	4	5
I feel liked	1	2	3	4	5
I feel meaningless	1	2	3	4	5
I feel rejected	1	2	3	4	5
I feel "disconnected"	1	2	3	4	5

*For each question, please circle the number that best represents the **feelings** you are **currently** experiencing.*	**Not at all**				**Extremely**
Sad	1	2	3	4	5
Unfriendly	1	2	3	4	5
Angry	1	2	3	4	5
Good	1	2	3	4	5
Pleasant	1	2	3	4	5
Bad	1	2	3	4	5
Friendly	1	2	3	4	5
Happy	1	2	3	4	5

Please circle the number that best represents how often you experience the following feelings.	**Hardly Ever**	**Some of the Time**	**Often**
How often do you feel left out?	1	2	3
How often do you feel isolated from others?	1	2	3
How often do you feel that you lack companionship?	1	2	3

*For each question, please click the number that best represents the **sensations** you felt from the chewing gum*	**Not at all**				**Extremely**
To what extent did the gum make you feel "awake"?	1	2	3	4	5
To what extent is the following statement true?: The gum I was given gives me the sensation of heat.	1	2	3	4	5
To what extent is the following statement true?: The gum I was given gives me the sensation of cold.	1	2	3	4	5
To what extent was the gum pleasant?	1	2	3	4	5
To what extent would you recommend the product to a friend	1	2	3	4	5
To what extent do you think the gum was sweet?	1	2	3	4	5
Was the gum effective? Yes___ No___ Would you recommend the product to a friend? Yes____ No___ What was the flavor of gum you chewed? Mixed-berry_____ Peppermint_____ Cinnamon_____ Did you see the color of the gum you chewed? Yes___ No___ What is the color of the gum you chewed? Purple_____ Red_____ White_____					

Please answer the following questions.

1. Age: _____
2. Sex:

Male_____ Female_____ Other (please specify)_____

3. Ethnicity:

White/Caucasian_____ Black/African American_____ Asian_____
Hispanic/Latino_____ Native American_____ Other_____

4. Are you a smoker? Yes___ No ____
   If yes, about how many cigarettes do you smoke in a day? _____
5. Have you taken any painkillers in the last 6 hours? Yes ___ No _____
6. Do you have trouble seeing colors? Yes___ No___
   If yes, what colors are you NOT able to detect? _____
7. What do you think the study was about? _____

APPENDIX C

DEBRIEFING STATEMENT

Debriefing Sheet: TASTE

You have just participated in a research study being conducted by the Psychology Department at Illinois State University. The purpose of this research was to examine how chewing gum may affect need satisfaction, mood, feelings of ostracism, and loneliness.

Specifically, we were interested if chewing red, cinnamon-flavored gum (which is associated with warm temperature) results in higher need satisfaction and mood as well as lower feelings of ostracism and loneliness than chewing white, peppermint-flavored gum (which is associated with cold temperature). We predict this because according to the theory of embodied cognition humans associate warm temperatures with social intimacy and cold temperatures with a lack of social intimacy. We also included a sweet, neutral temperature condition) i.e., purple colored, mixed-berry flavored gum) as a comparison group.

The confidentiality of your individual responses will be maintained at all times, and only group data will be identified and analyzed.

Due to the nature of this study, it is imperative that future participants do not know about the purpose of this study, or the manipulations we use to test this theory. Please refrain from talking to anyone about what you experienced today.

Thank you for your participation!

For more information about this study, please contact:

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