Embodyed Motivation: Using a Goal Systems Framework to Understand the Preference for Social and Physical Warmth

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Embodiment research has primarily focused on metaphor-assimilative effects (e.g., perceiving someone to be socially warmer when holding a warm object). Research shows these effects can occur by activating metaphor-associated knowledge constructs. This account is not sufficient, however, for explaining complementary effects—for example, the tendency to prefer social warmth when experiencing physical coldness (Experiment 1). We suggest that socially warm events are considered a means for achieving the goal of reducing physical coldness. Guided by this basic hypothesis and the principles of a goal systems framework, we examine whether the basic relationship between goals and means explains complementary embodiment effects. We find that socially warm activities are preferred over control activities when people are primed with the goal of reducing physical coldness, but not when primed with the concept of coldness (Experiment 2). We also find that activating an alternative goal decreases the attractiveness of socially warm activities when people are feeling cold (Experiment 3). Finally, we examine the effect of social coldness on preferences for physical warmth, showing that the attractiveness of physically warm items among socially excluded people is decreased by activating an alternative goal (Experiment 4). These results suggest that complementary embodiment effects follow the principles of goal activation.

Keywords: embodied cognition, metaphor, social warmth, goal activation, knowledge activation

For the last several decades, the long-assumed role of the human mind as an abstract processor has been challenged by an emerging stream of research on embodied cognition. The embodied cognition perspective (Barsalou, 1999; Lakoff & Johnson, 1980; Semin & Smith, 2008) suggests that the mind must be understood in the context of its relationship to a physical body that interacts with the world. This perspective highlights the importance of bodily and sensory experiences in influencing cognition and behavior.

Recently, embodiment research has focused in particular on the metaphorical link between physical and psychological experiences (Lakoff & Johnson, 1999). In everyday life, people use metaphors that tap into concrete physical experiences to describe their abstract psychological experiences. For instance, it is common to hear people describe a social interaction as “smooth” and a topic as “heavy.” Consistent with these daily metaphors, Ackerman, Nocera, and Bargh (2010) found that people judge a social interaction to be less smooth and coordinated when experiencing the tactile sensation of roughness and judge issues to be more “weighty” when holding a heavy clipboard. Researchers have found evidence in other domains as well, showing that people are more suspicious when exposed to a “fishy” smell (S. W. Lee & Schwarz, 2012), are more determined when firming their muscles (Hung & Labroo, 2011), and experience psychological closure after sealing their feelings in an envelope (Li, Wei, & Soman, 2010).

Assimilative and Complementary Effects for Physical and Social Warmth

Among all the findings that connect bodily experiences with cognition, the relationship between physical warmth and social warmth is one of the most robust (Bargh & Shalev, 2012; Ijzerman & Semin, 2009, 2010; Shalev & Bargh, 2014; Williams & Bargh, 2008; Zhong & Leonardielli, 2008; but see Donnellan, Lucas, & Cesario, 2014; Lynott et al., 2014). This connection is evident in metaphors such as “she has a warm personality” or “he gave me the cold shoulder” that are widely used in daily life across different cultures. Although the causal connection between physical and social warmth has only been experimentally demonstrated in recent years, the idea is captured in Harlow’s classic studies with rhesus monkeys back in 1958, highlighting the role of physical warmth in the mother–infant social bond (Harlow, 1958). There is also neurological evidence showing that physical warmth and social warmth activate similar neural activity in the ventral striatum and middle insula, suggesting that the neurobiological mechanisms that regulate body temperature may be shared by those that regulate feelings of social warmth (Inagaki & Eisenberger,
In explaining how social warmth and physical warmth get metaphorically associated with each other, Lakoff and Johnson (1999) suggested that early life experiences of getting both physical warmth and social warmth such as love and protection simultaneously from caregivers are repeated frequently enough that experiencing one (such as physical warmth) activates the other (social warmth) in mind.

Research on the relationship between physical warmth and social warmth can be broadly classified into two streams. One stream demonstrates how experiencing one state can increase perceptions of the other. This line of research reveals assimilative results that match the metaphor, such that physical warmth [coldness] leads to an increased judgment of social warmth [coldness], and social warmth [coldness] leads to an increased judgment of physical warmth [coldness]. For example, people judge a stranger to be friendlier when holding a cup of hot coffee than when holding a cup of cold tea (L. E. Williams & Bargh, 2008). Similarly, Ijzerman and Semin (2009) found that participants seated in a warm room report feeling interpersonally closer to the experimenter than do those seated in a colder room. Conversely, experiencing social rejection makes people feel physically cold (Ijzerman et al., 2012; Zhong & Leonardi, 2008), experiencing social connection makes people feel physically warm (Hahn et al., 2012; Inagaki & Eisenberger, 2013), and thinking about a target’s sociability traits increases estimates of room temperature (Szymkow et al., 2013).

Another stream of research has demonstrated complementary embodiment effects, showing that experiencing a physical state can increase people’s desire for the psychological state that complements the physical state rather than one that matches the physical state, and that experiencing a psychological state can increase interest in the complementary physical state. This stream of research has revealed, for example, that people seek social warmth when feeling physically cold (Hong & Sun, 2012; Kolb, Gockel, & Werth, 2012), and seek physical warmth when feeling socially cold (Bargh & Shalev, 2012; Shalev & Bargh, 2014; Zhong & Leonardi, 2008). These findings suggest that people consider warmth to be a buffer for either social or physical coldness. Complementary effects are also found in other domains. For example, people prefer stable romantic partners when sitting in an unstable physical body posture (Kille, Forest, & Wood, 2013), seek physical cleanliness when feeling morally impure (S. W. Lee & Schwartz, 2010; Zhong & Liljenquist, 2006), and cover up their physical warmth when feeling embarrassed (Dong, Huang, & Wyer, 2013).

Both streams of research have collected supportive evidence. However, research has not systematically investigated why similar manipulations can sometimes lead to an assimilative effect but other times lead to a complementary effect. In this research, we suggest that motivation plays a crucial role in complementary embodiment effects. Motivational processes that focus on undoing a physical or psychological state will lead to behaviors that provide a metaphorical complement for the original state. Using physical and social warmth as the context, the current research is designed to provide a motivational framework to understand the processes that underlie complementary embodiment effects.

**Psychological Processes Underlying Embodiment Effects**

Many assimilative embodiment effects can be understood through the lens of conceptual priming. Conceptual priming affects judgment and behavior by making associative knowledge constructs more accessible in mind (for a review of conceptual priming, see Förster & Liberman, 2007; Higgins, 1996; Wyer, 2004). For instance, unscrambling sentences that contain the word hostility can prime people with the concept of hostility, which leads people to interpret ambiguous behavior as more hostile and perceive target individuals to be more hostile (Strack, Martin, & Stepper, 1988). Indeed, some researchers may only consider an effect to be embodied if semantic activation can be ruled out as the underlying mechanism. In this research, we take a broader perspective and consider an effect embodied to the extent that a bodily or sensory experience is shown to play a causal role, rather than being epiphenomenal.

1 Motivation and goal activation have been examined in the embodiment literature before. The reason that arm flexion and extension affect cognition, for example, is because such bodily actions contain an element of approach and avoidance motivation, which cues people’s attention and cognition (Förster, 2003; Förster & Friedman, 2008; Förster, Higgins, & Idson, 1998). In the current article, we are interested in cases in which bodily or social states activate a motivation to undo the state, which is different from cases in which bodily movement contains motivational elements in itself.
a goal to undo an unpleasant state is primed, it activates the means that can be used to achieve the goal, which will complement the metaphorical meaning associated with the unpleasant state. Specifically, we suggest that because participating in socially warm events can be seen as a means for reducing physical coldness, events that produce social warmth will seem desirable for achieving the goal of reducing physical coldness. This goal activation perspective also implies that physical warmth can be seen as a means for undoing social coldness, and will be desirable when people have the goal to feel less socially cold.

Understanding Complementary Effects Through a Goal Systems Framework

Researchers have demonstrated complementary embodiment effects in the warmth domain, finding that physical coldness leads to stronger preferences for romantic movies that bring feelings of social warmth (Hong & Sun, 2012) and prompts service employees to seek social interaction with customers (Kolb et al., 2012). In the current research, we conceptually replicate these effects. More importantly, it explores whether a goal systems account can explain complementary embodiment effects. In their seminal article, Kruglanski et al. (2002) put forward a theory of goal systems. We apply this goal systems framework to the warmth context to examine whether the basic relationship between goals and means extends to complementary embodiment effects.

Applying established properties of goal systems to complementary embodiment effects generates a few novel predictions. First, one important property of goal systems is that the value of an object is dependent on whether or not it is instrumental to a goal. Activating a goal, even unconsciously, leads to a stronger preference for the means that are instrumental to it (Chartrand, Huber, Shiv, & Tanner, 2008). For example, “when we need to find a screwdriver to assemble furniture, the value of that object in-
Experiment 1: Socially Warm Versus Control Activities

As a conceptual replication of the experiments by Hong and Sun (2012), in this experiment, we examine people’s interest in socially warm activities and compare that with their interest in control activities that are positive but not socially warm. Because socially warm activities are considered instrumental to the goal of reducing physical coldness but positive activities that are not socially warm are not, we predict that feeling physically cold will increase people’s interest in socially warm activities but will not affect their interest in control activities. Including control activities also helps us rule out an alternative explanation that experiencing physical coldness increases people’s interest in all types of positive activities.

Method

We first conducted a pretest to select activities that would be used in the main experiment. Forty-three participants from the University of Chicago were randomly assigned to rate 19 activities on one of four dimensions: psychological warmth, social connection, positivity, and feelings of pride, using a 1 (not at all) to 9 (very much) scale. As one would expect, ratings of psychological warmth and social connection were positively correlated ($r = .89$, $p < .0001$), and the correlation remained significant after controlling for positivity ($r = .80$, $p < .0001$). Five socially warm activities and five control activities were selected from the pretest. The target activities were chosen to maximize the difference on ratings of psychological warmth ($M_{warm} = 6.80$, $SD = 1.69$ vs. $M_{control} = 4.58$, $SD = 1.18$), paired $t(10) = 4.07$, $p = .002$, $d = 1.52$, while keeping ratings of positivity as similar as possible ($M_{warm} = 7.02$, $SD = 1.00$ vs. $M_{control} = 6.53$, $SD = 0.69$; $p = .06$). For a complete list of chosen activities, please see Appendix A. We were also careful in only choosing indoor activities so that the socially warm activities could not produce greater physical warmth compared with the control activities.

Forty-nine students\(^3\) from the same university participated in the main experiment in exchange for $1. One participant did not complete the primary dependent measure, leaving 48 participants in the sample (18 women, $M_{age} = 27.06$).\(^4\) There was no effect of participants’ gender in this experiment or in later experiments; we therefore omit this factor from further analysis.

We manipulated feelings of coldness by conducting the experiment either inside or outside a heated building during the winter. Half of participants were randomly approached and completed the study outside, with the temperature ranging from 27 °F (−2.8 °C) to 43 °F (6.1 °C); the other half of participants answered the same questions indoors with the temperature fixed at 72 °F (22.2 °C). Participants were asked to indicate their interest in experiencing the 10 activities on a 1 (not interested at all) to 9 (very much interested) scale. To minimize the order effect of activity items, we randomized each participant’s activity order. If participants completed the primary dependent measure, this can only explain the main effect of activity type but not differences as well as any differences caused by the manipulation that may not have been due to feelings of coldness. For instance, if outdoor participants are happier or feeling more open to experience, they may be more interested in the socially warm activities as well as the control activities. Instead, we expect that when people feel physically cold, socially warm activities will be preferred above and beyond any differences in people’s interest in control activities.

After rating their interest in the activities, participants reported how calm, cold, happy, hot, angry, sad, hungry, excited, tired, and anxious they felt on a 1 (very slightly or not at all) to 5 (extremely) scale.

Results and Discussion

As a manipulation check, we subtracted the hot rating from the cold rating for each participant. Outside participants reported feeling marginally colder ($M = 1.00$, $SD = 1.18$) than inside participants ($M = 0.27$, $SD = 1.49$), $t(44) = 1.83$, $p = .075$, $d = 0.54$.\(^5\) No other state measures were close to significance ($t < 1$).

For each participant, we averaged interest in the five socially warm activities ($\alpha = .68$) and interest in the five control activities ($\alpha = .61$). We predicted that completing the experiment outside in the cold would increase people’s interest in activities that generate social warmth, whereas their interest in control activities would not be affected by whether or not participants felt cold. This prediction was confirmed by the results of a 2 (activity type: warm vs. control) $\times$ 2 (location: outdoor vs. indoor) mixed-model analysis of variance (ANOVA), with activity type as a within-participant variable. There was a significant main effect of activity type, $F(1, 46) = 16.07$, $p = .0002$, $\eta^2_p = .26$, qualified by the predicted interaction between activity type and location, $F(1, 46) = 4.40$, $p = .041$, $\eta^2_p = .09$. As shown in Figure 1, outside participants showed greater interest in the warm activities ($M = 6.90$, $SD = 1.25$) than in the control activities ($M = 5.79$, $SD = 1.74$), $F(46) = 19.46$, $p < .0001$, $\eta^2_p = .30$, but indoor participants were equally interested in warm and control activities ($M_{warm} = 6.17$, $SD = 1.18$ vs. $M_{control} = 5.83$, $SD = 1.23$), $F(1, 46) = 1.75$, $p = .19$, $\eta^2_p = .04$. The interaction remained significant after controlling for question order, $F(1, 45) = 5.96$, $p = .019$, $\eta^2_p = .12$.

Although it is possible that socially warm activities were preferred because they were slightly more positive than the control activities, this can only explain the main effect of activity type but

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\(^3\) In Experiment 1, we planned to run 25 participants per condition in as short of a time frame as possible to minimize the variance of outside weather. We collected data for 1 week and decided to stop data collection slightly short of our intended sample (49 out of 50) rather than start again the following week. We made the decision to stop without looking at the data. Experiments 2, 3, and 4 were run after the concern about false positives came to the forefront of the field, and we increased our sample size. We ran 35 participants per condition in Experiment 2, 75 participants per condition in Experiment 3, and 125 participants per condition in Experiment 4 on Amazon’s Mechanical Turk.

\(^4\) We report all data exclusions, all conditions, and all measures in the studies. Across all studies, we exclude participants who did not complete the primary dependent measure. If participants completed the primary dependent measure, but failed to complete subsequent measures, they are only excluded for the questions they did not answer but are included in the primary dependent measure analysis in the text. In the footnotes, we report the results for the primary dependent measure analysis that excludes those who did not complete the subsequent measures.

\(^5\) Two participants did not report their cold and hot feelings. Excluding them from the analysis of participants’ interest in activities does not change the significance of the interaction between activity type and location, $F(1, 44) = 5.27$, $p = .027$, $\eta^2_p = .11$. 

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This experiment was also designed to rule out an alternative explanation that socially warm activities are seen as a means for reducing physical discomfort rather than physical coldness. To do this, we included conditions that primed people with the goal of reducing heat, another physically uncomfortable state. If feeling both unpleasingly cold and unpleasingly hot increase people’s preference for social warmth, then that may suggest that social warmth is used as a means for reducing physical discomfort. However, if people show greater interest in socially warm activities when they are given the goal of reducing physical coldness than when they are given the goal of reducing heat, then it suggests that the effect is caused by a specific goal of reducing coldness rather than a goal of reducing physical discomfort.

Method

Two hundred eighty visitors to the Museum of Science and Industry in Chicago participated in exchange for small gift rewards. Two participants did not complete the primary dependent measure, and five participants reported identical answers for all questions, leaving 273 participants in the sample (145 women, two did not indicate gender, $M_{age} = 32.7, 68.40\%$ Caucasian).

The experiment was a 2 (type of prime: concept vs. goal) $\times$ 2 (content of prime: cold vs. hot) $\times$ 2 (type of warmth: physical vs. social) between-participants design. Participants first read a paragraph that primed either a concept or a goal that was either about coldness or about heat. In the concept priming condition, participants thought about the concept of coldness (heat). Specifically, they were asked to imagine “What thoughts come to mind when you think about the word ‘cold’ (‘hot’)? What other words and concepts come to mind when you think about coldness (heat)?” In the goal priming condition, participants were instead asked to imagine that they were feeling physically cold (hot). They were asked, “What thoughts come to mind as you imagine feeling cold (hot)? What would you make to do yourself feel better? How would you make sure that you no longer felt cold (hot)?”

After contemplating the priming questions, participants were randomly assigned to indicate their interest in 10 events that affect either social warmth or physical warmth. In the social warmth conditions, participants reported their interest in the 10 activities used in Experiment 1. We calculated participants’ interest in social warmth by averaging their interest in the five socially warm activities ($\alpha = .81$) and compared that with their average interest in the five control activities ($\alpha = .60$). In the physical warmth conditions, participants also reported their interest in 10 activities (see Appendix B). The five control activities were identical to those used in the social warmth condition, but the five socially warm activities were replaced with five physically warm activities (e.g., reading by the fire). We calculated participants’ interest in physical warmth by averaging their interest in the five physically warm activities ($\alpha = .85$) and compared that with their average interest in the five control activities ($\alpha = .60$).

Results and Discussion

We predicted that, compared with their interest in control activities, participants primed with the goal of reducing coldness would be more interested in both physically and socially warm activities than participants primed with the goal of reducing heat. We did not expect the same difference to emerge for those primed with the concept of coldness or heat. To test this prediction, we first conducted a 2 (priming type: concept vs. goal) $\times$ 2 (priming content: cold vs. hot) $\times$ 2 (type of warmth: physical vs. social) $\times$ 2 (activity type: warm vs. control) mixed ANOVA, with activity type as a within-participant variable and the other variables as between-participant variables. As predicted, a significant three-way interaction emerged between priming type, priming content, and activity type, $F(1, 265) = 34.88, p < .0001, \eta_p^2 = .12$. This three-way interaction suggests that the effect of priming coldness or heat on interest in warm versus control activities is dependent on whether we primed participants with a goal or concept. In other words, priming a goal of reducing coldness rather than a goal of reducing heat makes people more interested in warm activities, but this pattern was not observed when we primed people with the concept of coldness or heat. The four-way interaction with
warmth type was not significant, \( F(1, 265) = 1.63, p = .20 \), suggesting that the above three-way interaction was similar for social warmth and physical warmth.

Given that the three-way interaction pattern was similar for social warmth and physical warmth, we focused specifically on the embodiment effect next by analyzing participants’ preferences for social warmth. We predicted that participants primed with the goal of reducing coldness would be more interested in socially warm activities than participants primed with the goal of reducing heat. We did not expect the same pattern of results when participants were primed with the concepts of coldness or heat.

A 2 (type of prime: goal vs. concept) \( \times 2 \) (content of prime: cold vs. heat) \( \times 2 \) (type of social activity: warm vs. control) mixed ANOVA, with type of social activity as a within-participant variable, revealed a marginally significant three-way interaction, \( F(1, 131) = 3.72, p = .056, \eta^2_p = .03 \). Among those who were primed with a goal, we found an interaction between the content of the prime and the type of activity, \( F(1, 131) = 13.25, p = .0004, \eta^2_p = .09 \). Specifically, participants primed with the goal of reducing coldness showed greater interest in socially warm activities (\( M_{\text{warm}} = 5.79, SD = 1.83 \)) than in control activities (\( M_{\text{control}} = 3.55, SD = 1.61 \)), \( F(1, 66) = 66.06, p < .0001, \eta^2_p = .50 \), whereas this preference was much weaker for participants primed with the goal of reducing heat (\( M_{\text{warm}} = 4.77, SD = 1.94 vs. M_{\text{control}} = 3.83, SD = 1.62 \)), \( F(1, 66) = 12.30, p < .0008, \eta^2_p = .16 \).

In contrast, when participants were primed with the concepts of coldness or heat, their interest in socially warm activities was not affected by which concept was primed, \( F(1, 131) = 0.80, p = .37, \eta^2_p = .01 \). Specifically, participants’ interest in socially warm versus control activities did not differ between those primed with the concept of coldness (\( M_{\text{warm}} = 6.53, SD = 1.59 vs. M_{\text{control}} = 5.04, SD = 1.55 \)), \( F(1, 65) = 42.57, p < .0001, \eta^2_p = .40 \), and those primed with the concept of heat (\( M_{\text{warm}} = 6.24, SD = 1.58 vs. M_{\text{control}} = 5.07, SD = 1.66 \)), \( F(1, 65) = 23.95, p < .0001, \eta^2_p = .27 \). Although participants showed a preference for socially warm activities over control activities in general, it is clear from the analysis that this preference was not affected by which concept was primed. We illustrate the three-way interaction in Figure 2 by calculating participants’ preference for socially warm activities over control activities and presenting the difference scores for participants primed with either the goal to reduce coldness (or heat) or the concepts of coldness (or heat).

We also decomposed the three-way interaction by comparing the effect of priming a goal with the effect of priming a concept. First, we compared the effect of priming the goal of reducing coldness and the effect of priming the concept of coldness. A 2 (priming type: goal vs. concept) \( \times 2 \) (type of social activity: warm vs. control) mixed model ANOVA in the coldness priming conditions returned a significant interaction between priming type and activity type, \( F(1, 66) = 4.26, p = .043, \eta^2_p = .06 \), suggesting that compared with the preference for control activities, participants with a goal of reducing coldness had a stronger preference for socially warm activities (\( M_{\text{warm}} = 5.79, SD = 1.83 vs. M_{\text{control}} = 3.55, SD = 1.61 \)) than participants who were primed with the concept of coldness (\( M_{\text{warm}} = 6.53, SD = 1.59 vs. M_{\text{control}} = 5.04, SD = 1.55 \)). Next, we compared the effect for participants primed with the goal of reducing heat and those primed with the concept of heat. A 2 (priming type: goal vs. concept) \( \times 2 \) (type of social activity: warm vs. control) mixed-model ANOVA in the hot-priming conditions returned no significant interaction between priming type and activity type, \( F(1, 65) = 0.43, p = .52 \), suggesting that compared with the preference for control activities, participants’ preference for socially warm activities were not affected by whether the prime was a goal of reducing heat (\( M_{\text{warm}} = 4.77, SD = 1.94 vs. M_{\text{control}} = 3.83, SD = 1.62 \)) or the concept of heat (\( M_{\text{warm}} = 6.24, SD = 1.58 vs. M_{\text{control}} = 5.07, SD = 1.66 \)).

Finally, because we predicted that the preference for socially warm activities over control activities would be strongest for participants primed with the goal of reducing coldness, we submitted the difference scores for interest in socially warm versus control activities to a contrast analysis, assigning a contrast weight of 3 to the goal to reduce coldness condition and contrast weights of −1 for the other three conditions. As can be seen in Figure 2, people had the greatest preference for socially warm activities over control activities when they had the goal to reduce coldness, \( F(1, 131) = 12.40, p = .0006, \eta^2_p = .09 \).

These results suggest that when the goal of reducing physical coldness is primed, people seek warmth by engaging in activities that are socially warm. Priming the concept of coldness did not affect interest in social warmth, suggesting that the motivation to reduce coldness is central to the complementary embodiment effect. Furthermore, because participants were more interested in socially warm activities when they had the goal of reducing coldness than when they had the goal of reducing heat, and having the goal of reducing heat did not increase the desirability of socially warm activities compared with having the concept of heat activated, our results suggest that social warmth is considered a means for reducing coldness rather than a means for reducing discomfort.

**Experiment 3: Alternative Goal**

We have demonstrated that socially warm activities are more desirable when people have the goal to reduce coldness than when they do not have such a goal. To further demonstrate the role that the goal of reducing coldness plays in complementary embodiment,
effects, in Experiment 3 we examine whether activating an alternative goal reduces the desirability of social warmth.

If the effect is motivational in nature, the desire for social warmth will be reduced for participants who have a different goal activated because activating an alternative goal reduces the value of the means for the focal goal (Brendl, Markman, & Messner, 2003; Y. Zhang et al., 2007). In this experiment, the goal of reducing physical coldness is triggered for all participants by having them complete the experiment outside in the winter, and we manipulate whether people’s attention is drawn to the goal of reducing coldness or to an alternative goal. We predict that if a different goal is activated when people are feeling cold, the preference for social warmth will be diminished, because socially warm activities are not relevant for achieving the alternative goal.

Method

One hundred fifty students from the University of Chicago participated in exchange for a small gift. One participant did not complete the primary dependent measure, leaving 149 participants in the sample (62 women, $M_{age} = 21.3$). Participants completed the questionnaire used in Experiment 1 outdoors in the winter when the temperature varied between 29 °F (−1.7 °C) and 37 °F (2.8 °C). Before completing the questionnaire, half of participants were provided with a warmth goal by reading instructions that,

It is Chicago’s winter again. Most people want to get out of the cold after walking in the chilly wind for a while. Please pause a bit and think about what activities you would do to make yourself feel warmer.

and the rest of participants were provided with a fun goal by reading instructions that

It is Chicago’s winter again. Chicago as a city offers many fun activities to enjoy the snow as well as the cold weather. Please pause a bit and think about what activities you would do to enjoy your time while experiencing the crisp, cold weather of winter.

Then all participants completed the questionnaire asking about their interest in the 10 activities used in Experiment 1. We presented the activities in two different randomized orders with socially warm and control activities intermixed.

As in Experiment 1, all participants reported their current state of feeling calm, cold, happy, hot, angry, sad, hungry, excited, tired, and anxious on a 1–5 scale at the end of the experiment.

Results and Discussion

As a manipulation check, we subtracted the hot rating from the cold rating for each participant. A t test showed that the difference score was significantly higher than zero ($M = 1.61$, $SD = 1.28$), $t(148) = 15.33$, $p < .0001$, $d = 1.26$, suggesting that participants felt cold. In addition, a further comparison of the difference score between the warmth goal condition and the fun goal condition returned nonsignificant results ($M_{warmth} = 1.57$, $SD = 1.22$ vs. $M_{fun} = 1.64$, $SD = 1.34$), $t(147) = 0.33$, $p = .74$, suggesting that there was no difference in how cold participants in the two goal conditions felt. Those in the fun goal condition reported that they felt more tired ($M = 3.22$, $SD = 1.31$) than those in the warmth goal condition ($M = 2.52$, $SD = 1.20$), $t(147) = 3.40$, $p < .001$, $d = 0.56$. No other state measures were significant ($t < 1$).

We averaged the ratings for the five socially warm activities ($\alpha = .81$) and the five control activities ($\alpha = .46$) and then submitted the composites to a 2 (goal: warmth vs. fun) $\times$ 2 (activity type: warmth vs. control) mixed-model ANOVA, with activity type as a within-participant variable. The analysis returned a significant effect of activity type, $F(1, 147) = 196.33$, $p < .0001$, $\eta^2_p = .57$. As predicted, the analysis also returned a marginally significant interaction between motivation and activity type, $F(1, 147) = 3.60$, $p = .059$, $\eta^2_p = .02$. Specifically, the analysis showed that the preference for socially warm activities over control activities was stronger when participants had a warmth goal ($M_{warm} = 6.19$, $SD = 0.19$ vs. $M_{control} = 4.59$, $SD = 0.17$) than when participants had a fun goal ($M_{warm} = 6.40$, $SD = 0.17$ vs. $M_{control} = 5.18$, $SD = 0.14$).

These results demonstrate that when an alternative goal is made salient, the preference for socially warm activities over control activities is reduced, even though participants continue to experience the physical coldness. This suggests that the effect of physical coldness on preferences for socially warm events is dependent on whether an alternative goal—one that is not about reducing coldness—is made salient, providing evidence consistent with the goal systems property that activating an alternative goal will reduce the value of the focal means.

Experiment 4: From Social to Physical

We have demonstrated that socially warm activities are more desirable when people have the goal to reduce physical coldness than when they do not have such a goal. The metaphorical link between physical warmth and social warmth has been shown to be bidirectional. Besides seeking social warmth when feeling physically cold, there is also evidence showing that people will seek physical warmth when they are feeling socially cold (Bargh & Shaley, 2012; Shaley & Bargh, 2014; Zhong & Leonardelli, 2008; but see Donnellan et al., 2014). If such complementary effects are indeed driven by the motivation to undo the negative physical or social state, then goal activation should also play a role in the reverse link, motivating people to seek physical warmth when they have the goal to feel less social coldness. In Experiment 4, we examine the role of goal activation in driving people’s preference for physical warmth when they have the goal to reduce feelings of social coldness that are generated by social exclusion.

Just as the experience of physical coldness can activate different goals depending on what aspect of the coldness people attend to, the experience of social exclusion can also activate different goals depending on what aspect of the exclusion experience people focus on. According to goal systems theory, if our effects are motivational in nature, the desire for physical warmth will be active for socially excluded participants who have the goal of feeling less social coldness, but the desire will be reduced for socially excluded participants who have an alternative goal activated.

Research suggests that the experience of social exclusion threatens two broadly defined human needs: the relational need and the efficacy need (K. D. Williams, 2007, 2009). The relational need is threatened when a social exclusion experience makes people feel rejected and disliked, and the efficacy need is threatened when the social exclusion experience makes people feel a lack of control over their social environment. People who are socially excluded are expected to respond in ways that fortify their most saliently
threatened need (K. D. Williams, 2009). Consistent with this conjecture, research reveals that similar social exclusion experiences can cause different reactive behaviors, depending on which of the two needs is most threatened (J. Lee & Shrum, 2012).

Building on this research, we manipulate the goal to feel warm by having participants either experience social exclusion or not and by making the experience primarily threaten a relational need or an efficacy need. Specifically, after recalling a past social exclusion experience (or a control experience), we highlight either the feeling of being disliked or the feeling of lacking control. We believe that the goal to feel warm will be activated for people who experience social coldness and who have their relational need threatened. In other words, when the feeling of being rejected and disliked is highlighted following an exclusion experience, people should have a goal of restoring their relational need, which is metaphorically linked with physical warmth. In contrast, when the feeling of lacking control is highlighted following an exclusion experience, a goal of restoring their sense of efficacy should be more salient, which is not linked to physical warmth. Thus, we predict that among socially excluded people, highlighting the feeling of being rejected and disliked will make the primary goal of getting warmth more salient, which will lead to a stronger preference for physically warm products over cold products, whereas highlighting the feeling of lacking control will activate an alternative goal, and the preference for physically warm products will be diminished. We do not predict this pattern among those who are not socially excluded.

Method

Four hundred ninety-nine participants living in the United States were recruited from mturk.com to participate in exchange for $0.50. One participant did not complete the social exclusion manipulation, one participant indicated that he lived outside of the United States, and one participant reported identical answers for all questions, leaving 496 participants in the sample (250 women, M_age = 33.2, 81.45% Caucasian).

To manipulate the sense of social exclusion, half of participants recalled a recent past experience of being socially rejected or excluded, and the other half recalled their experience of getting up the previous day. Specifically, participants read:

We are interested in people’s memories and how people recall details. We would like you to spend the next 5-7 minutes trying to recall as vividly as possible an experience you have had in your past. Specifically, we wish for you to remember [an experience during which you felt rejected or excluded in a social interaction recently / your experience waking up yesterday morning]. We don’t just want you to remember sensory details but also how you felt. In the space below, write as detailed a memory as you can, describing the event and how it made you feel. Please write at least one full paragraph about the experience, using as much detail as possible.

After the recall task, participants were randomly assigned to either the warmth goal condition or the alternative goal condition. Participants in the warmth goal condition were asked to think about and indicate the extent to which they felt rejected and disliked, whereas those in the alternative goal condition were asked to think about and indicate the extent to which they felt a lack of control on 1 (not at all) to 9 (very much) scales (see Appendix C for the complete list of the questions used for the goal manipulation). The questions were adapted from the commonly used scales for the cyberball game, with modifications to fit the recall task.

Then all participants indicated their preferences for hot tea and hot coffee on a 1–9 bipolar scale, with hot tea or coffee anchored on one end and cold tea or coffee on the other. The order of tea and coffee was randomized.

As in previous experiments, all participants reported their current state of feeling calm, cold, happy, hot, angry, sad, hungry, excited, tired, and anxious on a 1–5 scale at the end of the experiment.

Results and Discussion

First, as a manipulation check, we confirmed that recalling an experience of social exclusion led participants to feel more rejected and less efficacious compared with those in the control condition. For participants in the warmth goal condition, we averaged the seven rejected and disliked ratings to form a composite measure of need for social warmth. For participants in the alternative goal condition, we averaged the seven ratings of lacking control to form a composite measure of need for control. As expected, in the warmth goal condition, participants reported feeling more disliked when they recalled a past experience of social exclusion (M = 7.32, SD = 1.27) than when they recalled a waking-up experience (M = 2.79, SD = 1.42), F(1, 492) = 477.2, p < .0001, ηp² = .49. Similarly, in the alternative goal condition, participants reported feeling less control after recalling a social exclusion experience (M = 6.83, SD = 1.62) than after recalling an experience of waking up (M = 4.08, SD = 2.05), F(1, 492) = 178.0, p < .0001, ηp² = .27.

In addition, an ANOVA on ratings of physical coldness returned an interaction between recall and goal, F(1, 492) = 4.80, p = .029, ηp² = .01. Replicating the findings by Zhong and Leonardielli (2008), we found that participants who recalled a social exclusion experience reported feeling marginally colder (M = 1.85, SD = 1.04) than those who recalled a wake-up experience (M = 1.63, SD = 0.94), F(1, 492) = 3.11, p = .078, ηp² = .006. Importantly, this effect was only observed when the goal of getting warmth was activated, but not when the alternative goal of getting control was activated (M_exclusion = 1.63, SD = 0.87 vs. M_waking up = 1.80, SD = 1.05), F(1, 492) = 1.78, p = .18, ηp² = .003. We also found that participants who recalled an exclusion experience reported feeling angrier than those who recalled a wake-up experience, F(1, 492) = 31.63, p < .0001, ηp² = .06 (see Buckley, Winkel, & Leary, 2004; K. D. Williams & Zadro, 2005, for similar findings), but this effect did not interact with goal activation, F(1, 492) = 0.63, p = .43, ηp² = .001. No other main effects or interactions were found in other state measures.

As our primary dependent measure, we averaged the preferences for hot tea and hot coffee (α = .46) and submitted the composite to a 2 (recall: exclusion vs. control) × 2 (goal: warmth vs. alternative) ANOVA. The analysis returned a significant interaction between recall and goal, F(1, 492) = 5.31, p = .022, ηp² = .01. As can be seen in Figure 3, socially excluded participants had a marginally stronger preference for warm drinks when their goal of getting warm was activated (M = 5.06, SD = 2.59) than when the alternative goal of gaining control was activated (M = 4.48, SD = 2.52), F(1, 492) = 3.06, p = .08, ηp² = .006. This difference was
not present, however, for participants who did not experience social coldness. In fact, it was in the opposite direction ($M_{\text{warmth}} = 4.57, SD = 2.48$ vs. $M_{\text{alternative}} = 5.04, SD = 2.52$), $F(1, 492) = 2.26, p = .13$, $\eta^2 = .005$.

These results provide a conceptual replication of Experiment 3, showing that the effect of socially cold experiences on preferences for physically warm items is reduced when an alternative goal—one that is not about reducing coldness—is made salient. Together, these two experiments provide evidence consistent with the goal systems property that activating an alternative goal will reduce the value of the focal means.

**General Discussion**

As the evidence for embodied cognition accumulates, it becomes more important to understand the mechanisms that underlie these phenomena. Recent advancement in exploring the mechanism is marked by two articles that demonstrate that bodily experiences and social experiences can influence each other by activating metaphor-associated knowledge constructs in mind (S. W. Lee & Schwarz, 2012; M. Zhang & Li, 2012). This associative knowledge activation account can help explain assimilative embodiment effects. However, it is not sufficient for explaining complementary embodiment effects.

Using physical and social warmth as the context, the current research builds on the associative knowledge activation account that assumes that physical and social warmth can semantically activate one another, but adds a motivational component to explain complementary embodiment effects. We suggest that the unpleasant state of feeling either physically or socially cold activates a goal of rectifying that state and that social and physical warmth is seen as a means for achieving the goal. This goal activation account generates novel predictions that have not been tested in the embodied cognition literature. Our research finds evidence that supports these predictions, suggesting that complementary effects are motivational in nature. Specifically, we predicted that the value of warmth depends on whether or not people have the goal to reduce coldness. Supporting this, Experiment 1 shows that people who stand in the cold are particularly interested in socially warm activities but not in positive activities that are not socially warm. Experiment 2 shows that socially warm activities are more strongly preferred over control activities when people are primed with the goal of reducing physical coldness than when they are primed with the concept of coldness, suggesting that goal activation is essential for producing complementary embodiment effects.

We also found that when people feel physically cold, activating an alternative goal lowers the attractiveness of socially warm activities (Experiment 3). Lastly, we demonstrate that when people feel socially cold, activating an alternative goal other than reducing social coldness lowers the attractiveness of physically warm products (Experiment 4). Taken together, these findings suggest that complementary embodiment effects follow the rules of goal activation, linking embodied cognition research with the well-established and broader goal literature.

The results from Experiment 3 help rule out an alternative explanation for the findings from Experiment 1. The alternative explanation argues that there might be some unknown difference between participants approached indoors and participants approached outdoors, which leads outdoor participants to prefer socially warm activities over control activities. In Experiment 3, all participants are approached outdoors, yet we reduce the preference for socially warm activities by activating an alternative, fun goal. These results provide indirect evidence that the effect in Experiment 1 is caused by whether participants are motivated to reduce feelings of coldness, not by some unknown difference between participants approached outdoors versus indoors. To be more certain, we ran a new wave of participants following the procedure of Experiment 1 during the spring season when the weather was warmer, with outdoor temperature ranging from 65 °F (18.3 °C) to 71 °F (21.7 °C). The indoor temperature was again fixed at 72 °F (22.2 °C). Unlike the effects found in Experiment 1, a 2 (activity type: warm vs. nonwarm) \times 2 (location: outdoor vs. indoor) mixed-model ANOVA, with activity type as a within-participant variable, revealed no significant interaction between activity type and location, $F(1, 50) = 0.21, p = .65$, $\eta^2 = .00$, suggesting that whether participants completed the experiment indoors or outdoors did not influence their interest in various activities when the indoor and outdoor temperatures were similar.

**Applying the Goal Systems Framework to the Existing Literature**

The present framework is useful for explaining and predicting when and why some embodied results assimilate to the original state but others complement the original state. Intuitively, goals to change a physical or psychological state should only be activated when the state is sufficiently unpleasant. Thus, complementary embodiment effects should be more likely when a physical or psychological state is unpleasant enough to activate the goal of rectifying the state. For example, the finding that recalling an immoral past experience leads to a preference for cleaning products (Zhong & Liljenquist, 2006) suggests that recalling immoral experiences may be unsettling enough to activate a goal of reclaiming moral purity. In contrast, we would not expect complementary effects if the physical or psychological state is not sufficiently uncomfortable to activate a goal to change it. For example, when people touch a rough piece of sandpaper, the concept of...
roughness may be activated, leading to an assimilative effect of perceiving social interactions to be rough, but the goal of changing the state is probably not activated.

By the same logic, we do not necessarily expect an elevated preference for social warmth if the physical experience of coldness is mild or pleasant. Sitting in a comfortably cool room may not cause people to show a preference for socially warm activities compared with sitting in a comfortably warm room because the cool room may not be unpleasant enough to activate the goal to feel warm. This explains why making people answer the questions outside in the cold of winter creates a complementary effect in our research, but holding a cup of coffee or sitting in a cool room leads to an assimilative effect in other research (Ijzerman & Semin, 2009; L. E. Williams & Bargh, 2008). Similarly, although the unpleasant psychological state of loneliness has been shown to prompt a desire for physical warmth (Bargh & Shalev, 2012; Zhong & Leonardelli 2008), we suspect that an abundance of social connection will not activate a preference for physical coldness because having a lot of social connection is not an unpleasant experience.

Because we were interested in examining complementary effects, we made sure that the state was unpleasant enough to activate the goal of reducing coldness. To do this, we examined participants’ desire for warmth after explicitly giving them the goal to reduce coldness (Experiment 2), while they were outside in winter (Experiments 1 and 3), or by highlighting the feelings of being rejected and disliked after recalling a social exclusion experience (Experiment 4). Experiment 2 produced the complementary effect without having participants experience unpleasant coldness, suggesting that the increased desire for social warmth does not require that someone physically experience coldness, but rather that the goal of reducing coldness be activated. This again is consistent with our argument that one mechanism by which bodily experiences can affect judgment and behavior is by activating an associated goal.

The present framework may also be useful for understanding why the finding that lonely people take longer and more frequent hot showers has not been consistently replicated (Donnellan et al., 2014; see also Shalev & Bargh, 2014, for further discussion about differences between the original and replication studies). Our findings suggest that social coldness does not always prompt a desire for physical warmth. Rather, physical warmth is especially desirable when the goal to feel less social coldness is active. Although lonely people may feel socially cold more often than others do, they may not always be focused on their socially cold feelings and their desire for social warmth. Our goal systems framework suggests that lonely people will be especially interested in a hot shower only if they are focused on the goal of feeling less lonely (rather than on an alternative goal) and if other means of getting social connection are not readily available.

### Applying the Goal Systems Framework to Future Research

By demonstrating that embodiment effects follow the goal systems predictions, our work suggests that other common principles of goal activation that are not tested in the current research might apply to complementary embodiment effects as well. For instance, research on goal systems has established that, when trying to attain a goal, the likelihood that a particular means is chosen depends on the uniqueness and effectiveness of the means (Fishbach, Shah, & Kruglanski, 2004; Kruglanski et al., 2002; Shah & Kruglanski, 2003). Reminding people of an alternative means to their goal can reduce the uniqueness of the original means, decreasing their desire for the original means. In addition, when there is more than one means available for achieving the same goal, people will prefer the one with the highest expectancy of attaining the goal. For example, when feeling hungry, food served by a vending machine might seem very desirable. However, if one is reminded that lunch is going to be served in a few minutes, one should be less interested in the vending machine food because lunch has been introduced as an alternative means that is more effective in achieving the goal of reducing hunger. This property of goal systems implies that reminding people of physical means for achieving a physical goal or making the physical means available should make the social means less attractive. Thus, we would expect that people who are experiencing physical coldness would be less interested in activities that provide social warmth if, for example, they have been reminded that they will be inside a heated building momentarily.

In addition, research suggests that goal-relevant objects or experiences are activated during goal pursuit and are inhibited following goal completion ( Förster, Liberman, & Higgins, 2005; Marsh, Hicks, & Bink, 1998). This suggests that socially warm activities may be more accessible in mind when one is outside in the cold but that they may be inhibited as soon as one comes inside. Similarly, physically warm items may be more accessible when one experiences social exclusion, but they may be inhibited the moment one is welcomed by others. In addition, research suggests that goal-related constructs are more accessible after a failure to attain a goal than after a success (Koole, Smeets, van Knippenberg, & Dijksterhuis, 1999; Moskowitz, 2002). Thus, if someone is outside in the cold and a socially warm experience is interrupted, or if the experience is not successful in generating feelings of social connection, the concept of both physical and social warmth may remain activated until the goal of reducing coldness is reached. Further research could test whether these predictions are supported.

Although we have demonstrated that a goal activation account helps explain complementary effects, this does not mean that the goal activation account is not applicable to assimilative effects as well. The assimilative effect that holding a warm cup of coffee leads people to judge a target individual to be socially warmer (L. E. Williams & Bargh, 2008) may occur, as we explained in the introduction, by semantically activating the concept of warmth. Alternatively, it is also possible that holding a warm beverage primes the goal to experience social warmth, which could also lead people to perceive warmth in others. In other words, unpleasant physical warmth may activate a goal of reducing it, whereas mild physical warmth may prime a goal to experience warmth. Consistent with this conjecture, Fay and Maner (2012) found that participants sitting on a heating pad showed a stronger affiliative motivation than those who sat on chairs without a heating pad. Although both accounts can explain the same phenomena in theory, the two accounts can be differentiated using designs similar to those used in the present set of experiments. If participants who hold a warm beverage judge a target individual as socially warmer regardless of whether an alternative goal is activated, then it would suggest that the assimilative effect is due to knowledge activation. If a target is judged to be less socially warm when another goal is active, it would suggest that the assimilative effect is due to goal activation.
We did not examine in the current article whether engaging in socially warm activities can actually reduce the experience of physical coldness or whether drinking a cup of hot coffee can actually make social exclusion less hurtful. Inagaki and Eisenberger (2013) found that social warmth can make people feel physically warmer, which suggests that socially warm activities may effectively reduce physical coldness. Other research also hints at this possibility, suggesting that social warmth can be used as a buffer for physical coldness (Kolb et al., 2012; Zhou et al., 2012). In other words, experiencing physical or social warmth may help protect people from feeling social or physical coldness that they would otherwise feel. These findings suggest that people may be wise to recruit social warmth when they are feeling physically cold and physical warmth when they are feeling socially cold. Future research should continue to test the merits of these strategies.

Complimentary embodiment strategies—especially to the extent they are successful in making people feel less physically cold—are consistent with a temperature homeostasis account, which suggests that people regulate their body temperature to keep it in a relatively stable state. As a basic biological mechanism, homeostasis operates automatically and does not require that a higher order goal is activated. We suggest, however, that our findings are better explained by the goal systems framework because the desire to regulate one’s body temperature with social warmth is stronger when the goal to feel less cold is consciously or unconsciously activated and when an alternative goal is not activated. Moreover, homeostasis is generally restricted to physiological processes like temperature, pH, or glucose. To account for our findings from Experiment 4, one would have to assume that people also regulate their experiences to keep social warmth stable.

Lastly, our research sheds some light on why some emotions become embodied. Kille, Forest, and Wood (2013) contended that one possible reason that cognition is embodied is to ensure that one’s needs are met through goal pursuit. Bodily states send strong and clear signals to the human brain that the psychological state deserves attention, thus creating a stronger motivation to fulfill our psychological needs. For instance, it might be the case that a physical feeling of coldness after being socially rejected highlights the importance of the issue and motivates people to correct it. Had the experience of social rejection not been grounded in the physical body, one may fail to infer that the issue is serious. Similarly, the strong sense that one is physically contaminated after a moral transgression may highlight the seriousness of the transgression and motivate people to seek moral cleanliness. Future research could test whether individual differences in the strength of the association between a physical state and the corresponding psychological concept is correlated with the strength of preference for the psychologically desired state. For example, would people who show a weaker link between physical and moral purity have more relaxed moral standards? Would those with a weaker mental link between physical and social warmth have weaker motivation for social connection and lower quality social relationships? Such tests could potentially answer the question of whether grounding an emotion in the human body provides any tangible benefits to the well-being of human being.

Conclusion

Socially warm activities, such as visiting one’s parents, having a romantic dinner with loved ones, or celebrating a holiday, are especially attractive when one feels physically cold. Similarly, warm drinks are especially desirable when one feels socially cold. We explain this complementary embodiment effect by providing evidence that the interplay between a physical or social state and preferences for physical or social warmth is driven by goal activation. When a physically or socially cold state is unpleasant enough to elicit the goal of becoming warm, this motivation will guide preferences for both physical and social warmth. By providing a motivational framework for complementary effects, we believe we have taken an important step forward in understanding the processes that underlie embodied cognition.

References


Appendix A
Activities Used in Experiments 1–3
1. Getting a great haircut
2*. Visiting your parents
3. Listening to a provoking lecture
4. Successfully keeping your New Year’s resolution
5*. Having dinner with your loved one
6*. Buying a gift for someone you love
7. Successfully building a cabinet by yourself
8*. Looking at a photo album filled with pictures of friends and loved ones
9*. Receiving encouragement from someone when you are facing a life challenge
10. Having your plane arrive one hour early when traveling

Note. Activities marked with * are socially warm activities.

Appendix B
Physical Activities Used in Experiment 2
1. Getting a great haircut
2*. Drinking a hot cup of coffee
3. Listening to a provoking lecture
4. Successfully keeping your New Year’s resolution
5*. Reading by the fire
6*. Taking a hot bath or shower
7. Successfully building a cabinet by yourself
8*. Eating homemade chicken soup
9*. Sun bathing on the beach
10. Having your plane arrive one hour early when traveling

Note. Activities marked with * are physically warm activities.

Appendix C
Goal Manipulation Questions in Experiment 4

Questions used in the warmth goal condition:
1. I felt excluded.
2. I felt rejected.
3. I felt ignored.
4. I felt that others did not care about my feelings.
5. I felt lonely.
6. I felt liked by others.*
7. I felt loved by others.*

Questions used in the alternative goal condition:
1. I felt lack of control over things happening around me.
2. I felt powerless in the event that I just recalled.
3. I felt helpless in the event that I just recalled.
4. I felt that I did not have ability to significantly alter events
5. I felt I was unable to influence the actions of others.
6. I felt I am in control.*
7. I felt powerful.*

Note. Questions marked with * were reverse coded.

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