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When does heat promote hostility? Person by situation interactions shape the psychological effects of haptic sensations

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HIGHLIGHTS

- We examine effects of heat on hostile cognition and behavior.
- Heat promoted hostility, but only in the presence of agonistic social motives.
- Effects were only observed after a rejection and only among people high in FNE.
- Results imply sensory primes interact with aspects of the person and situation.

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ABSTRACT

The current article provides evidence that the psychological consequences of incidental haptic sensations depend on motivations within the perceiver and, consequently, the effects of those sensations are moderated by motivationally relevant aspects of the individual and the immediate social context. Results from two experiments demonstrate that the physical experience of heat promotes hostile social responses, but that the strength of this effect depends on an interaction between factors in the person (level of fear of negative evaluation) and the situation (whether or not someone has just experienced rejection). People primed with heat (compared to neutral temperature) displayed increases in aggressive cognitions (Experiment 1) and aggressive behavior (Experiment 2), but those effects were observed only after rejection (not in a control condition) and only among individuals high in fear of negative evaluation (those who typically respond with agonistic motives following rejection). Findings suggest that motivationally relevant aspects of the person and situation are critical to understanding the priming effects of haptic sensations.

Introduction

Fluid motions promote creative thinking (Slepian & Ambady, 2012). Tactile sensations influence gender and political categorization (Slepian, Rule, & Ambady, 2012; Slepian, Weisbuch, Rule, & Ambady, 2011). Physical weight increases perceptions of importance (Ackerman, Nocera, & Bargh, 2010; Jostmann, Lakens, & Schubert, 2009). A growing literature suggests that low-level sensory experiences can exert profound and surprising effects on higher-order cognition. How people perceive and think about the world around them is shaped by fundamental links between physical and psychological states.

Research from a variety of theoretical perspectives, most notably theories of priming (e.g., Bargh, 2006; Tulving & Schacter, 1990; Williams & Bargh, 2008) and embodied cognition (e.g., Barsalou, 2008; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005), suggests that incidental haptic sensations can affect a variety of higher-order cognitive processes. Thus far, however, such studies have focused primarily on demonstrating the presence of main effects of sensory states on psychological processes. Thus, the extant literature sometimes provides a view in which sensory primes seem to activate higher-order psychological processes in a relatively constant fashion across people and situations.

Nevertheless, there are reasons to think that effects of haptic sensations on psychological processes depend on the perceiver's current motivations. Because motivations vary considerably across individuals and situations, the effects of sensory primes too may vary across people and situations. Thus, an important step toward understanding the motivational properties of sensory priming effects is to delineate their boundary conditions (i.e., moderating factors; see Bargh, 2006; Meier, Schnall, Schwarz, & Bargh, 2012).

We propose that low-level sensory experiences interact with features of the person and the situation to shape how people interface with the social world. Classic perspectives in social psychology emphasize the importance of person by situation interactions (Lewin, 1935). In particular, psychological processes are influenced by an interplay between goals within the perceiver and motivationally relevant

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aspects of the social context (Kenrick, Griskevicius, Neuberg, & Schaller, 2010). We suggest that such interactions also influence how and when haptic sensations shape people's responses to social situations. Although studies have started attending to individual difference moderators of sensory primes (IJzerman, Karremans, Thomsen, & Schubert, 2013; Schnall, Haidt, Clore, & Jordan, 2008), very few to our knowledge have assessed whether effects of haptic primes hinge on a functional interplay between aspects of the person and aspects of the situation.

In the current paper, we attempt to enrich the sensory priming literature by testing the hypothesis that motivationally relevant features of the person and situation jointly determine psychological responses to sensory primes. We predicted that the experience of heat would interact with motivationally relevant aspects of the situation (whether or not one has just experienced rejection) and the person (level of fear of negative evaluation) to affect social cognition and behavior. In testing this hypothesis, we integrate literatures on sensory priming, social exclusion, and social anxiety.

Heat and reactions to social threats

One important sensation that powerfully influences social processes is heat (DeWall & Bushman, 2009; Lakoff, 1987). A sizable literature in social psychology demonstrates that heat can promote hostility (Anderson, 2001; Anderson, Anderson, Dorr, DeNeve, & Flanagan, 2000; DeWall & Bushman, 2009; Wilkowski, Meier, Robinson, Carter, & Feltman, 2009). Being primed with hot temperatures, for example, causes people to display anger and hostile cognitions (Anderson, Deuser, & DeNeve, 1995; DeWall & Bushman, 2009; Wilkowski et al., 2009) and to become more aggressive (Anderson, 2001).

One explanation for the heat-hostility link involves the fact that heat can produce physical discomfort and high levels of negative affect. Indeed, classic studies demonstrate that when people experience negative affect or discomfort as a result of heat, they tend to become more aggressive (Reifman, Larrick, & Fein, 1991). For example, violent crimes tend to increase during hot summer months and this can be attributed, at least in part, to increases in negative affect and physical discomfort (Anderson, 1989).

However, there is also a deeper psychological explanation for the link between heat and hostility. As illustrated by metaphors such as “hot under the collar,” there are conceptual and semantic associations between representations of heat and hostility. Indeed, merely priming the abstract concept of heat can activate hostility-related concepts. For example, compared to cold or neutral temperature word primes, heat word primes lead people to complete more word stems with aggressive words and to interpret ambiguous behaviors as more hostile (DeWall & Bushman, 2009). Moreover, heat-related imagery (compared to neutral temperatures) biases the categorization of ambiguous facial expressions as reflecting anger, an emotion which facilitates hostile social behavior (Wilkowski et al., 2009). Thus, heat can promote hostility, even in the absence of physical discomfort.

It should be noted that temperature-related words and experiences can be applied to a range of social experiences. Heat, warmth, or coldness may be linked with hostility and aggression (e.g., DeWall & Bushman, 2009), propensities for clear, logical thinking versus impulsivity (e.g., Metcalfe & Mischel, 1999), and friendliness versus social isolation (e.g., Fiske, Cuddy, Glick, & Xu, 2002; IJzerman & Semin, 2009). Thus, there are several domains of social phenomena that may be related to or activated by tactile experiences involving temperature. Our framework implies that the specific effects of temperature should depend on the perceiver's active social motives and, in the current research, we are interested specifically in the link between agonistic social motives, heat, and hostility. We refer to ‘heat’ rather than ‘warmth’ to remain consistent with common metaphors that are used to describe hostility, not to describe a particular range of temperature.

Heat, hostility, and rejection

The psychological association between heat and hostility may become particularly important in negative contexts involving agonistic interpersonal motivations. The presence of agonistic motives might potentiate the link between heat and hostility because hostility reflects a potentially functional response to situations involving such motives. That is, the heat-hostility link may come online especially in situations that are perceived as warranting hostile behavior. Rejection, for example, thwarts people's need for social belonging (Baumeister & Leary, 1995) and constitutes a painful and highly motivating interpersonal experience (Eisenberger, Lieberman, & Williams, 2003; Leary, 1990; Williams, 2001). The agonistic motives that result from rejection may potentiate the activational link between heat and hostility. Models of parallel constraint satisfaction (e.g., Schröder & Thagard, 2013) imply that, although heat is semantically related to many different concepts (Lakoff, 1987), those relationships can become activated or inhibited based on the present context and state of the perceiver.

Hostile and highly agonistic social motives are commonly observed in response to rejection (DeWall, Twenge, Gitter, & Baumeister, 2009; Reijntjes et al., 2011; Twenge, Baumeister, DeWall, Ciarocco, & Bartels, 2007; Twenge, Baumeister, Tice, & Stucke, 2001) and thus rejection may increase the likelihood that heat would result in hostile social responses. Under neutral conditions, in contrast, the absence of any salient motivating context might result in weaker links between heat and hostility. As noted earlier, heat is associated with a variety of mental structures (e.g., sunbathing, cooking, impulsivity) and in the form of “warmth” is even associated with benevolent forms of cognition (Williams & Bargh, 2008). In the absence of clear social motives, such as those following rejection, heat might activate a variety of mental structures and thus none, in particular, should move to the fore. In a neutral social context, therefore, one might expect weaker effects of heat on hostility than would be expected after rejection.

The role of fear of negative evaluation

The motives people experience in response to rejection depend on individual differences. Evidence suggests that those motives depend, in particular, on people's levels of social anxiety and its core component — fear of negative evaluation (Mallott, Maner, DeWall, & Schmidt, 2009; Maner, DeWall, Baumeister, & Schaller, 2007; Maner, Miller, Schmidt, & Eckel, 2010). Fear of negative evaluation (FNE; Leary, 1983) reflects chronic concerns about eliciting negative reactions from others. People high in FNE tend to interpret their social environments as being threatening and filled with possible rejection (Heimberg, Lebowitz, Hope, & Schneier, 1995) and they tend to respond to rejection with agonistic interpersonal motives (Maddux, Norton, & Leary, 1988). Those motives often take the form of social passivity and withdrawal (Mallott et al., 2009; Maner et al., 2010), because such reactions reduce the likelihood of immediate rejection (Allen & Badcock, 2003). Thus, after rejection, people high in FNE often withdraw and behave passively to avoid the threat of negative social evaluation. Indeed, just as flight often is the preferred initial response to threat among many species (Blanchard, Flannelly, & Blanchard, 1986; Stankowich & Blumstein, 2005), flight (in the form of passivity and withdrawal) is also the default respond to rejection among people high in FNE. By avoiding others, people high in FNE reduce the possibility that they will be harmed through further rejection.

Sometimes the agonistic motives of high FNE individuals can manifest in anger and hostility (Erwin, Heimberg, Schneier, & Liebowitz, 2003), however, and we hypothesized that this tendency would become exacerbated by the experience of heat. Although flight may be the preferred initial threat response, humans and other animals often instead opt to fight, particularly when aggression is perceived as a useful response to the threat (Blanchard et al., 1986). The activation of hostile mental structures resulting from exposure to heat may shift the responses of high FNE people from flight to fight. That is, hot temperatures may lessen high FNE people's characteristic passivity as aggressive action tendencies become activated. Thus, we predicted that a heat prime would cause rejected people high in FNE to display signs of aggressive cognition and to behave aggressively. This prediction is in line with our overarching hypothesis that the effect of heat on hostility would be potentiated by the presence of agonistic social motives.

Instead of responding agonistically to rejection, people low in FNE generally respond by displaying socially optimistic and affiliative motives (Mallott et al., 2009; Maner et al., 2007). Our conceptual framework implies that heat evokes hostility mainly when one is experiencing agonistic social motivations. Thus, heat would not be expected to elicit hostility for individuals low in FNE, for whom rejection evokes a desire for social connection rather than resentment and a desire to withdraw or lash out. In sum, experiences of rejection are highly motivating, and the specific social motivations that result from rejection depend in part on people's levels of FNE. Whereas people high in FNE tend to display agonistic social motivations following rejection, people low in FNE do not. As a result, we expected to observe especially strong hostile responses to heat among high FNE individuals after rejection.

Current work

We expected that the effect of heat on hostile cognition and behavior would depend on an interaction between the situation (whether someone has just been rejected) and the person (his or her level of fear of negative evaluation). In two experiments, we tested hypothesized interactions among rejection, fear of negative evaluation, and the experience of heat. In each experiment, participants underwent a commonly used rejection manipulation in which they were led to believe that they had been rejected by another participant (or a control condition involving no rejection) and then were exposed to a heat prime (or a neutral temperature control). We collected measures designed to test whether, following rejection, heat would promote aggressive cognitions (Experiment 1) and aggressive behavior (Experiment 2). We expected high FNE participants primed with heat (as compared to neutral temperatures) to display high levels of aggressive cognition and behavior after being rejected; these responses to heat were not expected in a neutral (non-rejection) social context or for low FNE participants.

Our theoretical framework implies that effects of heat are caused by the psychological association between heat and hostility, rather than merely by physical discomfort or negative affect produced by heat. Therefore, we also included measures of physical comfort (Experiment 1) and affect (Experiment 2) to control for the possibility that participants' hostility was driven merely by changes in affect or physical discomfort.

Experiment 1

Experiment 1 used a personal rejection manipulation that has been used widely in past research (DeWall et al., 2009; Maner et al., 2007). Participants were told that a partner left either because s/he did not want to work with them (*rejection condition*), or because s/he forgot about something s/he needed to do (*irrelevant departure condition*). Participants then sat on either an electric head pad set to low heat (*heat condition*) or no heat pad (*neutral temperature control*) and we measured the activation of aggressive cognitions.

Method

Participants

Sixty-three participants (age 18–22; 37 female, 26 male) participated in exchange for course credit. Of these, 81% were White, 6% were Asian, 5% were Black, 5% were multiracial, and 3% did not report their race.

Procedure

Participants were told that the experiment would involve an interaction with a partner. Participants first recorded a brief video interview to exchange with their partner. Participants responded to a series of questions regarding their social and academic experiences (e.g., "Tell me about some of your positive academic experiences" and "Have you had any negative social experiences?") while a video camera recorded the responses. After the interview, the experimenter left the room, ostensibly to exchange videotapes with another experimenter. After several minutes the experimenter returned with a new video, ostensibly recorded by the participant's partner. The 5-minute video portrayed a friendly, same-sex confederate describing his or her social and academic experiences. The experimenter rewound the partner's video in front of the participant in order to increase the face-validity of the cover story, and then left the room while the participant viewed the videotape.

After five minutes, the experimenter returned to deliver the exclusion manipulation. In the personal rejection condition, participants were told that after watching their video, the partner did not want to meet the participant and refused the interaction. In the irrelevant departure condition, participants were told their partner had to leave because they had forgotten to do something. In both conditions, the experimenter explained that the participant would continue the study without a partner.

Next, participants completed a word fragment completion task to assess the activation of aggressive cognitions (Anderson, Carnagey, & Eubanks, 2003). For this task, participants were randomly assigned to sit on either a Sunbeam 765-500 electric heating pad placed on the "low" setting (approximately 47 °C) (*heat condition*) or no heat pad (*neutral temperature control*). In the heat conditions, the experimenter placed the heating pad on the chair and turned it on prior to the experimental session to ensure that the heating pad was fully heated before the participant sat on it. Participants were shown 98 word fragments and asked to fill in the missing letters to form actual words. Fifty of the fragments could be completed with aggressive words or neutral words (e.g., INS_ _ _ as *INSULT* or *INSERT*). The remaining fragments could only be completed with neutral words. The experimenter instructed participants to respond as quickly as possible, completing each fragment with the first word that came to mind. The number of fragments completed with aggressive words was summed as an index of aggressive cognition.

At the end of the session, participants completed the Fear of Negative Evaluation scale (FNE; Leary, 1983; e.g., "I am afraid that other people will find fault with me"). Participants responded on 5-point scales from *not at all characteristic of me* to *extremely characteristic of me* ($\alpha = .88$). Responses were unaffected by the rejection or heat manipulations ($Fs < 1$), or their interaction, $F(1,59) = 1.77$, $p = .19$.

While still on the heat pad, participants rated their level of physical comfort on a 9-point scale from *very uncomfortable* to *very comfortable*. This allowed us to assess whether any effect of the heat manipulation on aggressive cognitions might have been due to discomfort. Before leaving, participants were debriefed and assured that they were not actually rejected by another participant.

Results

We regressed the number of aggressive word completions ($M = 13.90$, $SD = 3.70$) onto dummy variables representing the heat manipulation and rejection manipulation, centered FNE scores ($M = 2.83$, $SD = .74$), and all two- and three-way interactions. We included participants' comfort levels as a covariate to control for the possibility that any increase in aggressive cognitions might have been caused by physical discomfort. There were no main

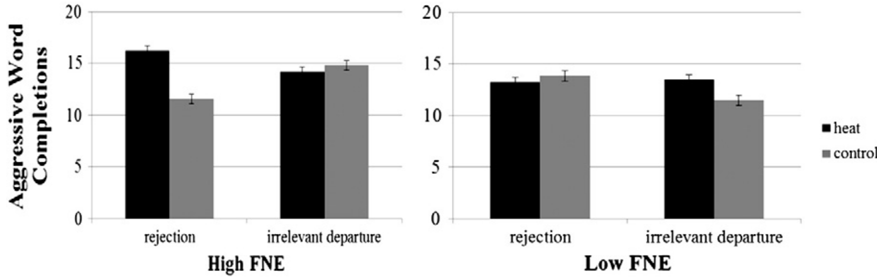

Fig. 1. Participants high in FNE who had been rejected responded to heat (relative to control) with increased activation of aggressive cognitions. There was no effect of heat among participants low in FNE or those who had not been rejected.

effects or two-way interactions (all *ps* > .15). However, the predicted three-way interaction between heat condition, rejection condition, and FNE was marginally significant, $\beta = .26$, $t(54) = 1.99$, $p = .05$, partial *r* (*pr*) = .26. See Fig. 1. We explored possible moderating effects of gender, but none were found and this variable is not discussed further.

To interpret the interaction, we tested for the presence of heat X rejection interactions at high and low levels of FNE (Mean +/− 1 *SD*). At high levels of FNE, we observed a heat X rejection interaction, $\beta = .36$, $t(54) = 1.92$, $p = .06$, $pr = .25$. This interaction was not present at low levels of FNE, $\beta = -.18$, $t(54) = -.94$, $p = .35$, $pr = -.13$. To interpret the interaction among high FNE participants, we tested the simple effects of the heat manipulation in the rejection condition and irrelevant departure control condition. People high in FNE in the rejection condition responded to the heat prime (relative to neutral temperature control) with more aggressive word completions, $\beta = .62$, $t(54) = 2.15$, $p < .05$, $pr = .28$. High FNE participants in the irrelevant departure condition did not show any effects of heat ($\beta = -.10$, $t(54) = -.42$, $p = .68$, $pr = -.06$).

Overall levels of physical comfort were high ($M = 6.08$, $SD = 1.76$) and there was no effect of comfort on aggressive cognitions, $\beta = .02$, $t(54) = .13$, $p = .90$, $pr = .02$. Moreover, an additional regression analysis revealed no significant effects of either manipulation, FNE, or their interactions on participants' comfort ratings (all *ps* > .15). Thus, the effect of heat on the activation of aggressive cognitions was not related to the measure of physical discomfort. Removing physical comfort from the model did not alter the results; if anything, the effects reported above became stronger: The three-way interaction between heat, rejection, and FNE ($\beta = .26$, $t(55) = 2.02$, $p < .05$, $pr = .26$), the 2-way interaction between heat and rejection among high FNE participants ($\beta = .37$, $t(55) = 1.97$, $p = .05$, $pr = .26$), and the simple effect of heat among high FNE participants in the rejection condition ($\beta = .62$, $t(55) = 2.19$, $p < .05$, $pr = .28$) were all observed without the covariate.

Discussion

The effect of heat on aggressive cognition depended on an interaction between variables in the person and the situation. Heat increased aggressive cognitions only for participants who were high in fear of negative evaluation and only after they had been rejected. Unlike those low in FNE, individuals high in FNE tend to view others as social threats and they tend to experience socially agonistic motivations when feeling rejected. Thus, findings are consistent with our hypothesis that the presence of agonistic motives would potentiate the effects of heat on hostile cognition.

People high in FNE who had been rejected but did not experience heat displayed relatively low levels of aggressive cognition. This pattern is consistent with findings suggesting that people high in FNE often display passivity and social withdrawal in response to social threats (Maner et al., 2010). In contrast, aggressive word completions were relatively high among high FNE participants in the irrelevant departure (control) condition. Even the control condition involved an impending interaction with a stranger — typically a negative and anxiety provoking event for those high in FNE. Upon preparing for such an interaction, people high in FNE sometimes experience some level of anger, reflecting their initial preparedness for dealing with social threat (Hawkins & Cougle, 2011; Kashdan & Collins, 2010). The rejection manipulation was expected to (and did) substantially amplify high FNE participants' level of hostile thinking in response to heat. Nevertheless, it is not surprising that we saw some evidence for hostile thinking even in the control condition.

Finally, it should be noted that effects were statistically unrelated to the measure of physical discomfort. The heat manipulation did not affect participants' comfort ratings, and those ratings did not predict aggressive cognition. Thus, findings are consistent with the possibility that effects were due to the psychological association between heat and hostility, rather than being a byproduct of physical discomfort.

Experiment 2

Experiment 2 extended the investigation by testing whether a heat prime would lead to aggressive behavior following rejection. After undergoing a rejection manipulation, participants played a competitive reaction time game (a noise-blast task), ostensibly with a new partner. The noise blast task provided a measure of aggression and was performed while participants were primed with heat (or not primed, in a control condition). Based on the results of Experiment 1, we predicted that the heat prime would cause increased aggression, but only among participants high in FNE (not low in FNE) and only after a rejection (not in a neutral context). We also included a measure of affect to ensure that any experimental effects were not due simply to changes in participants' emotional state; this measure supplemented the physical discomfort measure used in Experiment 1.

Method

Participants

One-hundred twenty-nine undergraduates (Ages 18–34; 106 female, 23 male) participated in exchange for course credit. Twelve participants (9%) were excluded because they had previously participated in a study involving the noise-blast task and knew there was not a real opponent; 10 others (8%) were excluded because during a post-experimental probe they expressed suspicion that their partner was not a real participant. Of the remaining 107 participants, 72% were White, 13% were Black, 3% were Asian, 5% were multiracial, and 8% did not report their race. Three additional participants were unable to complete the noise-blast task due to computer malfunctions and were not included.

Procedure

The first part of the procedure was identical to Experiment 1. Participants learned that their ostensible partner left because they did not want to interact with the participant (rejection condition) or because they had forgotten to do something (control condition).

Participants in both conditions were then told that a new participant had just arrived to the lab and that they would be partnered with this new participant for the remainder of the experiment. They were told that, due to time constraints, they would not meet their new partner face-to-face. At this point, participants were randomly assigned to sit on a heat pad set to low heat (*heat condition*) or an inactive head pad (*neutral temperature control*). Participants then completed the Positive Affect Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988) to assess positive ($\alpha = .87$) and negative affect ($\alpha = .84$), ostensibly while the experimenter prepared the new partner for the next task.

When the experimenter returned, participants were told that they would play a competitive reaction-time game with their new partner. This noise blast task has been widely used as a behavioral measure of aggression (Bushman & Baumeister, 1998). Participants were instructed to race their partner to click a button as fast as possible after a colored square signaled the start of each trial. Whoever reacted more slowly would hear a blast of white noise determined by the other competitor. The game consisted of 25 trials. Before each trial, participants specified the volume (ranging from 0 to 10) and the duration (ranging from 0 to 4 s) of the noise blast their competitor would hear upon losing. The computer recorded these settings for each trial. Participants' average volume and duration settings were standardized and the two values were summed as an indicator of aggression.

After completing the reaction time game, participants completed the Fear of Negative Evaluation scale (FNE; Leary, 1983; $\alpha = .89$). FNE scores were not significantly affected by the rejection or heat manipulations ($Fs < 1$), although there was a trend toward an interaction, $F(1,103) = 2.90$, $p = .09$. However, heat did not increase reported levels of FNE in the rejection condition, $F(1,103) = 1.60$, $p = .21$, or the irrelevant departure condition, $F(1,103) = 1.33$, $p = .25$. Finally, participants were thoroughly debriefed.

Results

We regressed participants' standardized aggression scores ($M = 0$, $SD = 1.91$) on dummy variables for heat condition and rejection condition, centered FNE scores ($M = 2.88$, $SD = .77$), and all two- and three-way interactions. We also included PANAS scores as measures of positive and negative affect to ensure that any effects of heat were not driven merely by changes in affect.

We observed a significant heat X rejection interaction, $\beta = .21$, $t(97) = 2.20$, $p < .05$, $pr = .22$. However, this was qualified by the predicted, marginally significant three-way interaction with FNE, $\beta = .18$, $t(97) = 1.93$, $p = .06$, $pr = .19$, which replicated the pattern from Experiment 1. See Fig. 2. We tested for the presence of heat X rejection interactions at high and low levels of FNE (Mean +/− 1 *SD*). As in Experiment 1, at high levels of FNE, the heat X rejection interaction was significant, $\beta = .39$, $t(97) = 2.87$, $p < .01$, $pr = .28$. This interaction was not present for people low in FNE, $\beta = .02$, $t(97) = .13$, $p = .89$, $pr = .01$.

To interpret the interaction in high FNE participants, we examined the simple effects of heat in each rejection condition. For people high in FNE, heat increased aggression in the rejection condition, $\beta = .42$, $t(97) = 2.45$, $p < .05$, $pr = .24$. This effect was not significant (and in the opposite direction) for people who were not rejected, $\beta = -.37$, $t(97) = -1.70$, $p = .09$, $pr = -.17$.

Participants low in FNE appeared to display less aggression after rejection than after the irrelevant departure (in both temperature conditions). Although such a trend would be consistent with the prosocial motives often displayed by low FNE people following rejection (Maner et al., 2007), this effect was not statistically significant ($\beta = -.18$, $t(97) = -1.39$, $p = .17$, $pr = -.14$) and should therefore be interpreted cautiously.

There were no effects of positive affect ($\beta = .14$, $t(97) = 1.47$, $p = .14$, $pr = .15$) or negative affect ($\beta = -.16$, $t(97) = -1.57$, $p = .12$, $pr = -.16$) on aggression. Moreover, an additional analysis revealed no main or interactive effects of either the heat or rejection manipulation on measures of participants' affect ($ps > .17$). Thus, the effect of heat on aggressive behavior did not appear to be driven by changes in positive or negative affect. Removing these covariates from the model did not substantially change the results. The 3-way interaction between heat, rejection, and FNE was unchanged ($\beta = .18$, $t(99) = 1.92$, $p = .06$, $pr = .19$); the heat X rejection interaction at high levels of FNE ($\beta = .40$, $t(99) = 2.90$, $p < .01$, $pr = .28$) and the simple effect of heat in the rejection condition at high levels of FNE ($\beta = .47$, $t(99) = 2.74$, $p = .01$, $pr = .27$) remained significant.

Discussion

As in Experiment 1, the effect of heat depended on an interaction between factors within the person and the situation. Heat increased aggressive behavior, but only among participants high in FNE, and only after rejection. Participants low in FNE and those who had not been rejected did not become more aggressive after a heat prime. Notably, in both Experiments 1 and 2, high FNE participants who were rejected but who were not primed with heat showed relatively low levels of aggression and hostile cognition. These responses are consistent with the passivity and avoidance typically shown by high FNE individuals after rejection.

Effects in this study were unrelated to measures of positive and negative affect, suggesting that effects were not caused by emotional responses to the rejection manipulation or the heat manipulation. Together, the results from Experiments 1 and 2 suggest that people's underlying social motivations play a role in determining when heat promotes hostile social responses.

General discussion

A growing literature suggests that low-level physical sensations can exert profound effects on social cognition. The current work provides evidence that effects of sensory experiences depend on an interaction

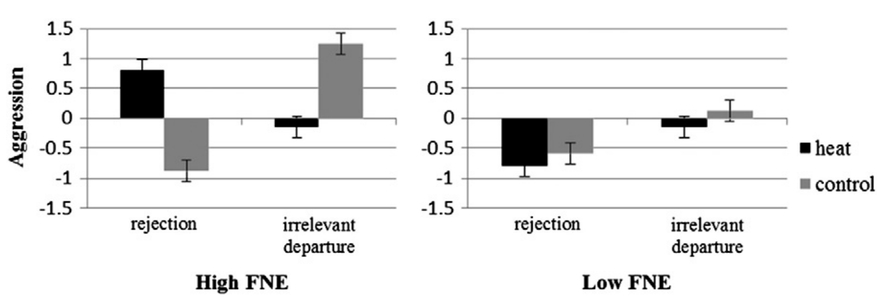

Fig. 2. Participants high in FNE who had been rejected responded to heat (compared with control) with heightened aggression. There was no effect of heat among participants low in FNE or those who had not been rejected.

between motivationally relevant aspects of the person and the immediate social context.

Our main hypothesis was that the presence of agonistic social motivations would potentiate the effects of heat on hostility. Findings from both studies confirmed that heat led to hostile cognition (Experiment 1) and aggression (Experiment 2), but only after rejection and only among individuals high in FNE — those who tend to experience agonistic motives following rejection. Under routine circumstances, those agonistic motives often take the form of passivity and avoidance. Indeed, when not primed with heat, high FNE participants did display relatively low levels of hostility and aggression after rejection. This pattern is consistent with the characteristic social withdrawal often displayed by high FNE people in responses to social threats. When primed with heat, however, the responses of high FNE individuals became substantially more hostile. This pattern resembles the transition from flight to fight that often occurs in response to threat (Blanchard et al., 1986).

More broadly, these results are consistent with the idea that the effects of low-level sensory experiences depend on the motivational state of the perceiver. Incidental haptic sensations may not affect social processes in the same way across people and situations. Rather, they may interact with motivationally relevant individual differences and aspects of the social context. For example, heat did not promote hostility among individuals low in FNE. This makes sense in light of the fact that those individuals tend to display affiliative motives rather than agonistic motives after rejection (Maner et al., 2007). Among those individuals, heat could interact with affiliative motives to influence prosocial responses. Although the current studies were not designed to assess people's propensity for affiliation, Bargh and Shalev (2012) suggested that, among those experiencing affiliative social motives after rejection, warm temperature sensations might help fulfill people's desire for social bonding. Overall, these findings support the notion that heat can promote hostility, but mainly when such responses are consistent with an individual's current agonistic motivations

Although the interplay between social contexts and individual differences is a central and classic tenet of social psychology, few studies in the sensory priming literature have demonstrated that person by situation interactions moderate the psychological effects of sensory states. Sensory states are invariably experienced within some broader social context and by individuals experiencing particular motivations (Smith & Semin, 2004). The current paper provides a valuable springboard for investigating the manner in which situational factors and individual differences shape responses to a range of bodily sensations.

The current data may contribute to current discussions regarding the replicability of priming effects in social psychology (see Kahneman, 2012). Although priming research has seen a long and successful history in social psychology, recently some have questioned the reliability of these findings (e.g., Lebel & Campbell, 2013). By highlighting the importance of moderating variables, the current research suggests a possible reconciliation. Sensory primes may elicit psychological responses only in some people and some situations. Many previous priming studies have fallen short of attending to moderating variables and thus the effect of those variables could have been obscured. Integrating a greater focus on boundary conditions into theories of sensory priming has potential for advancing the field.

Limitations and future directions

Limitations of the current work provide valuable opportunities for future research. In the experiments we reported here, we did not examine all possible cognitive and behavioral responses to heat. In addition to psychological links between heat and hostility, for example, there is evidence for links between warm temperatures and affiliation (Fay & Maner, 2012; IJzerman & Semin, 2009; IJzerman et al., 2013; Williams & Bargh, 2008). For example, warm temperatures can lead people to see others as friendlier — as "warmer" or more interpersonally close (Williams & Bargh, 2008). The current studies were not designed to assess links between heat and interpersonal closeness. Nevertheless, consistent with the overall conceptual framework of the current paper, some previous work suggests that effects of warmth on affiliation depend on the social motives of the perceiver (Fay & Maner, 2012; IJzerman et al., 2013). Indeed, the sensory prime used here (sitting on a heating pad) has been shown to evoke both hostile responses (in the current research) and affiliative responses (as in Fay & Maner, 2012), depending on the motives of the perceiver. Thus, the type of responses observed after a temperature prime may be more a function of the perceiver's social motives than simply the objective temperature.

A second limitation pertains to our reliance on a relatively artificial laboratory environment. Our studies were designed to provide rigorous and highly controlled tests of our hypotheses. However, heat and other bodily sensations are usually experienced in complex environments that can activate a variety of social motives. This complexity is likely to be reflected in the operation of psychological responses to haptic sensations. Indeed, the effects we report may be sensitive to other variables that we held constant in these studies. Moreover, some of the interactions we observed were only marginally significant and the effect sizes were generally in the small-to-medium range. With these caveats in mind, we cannot speak to how straightforwardly these effects would replicate in less controlled environments. The literature would benefit from future experiments that examine the robustness of the effects reported here (and other sensory priming effects) in more complex and naturalistic settings.

An additional limitation is that we assessed levels of FNE near the end of the experimental procedure, after the manipulations, in order to reduce suspicion about the hypotheses. Although we saw only one marginally significant interactive effect of the manipulations on the FNE measure (in Experiment 2), it is possible that the measure could have reflected reactivity to the experimental procedures in addition to trait levels of FNE.

Although the current studies examined moderation by one type of social context (rejection) and one individual difference variable (level of FNE), these factors are by no means the only ones likely to influence responses to temperature primes. Low-level sensations such as heat are experienced in a range of social contexts and are interpreted through the lenses of a variety of social goals that were left unexamined here. The heat-aggression link may well be moderated by the social motives evoked by other recent experiences and individual differences. More broadly, other types of physical sensations are likely to have their own sets of contexts and individual differences that moderate the manner in which they influence higher-order cognitive processes. Future research would benefit from delineating other important boundary conditions for sensory priming effects. The current work provides a valuable springboard for such investigations.

Conclusion

The current findings demonstrate that low-level sensory primes interact with factors in the person and the situation to shape social cognition and behavior. Sensations of heat evoked hostility, but only in a rejection context and only for people high in FNE — those who tend to display agonistic social motives in response to rejection. These findings illustrate the value of incorporating a classic interactionist perspective from social psychology into the study of sensory priming. Links between bodily sensations and social variables should be understood as a complex interplay between motivationally relevant features of the person, situation, and low-level sensory experiences.

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