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BRIEF REPORT

Heartwarming Memories: Nostalgia Maintains Physiological Comfort

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Nostalgia, a sentimental longing or wistful affection for the past, is a predominantly positive and social emotion. Recent evidence suggests that nostalgia maintains psychological comfort. Here, we propose, and document in five methodologically diverse studies, a broader homeostatic function for nostalgia that also encompasses the maintenance of physiological comfort. We show that nostalgia—an emotion with a strong connotation of warmth—is triggered by coldness. Participants reported stronger nostalgia on colder (vs. warmer) days and in a cold (vs. neutral or warm) room. Nostalgia, in turn, modulates the interoceptive feeling of temperature. Higher levels of music-evoked nostalgia predicted increased physical warmth, and participants who recalled a nostalgic (vs. ordinary autobiographical) event perceived ambient temperature as higher. Finally, and consistent with the close central nervous system integration of temperature and pain sensations, participants who recalled a nostalgic (vs. ordinary autobiographical) event evinced greater tolerance to noxious cold.

Keywords: nostalgia, emotion, homeostasis, temperature, pain

Nostalgia is experienced frequently (1–3 times a week) and virtually by everyone (Sedikides, Wildschut, Arndt, & Routledge, 2008; Wildschut, Sedikides, Arndt, & Routledge, 2006), but, until recently, a coherent and consensual definition of nostalgia was lacking. Adopting a prototype approach to address this omission, Hepper, Ritchie, Sedikides, and Wildschut (in press) found that laypersons conceptualize nostalgia as a predominantly positive, social, and past-oriented emotion. In nostalgic reverie, one remembers an event from one's past—typically a fond, personally meaningful memory such as one's childhood or a close relationship. One often views the memory through rose-tinted glasses, misses that time or person, and may even long to return to the past. As a result, one typically feels sentimental, most often happy but with a tinge of loss and longing. These lay conceptions of nostalgia correspond with formal dictionary definitions; The *New Oxford Dictionary of English* (1998) defines nostalgia as "a sentimental longing or wistful affection for the past" (p. 1266).

Hepper et al. (in press) further found that nostalgia can be induced in both younger and older individuals by instructing them to recall an event from their past that is characterized by highly prototypical features of nostalgia (e.g., "sentimental," "love," "longing," "rose-tinted memories," "childhood," "family"). This prototype-based nostalgia induction was equally effective as an established induction which instructs participants to recall "a nostalgic event" from their past (Routledge, Arndt, Sedikides, & Wildschut, 2008; Turner, Wildschut, & Sedikides, 2012; Wildschut et al., 2006; Zhou, Sedikides, Wildschut, & Gao, 2008; Zhou, Wildschut, Sedikides, Shi, & Feng, 2012). Thus, the manner in which "nostalgia" has been operationalized in prior investigations (and in the present research) dovetails with lay conceptions of nostalgia across the age range and with formal dictionary definitions of the term.[1]

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[1] The term "nostalgia" is a compound of the Greek words *nostos* (return) and *algos* (pain, relentless longing). It was coined by the 17th-century Swiss physician Johanes Hofer to describe the adverse symptoms of Swiss mercenaries serving European monarchs. For most of its intellectual history, nostalgia has been considered a negative and maladaptive emotion (McCann, 1941), but current theoretical and empirical treatises of nostalgia have explored its predominantly positive and social nature, as well as its adaptive psychological functions (Sedikides et al., 2008; Sedikides, Wildschut, Routledge, Arndt, & Zhou, 2009).

There is growing evidence that nostalgia counteracts aversive psychological states and maintains psychological equanimity. For example, when triggered through interpersonal isolation or meaning threat, nostalgia counteracts these aversive states, in part, by strengthening a sense of interpersonal affiliation (Routledge et al., 2011; Wildschut et al., 2006; Wildschut, Sedikides, Routledge, Arndt, & Cordaro, 2010; Zhou, Sedikides, et al., 2008). Although it may seem counterintuitive that aversive states should trigger nostalgia, psychology has witnessed burgeoning interest in positive emotions precisely because they facilitate "psychological homeostasis" (DeWall & Baumeister, 2007; Manstead, Frijda, & Fischer, 2004). We advance a still broader homeostatic role for nostalgia that encompasses the maintenance of both psychological and physiological comfort. This hypothesis was guided by accumulating evidence for the role of the anterior insular cortex (AIC) both in the representation of interoceptive conditions (temperature, pain, hunger) that generate the sense of the physiological condition of the body and in emotional awareness (Craig, 2009; Damasio et al., 2000). This evidence identifies a neuroanatomical substrate for the interaction of interoceptive conditions with emotional states and is consistent with the view that emotions are part of a hierarchical system maintaining homeostasis (Craig, 2009; Damasio, 1993; Damasio et al., 2000).

According to this view, emotions serve as homeostatic correctives via two mechanisms. First, emotions can directly influence the physiological condition of the body. This "body loop" mechanism (Damasio, 1993) is accorded a pivotal role in Levenson's "undoing hypothesis": the evolutionary significance of positive emotions resides in their capacity to undo patterns of physiological arousal resulting from negative emotions and to facilitate a return to homeostasis (Levenson, 1999). Second, emotions can bypass the body and afford homeostatic comfort by simulating a felicitous body state as if it were occurring. Evidence for this "as-if body loop" mechanism (Damasio, 1993) originates from research showing that individuals with right-hemisphere damage to the insula and somatosensory cortex perform poorly on emotion recognition tasks, presumably because their capacity to simulate in these damaged areas others' observed body state is impaired (Adolphs, Damasio, Tranel, Cooper, & Damasio, 2000). The same structures may provide the neural substrate for simulating one's own body state, particularly when, as suggested by Damasio and Damasio (2006), this is a state that has already occurred in the organism. Nostalgia, then, could be eminently suited to engage the "as-if body loop" mechanism, given that it involves a recalled image of the self in a felicitous state.

Although the homeostatic function of nostalgia may encompass multiple interoceptive conditions (see Study 5), we initially focused on the feeling of temperature, because nostalgia has a strong connotation of warmth. It has been labeled a "warm feeling about the past" (Kaplan, 1987, p. 465) and a "warm glow from the past" (Davis, 1977, p. 419). Linguistic analyses corroborate this label: participants associate readily the words "warm" and "nostalgia" (Davis, 1979), judge nostalgic narratives to be "warm-hearted," "affectionate," and "loving" (Holak & Havlena, 1998), and consider "warmth" a prototypical feature of nostalgia (Hepper et al., in press). The nostalgia−warmth association is consistent with the notion that people use metaphors based on concrete physical experiences (warmth) to conceptualize more abstract psychological processes (nostalgia) (Lakoff & Johnson, 1980; Niedenthal, Barsalou, Winkielman, Krauth-Gruber, & Ric, 2005). An explanation for the nostalgia−warmth association is that (a) nostalgia fosters feelings of interpersonal affiliation (Zhou, Sedikides, et al., 2008), and (b) a strong mental association exists between feelings of interpersonal affiliation and warmth that might develop early in life due to repeated juxtaposition of affiliation and physical warmth in interactions with nurturing caregivers (IJzerman & Semin, 2009; Williams & Bargh, 2008). We have a further reason for focusing on the feeling of temperature. Considering the close integration of temperature and pain sensations in the central nervous system (CNS), which reflects their shared evolutionary significance for maintaining body integrity (Craig, 2003), it is surprising how little is known about the role of positive emotions in regulating the feeling of temperature relative to their role in pain regulation (Roy, Peretz, & Rainville, 2003; Zhou, Feng, He, & Gao, 2008; Zhou & Gao, 2008; Zhou, Vohs, & Baumeister, 2009). We aimed to redress this imbalance.

To summarize, we propose that nostalgia is integral to a hierarchically organized system of homeostatic correctives that serves to restore and maintain thermoregulatory comfort. Thus, the thermoregulatory discomfort one feels on a chilly day or in a cold room reflects homeostatic drive and mobilizes homeostatic correctives to restore comfort (Craig, 2003). We conducted five studies to test whether nostalgia, an emotion with a strong warmth connotation, can function in such a restorative capacity.

Study 1

Study 1 examined naturalistically whether nostalgia is triggered by physical coldness. We hypothesized that participants would experience more nostalgia on colder (vs. warmer) days.

Method

Nineteen Sun Yat-Sen University undergraduates (13 women) took part in exchange for 30 Yuan in RMB. We assessed participants' daily level of nostalgia on 30 consecutive days (February 18−March 19, 2008). Participants rated their daily level of nostalgia (0 = *not at all nostalgic*, 10 = *extremely nostalgic*) and sent the experimenter this information each day at approximately 10.00 p.m. via cell phone. They were reminded via a text message at 9:45 p.m. and, if necessary, at 10:05 p.m. Participants were not provided with a definition of nostalgia in this study, but, as already mentioned, lay conceptions of nostalgia dovetail with formal dictionary definitions of the term (Hepper et al., in press). We retrieved temperature data from a local weather station. Average daily temperature was reported as the average of maximum and minimum daily temperature (in °C; $M = 14.32$, *range* = 4–26, $SD = 6.43$).

Results and Discussion

We tested the association between average daily temperature and nostalgia using hierarchical linear modeling, with days

(level 1) nested within individuals (level 2). Results revealed a negative association between average daily temperature and daily nostalgia, $B = -0.03$, $SE = 0.02$, $t(550) = -2.17$, $p = .031$ (see Figure 1). Participants felt more nostalgic on colder days.[2]

Study 1 was correlational and thus carries some important limitations. We assumed that individuals experience more thermoregulatory discomfort on colder (compared to warmer) days, but we cannot rule out the possibility that participants avoided thermoregulatory discomfort on cold days, perhaps by wearing warmer clothing or staying indoors. Could this, rather than thermoregulatory discomfort, have increased nostalgia? Further, we cannot rule out the potential role of other climatic variables that may have covaried with temperature (e.g., insolation, precipitation). We addressed these limitations in Study 2 by manipulating experimentally ambient temperature.

Study 2

In Study 2, we manipulated experimentally ambient temperature to test the causal effect of temperature on nostalgia. Also, in Study 2, we addressed a cardinal theoretical issue: lower (vs. higher) temperatures should increase nostalgia to the extent that they produce thermoregulatory discomfort. The thermoneutral (comfortable) ambient temperature for humans is ~24 °C and, although there is sensitivity to cooling above this point, humans experience increasing thermoregulatory discomfort at temperatures below this point (Craig, 2003). The vital implication is that lower temperatures should increase nostalgia when they fall below ~24 °C only. We randomly assigned participants to three levels of ambient temperature: 20 °C, 24 °C, 28 °C. We hypothesized that momentary nostalgia would be significantly higher in the 20 °C condition than the 24 °C and 28 °C conditions, but that the latter two conditions would not differ significantly.

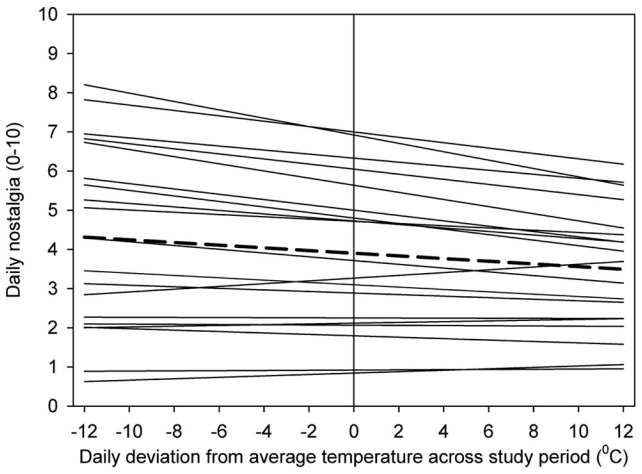

Figure 1. Negative association between daily temperature and daily nostalgia. The plotted regression lines represent the association between daily temperature (deviation from average temperature across study period) and daily nostalgia. Solid lines represent this association for individual participants (N = 19). The dashed line represents the sample average.

Method

Participants were 90 Sun Yat-Sen University undergraduate volunteers (50 women). They were seated for 5 min in a waiting area kept at neutral temperature (24 °C). Next, they were randomly assigned to either a cold (20 °C), neutral (24 °C), or warm (28 °C) room. Room temperature was thermostat-controlled. Participants first performed a 5 min filler task and then completed a state version of the Nostalgia Inventory (NI; Batcho, 1995). Participants rated (1 = *not at all*, 7 = *very much*) the extent to which they felt nostalgic for 20 items from their past (e.g., "music," "my friends," "places," "someone you loved," "TV shows/movies," "pets," "your family house").[3] Batcho originally selected the 20 items to sample broadly across facets of everyday experience. She reported a split-half correlation of .78 and a test-retest correlation of .84. Routledge et al. (2008) reported a significant and substantial correlation between the NI and their Southampton Nostalgia Scale ($r[38] = .40$, $p = .0001$). Zhou, Sedikides, et al. (2008) reported a similar correlation between the two scales in a sample of Chinese factory workers ($r[193] = .41$, $p = .0001$). In the present sample, the NI reliability alpha was .87 ($M = 3.99$, $SD = 1.09$). We prefaced items with the stem "right now" to assess state nostalgia.

Results and Discussion

The three temperature conditions differed significantly in state nostalgia, $F(2, 87) = 3.51$, $p = .035$. A planned contrast revealed that participants seated in the cold room were more nostalgic ($M = 4.41$, $SD = 1.13$) than participants in the neutral room ($M = 3.81$, $SD = 1.12$) and warm room ($M = 3.76$, $SD = 0.91$) combined, $F(1, 87) = 6.98$, $p = .011$. A second planned contrast revealed that participants seated in the neutral and warm room did not differ significantly on nostalgia, $F(1, 87) = 0.04$, $p = .848$. These findings underscore the importance of thermoregulatory discom-

[2] As stated, we tested the association between average daily temperature and daily nostalgia using hierarchical linear modeling (HLM). The analyses were implemented with SAS Proc MIXED. The initial model included a random intercept representing differences in the mean level of nostalgia between participants. The variance component for the intercept was significant, $\tau = 3.59$, Wald $Z = 3.29$, $p = .001$. This indicates that there was a fair degree of clustering of nostalgia ratings within subjects across days and underscores the appropriateness of conducting an HLM analysis. In a second model, we also included a random slope for temperature. By including this additional random effect, we stipulate that the association between temperature and nostalgia may vary between subjects. However, the variance component for the slope was not significant, $\tau = 0.003$, Wald $Z = 1.20$, $p = .115$. Furthermore, there was no significant correlation between intercepts and slopes, $\tau = -0.08$, Wald $Z = -1.49$, $p = .137$. Thus, there is no evidence that the association between daily temperature and daily nostalgia differs depending on participants' average level of nostalgia across days. Based on these findings, we retained the more parsimonious initial model, which included a random intercept and fixed slope.

[3] Batcho (1995) instructed participants to rate how much they "miss" the NI items. We, instead, instructed participants to rate how "nostalgic" they felt about the items. Two recent findings support this modification (Hepper et al., in press). First, laypersons consider "missing/loss" to be peripheral to the concept of nostalgia. Second, lay conceptions of nostalgia dovetail with formal dictionary definitions, indicating that nostalgia can be operationalized by relying on participants' personal understanding of the term.

fort (rather than cooling per se) for triggering nostalgia. Documenting the effect of physical coldness on increased nostalgia tells only half the story. Hence, Studies 3 and 4 examined whether nostalgia, in turn, generates the feeling of physical warmth.

Study 3

Study 3 capitalized on music's capacity to evoke nostalgia (Barrett et al., 2010) for investigating naturalistically whether nostalgia predicts increased physical warmth.

Method

Participants were 1,070 volunteer members of the Dutch public (534 women, 518 men, 18 undeclared) who took part in a larger online survey on musical preferences. Their age ranged from 12 to 68 ($M = 37.49$, $SD = 12.96$). Participants navigated to the online survey by following a link on the Web site of a popular Dutch radio and TV program that is aired annually in December (Top 2000). As part of the survey, participants played four pop songs in their Web browser. These songs were selected for their evocative lyrics, which cover themes of love and personal loss. Musical genres were diverse. Participants listened to all four songs and, after each song, indicated how nostalgic the song made them feel (1 = *not at all*, 5 = *very much*) and whether the song produced the physical (i.e., bodily) sensation of warmth (yes/no). Individuals habitually assess their emotional responses to music (Juslin, Liljestrom, Vastfjall, Barradas, & Silva, 2008; Zentner, Grandjean, & Scherer, 2008), but, in our experience, less often reflect on their physical responses to music. We therefore considered the use of a rating scale appropriate to measure music-evoked nostalgia, but we used a dichotomous scale to simplify and facilitate retrospective judgments of warmth sensation.

Results and Discussion

We tested the association between music-evoked nostalgia and the physical sensation of warmth (yes/no) with a random intercept logistic regression analysis (Kuss, 2002). Songs (level 1) were nested within individuals (level 2). Music-evoked nostalgia and song were the independent variables (both level 1), and physical warmth was the binary dependent variable. Higher levels of music-evoked nostalgia predicted increased physical warmth, $B = 0.42$, $SE = 0.05$, $t(3206) = 8.51$, $p = .001$ (see Figure 2). Participants varied widely in age, but a supplementary analysis revealed that age did not significantly moderate the nostalgia-warmth link, $B = 0.002$, $SE = 0.003$, $t(3151) = 0.58$, $p = .563$.[4]

In everyday life, nostalgia is a common emotional reaction to music (Barrett et al., 2010; Juslin et al., 2008; Zentner et al., 2008). This allowed us to diversify further our assessments of state nostalgia, and created an opportunity to investigate naturalistically the association between music-evoked nostalgia and the physical sensation of warmth. Study 3 findings provide preliminary evidence for the idea that nostalgia is associated with the physical sensation of warmth.

Study 3 has at least two limitations. First, the correlational design rules out causal inferences. We addressed this limitation in Study 4 by manipulating nostalgia and then assessing the interoceptive feeling of warmth. Second, individuals associate readily

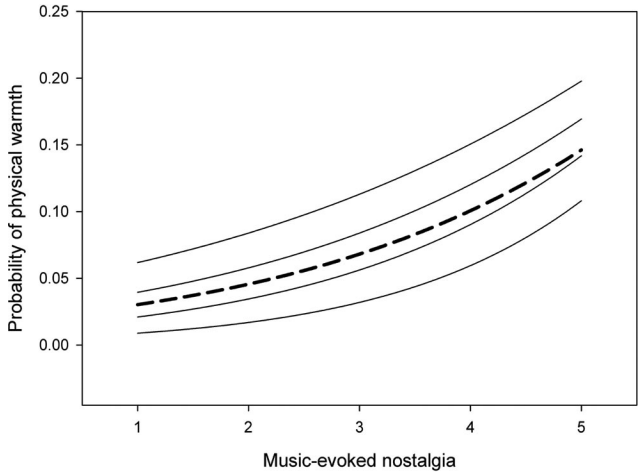

Figure 2. Positive association between music-evoked nostalgia and music-evoked physical warmth. Solid lines are logistic regression curves for each of the four songs. Nostalgia predicted increased physical warmth for each song. The dashed line is the average logistic regression curve, controlling for between-song differences in music-evoked warmth.

the words "warm" and "nostalgia" (Davis, 1979; Holak & Havlena, 1998) and consider "warmth" a prototypical feature of nostalgia (Hepper et al., in press). This raises the possibility that the association between nostalgia and warmth ratings in Study 3 reflects response bias. We addressed this limitation in Study 4 by instructing participants to estimate room temperature. Innocuous temperature sensation is often incorrectly considered an exteroceptive capacity. That is, one typically projects thermal sensations to the environment when, in fact, it is changes in the temperature of the skin and the body core that are reported by thermosensory afferent pathways (Craig, 2003, p. 303). The important implication is that, by instructing participants to estimate room temperature, we could assess the interoceptive feeling of warmth without referencing the term "warmth" or focusing subjective attention on the physiological condition of the body. This should reduce potential response bias. Further, because individuals habitually monitor ambient temperature, the sensation of physical warmth could be suitably assessed on a continuous scale (as compared to a dichotomous scale in Study 3).

[4] As mentioned, we tested the association between music-evoked nostalgia and the physical sensation of warmth (yes/no) with a logistic regression analysis. We used SAS Proc GLIMMIX to implement a random intercept logistic regression analysis in the context of a hierarchical data structure. Songs (level 1) were nested within individuals (level 2). The model included a random intercept representing differences in the mean level of music-evoked warmth between participants, $\tau = 1.29$, $SE = 0.16$, $z = 8.06$, $p = .001$. Music-evoked nostalgia and song were the independent variables (both level 1), and physical warmth was the binary dependent variable. We omitted the Nostalgia × Song interaction from the model after an initial analysis showed that it was not significant, $F(3, 3203) = 1.50$, $p = .213$. Supplementary analyses included age and the Nostalgia × Age interaction as additional independent variables, but neither was significantly associated with physical warmth.

Study 4

In Study 4, we experimentally manipulated nostalgia to test the causal effect of nostalgia on physical warmth. We hypothesized that nostalgia would increase perceived warmth.

Method

Participants were 64 Sun Yat-Sen University undergraduate volunteers (35 women). They were seated in a room thermostat-controlled at 16 °C. Participants brought to mind a nostalgic or ordinary autobiographical event, listed four event-relevant keywords, and reflected briefly upon the event and their feelings (Wildschut et al., 2006). Participants in the nostalgia condition were given the *New Oxford Dictionary of English* (1998) definition of nostalgia ("sentimental longing or wistful affection for the past"). Subsequently, they completed a manipulation check consisting of two items: "Right now, I am feeling quite nostalgic" and "Right now, I am having nostalgic feelings" (1 = *strongly disagree*, 7 = *strongly agree*) (Wildschut et al., 2006; Zhou, Sedikides, et al., 2008). We averaged the items to create a composite ($r[64] = 0.84$, $p = .001$). Participants then estimated as accurately as possible the room temperature in °C.

Results and Discussion

As intended, participants in the nostalgia condition ($M = 5.47$, $SD = 1.41$) reported more nostalgia than those in the control condition ($M = 3.78$, $SD = 1.20$), $F(1, 62) = 21.54$, $p = .001$. Nostalgic participants ($M = 19.81$, $SD = 4.47$) perceived room temperature to be warmer than control participants ($M = 17.44$, $SD = 4.48$), $F(1, 62) = 4.51$, $p = .039$. Nostalgia made participants feel warmer.

Study 5

Study 5 examined whether the homeostatic function of nostalgia encompasses additional interoceptive conditions beyond the feeling of temperature. The close CNS integration of temperature and pain sensations (Craig, 2003) suggests that emotions that ameliorate the thermoregulatory discomfort associated with innocuous cooling may also ameliorate the thermal distress associated with exposure to noxious cold. We therefore hypothesized that thinking about a nostalgic (compared to ordinary autobiographical) event would increase exposure tolerance in a cold pressor test (Mitchell, MacDonald, & Brodie, 2004). Study 5 also addressed a rival explanation: the hypothesized increases in exposure tolerance are due to increases (decreases) in generalized positive (negative) affect rather than the discrete emotional state of nostalgia.

Method

Participants were 80 Sun Yat-Sen University undergraduate volunteers (55 women). Following the same nostalgia manipulation and manipulation check ($r[79] = 0.79$, $p = .001$) as in Study 4, participants completed a state version of the Positive and Negative Affect Schedule (PANAS; Watson, Clark, & Tellegen, 1988). The PANAS comprises 10 items assessing PA (e.g., "interested," "enthusiastic"; $\alpha = .79$, $M = 3.10$, $SD = 0.66$) and 10 items assessing NA (e.g., "distressed," "upset"; $\alpha = .69$, $M = 1.47$, $SD = 0.39$). Participants indicated to what extent they were feeling each emotion "right now" (1 = *not all*, 5 = *very much*). Consistent with previous findings (Watson et al., 1988), PA and NA were uncorrelated, $r(80) = -0.06$, $p = .580$. Participants then became involved in an ostensibly unrelated cold pressor test (Mitchell et al., 2004). They were instructed to immerse their dominant hand for as long as possible in a commercially available water bath maintained at a constant temperature of 4 °C. Participants were instructed not to move their hand while it was immersed and to withdraw their hand when the sensations became too uncomfortable. An experimenter (unaware of condition) recorded immersion duration with a stopwatch.

Results and Discussion

As intended, participants in the nostalgia condition ($M = 4.90$, $SD = 1.28$) reported more nostalgia than those in the control condition ($M = 3.06$, $SD = 1.63$), $F(1, 77) = 31.21$, $p = .001$ (one participant did not complete the manipulation check). Nostalgic participants ($M = 25.94$ sec, $SD = 14.83$) kept their hand immersed longer than control participants ($M = 19.71$ sec, $SD = 12.56$), $F(1, 78) = 4.10$, $p = .047$. A subsequent Analysis of Covariance included the uncorrelated measures of PA and NA as covariates. The difference between the nostalgia and control condition remained significant when controlling for PA and NA, $F(1, 76) = 3.98$, $p = 0.049$. The null finding for PA is consistent with recent findings that the effect of nostalgia on empathy and concomitant charitable giving is not mediated by PA (Zhou et al., 2012), and that recollections of nostalgic life events can be meaningfully differentiated from recollections of positive life events (Stephan, Sedikides, & Wildschut, in press). Nostalgia modulated the interoceptive feeling of pain.

General Discussion

Our point of theoretical departure was that nostalgia's homeostatic role encompasses the maintenance of both psychological and physiological comfort. This perspective on nostalgia is a marked divergence from disconsolate historical treatises (McCann, 1941), yet it received compelling support. Nostalgia is triggered by thermoregulatory discomfort: nostalgia was stronger on colder (vs. warmer) days and in a cold (vs. neutral or warm) room. In turn, nostalgia increases physical warmth: music-evoked nostalgia predicted the physical sensation of warmth, and recalling a nostalgic (vs. ordinary autobiographical) event made a cold room feel warmer. The finding that bringing to mind a nostalgic (vs. ordinary autobiographical) event altered interoceptive feelings (sense of the physiological condition of the body) is consistent with contemporary elaborations of the James-Lange theory of emotion (Craig, 2009; Damasio, 1993) and challenges a vocal criticism, namely, that it did not account for the feeling of self-generated emotions (Damasio, 1993).

We found that nostalgia ameliorates not only the thermoregulatory discomfort associated with innocuous cold but also the thermal distress associated with noxious cold: Participants who recalled a nostalgic (vs. ordinary autobiographical) event showed greater tolerance to noxious cold in a cold pressor test. These parallel effects on temperature and pain sensation suggest a broader homeostatic role for nostalgia encompassing additional

interoceptive feelings, such as hunger and thirst. Relevant to hunger, it is worth noting anecdotal evidence that a common response to starvation is the recollection of satisfying meals and recipes. Testimonies of concentration camp survivors provide a poignant illustration. Goldenberg (2003) likened such responses to a form of nostalgia that served to revive moments and places of comfort. Thirst is an interoceptive feeling that reflects homeostatic drive to drink fluids and serves to prevent (intracellular and extracellular) dehydration (McKinley & Johnson, 2004). The feeling of thirst, then, is directly relevant to the question of whether nostalgia can reduce physiological discomfort from exposure to heat (as well as cold). Anecdotal evidence abounds that heat-induced dehydration and the concomitant feeling of intense thirst triggers thoughts of water. As with hunger, we suspect that such thoughts can take the form of nostalgic recollections and maintain (if only temporarily) physiological comfort.

Viewing nostalgia as a versatile homeostatic corrective opens the path for research on fundamental theoretical questions. Does nostalgia involve a "body loop" mechanism; does it have autonomic sequelae? Does nostalgia involve an "as-if body loop" mechanism; does it engage the same neural circuitry involved in simulation of observed body states? Further, what are the implications of nostalgia for motivation and, more specifically, how is nostalgia's capacity to ameliorate feelings of cold and pain (and perhaps hunger and thirst) balanced with the need to counter or escape from adverse conditions producing these feelings? Individuals who recruit nostalgia as a homeostatic corrective should be less motivated to recruit other coping mechanisms, because nostalgia contributes to the goal of maintaining comfort. When carried to extremes, this could conceivably lead to a paralyzing, pathological form of nostalgia that prevents the individual from countering or escaping adverse conditions that pose a threat to survival. Precisely for this reason, Frankl (1963) questioned the aforementioned obsession with "food talk" among concentration camp prisoners. Although he acknowledged that such conversations afford "momentary psychological relief," he worried that it "was an illusion which physiologically, surely, must not be without danger" (p. 46).

Future research could also address the question of whether nostalgia functions in a different capacity for individuals reared in warm (compared to colder) climates. Conceivably, in colder climates nostalgia could primarily serve to ameliorate thermoregulatory (cold) discomfort, whereas in warmer climates it could primarily serve to ameliorate thirst. The limited available evidence speaks against this possibility. Except for Study 3, the present studies involved participants residing in a subtropical climate, yet provided evidence for a role of nostalgia in ameliorating thermoregulatory (cold) discomfort. This is consistent with the idea that the nostalgia-warmth link derives from a universal mental association between interpersonal affiliation (which nostalgia fosters) and warmth, which is rooted in infant-caregiver interaction (IJzerman & Semin, 2009; Williams & Bargh, 2008). Whether interpersonal affiliation mediates the nostalgia-warmth link is an important question for future research. This issue could be addressed, for instance, by detailed examination of the content of the nostalgic memories prompted by thermoregulatory discomfort. Do these memories center on interpersonal affiliation (i.e., memories of previously having been psychologically warm, in a metaphorical sense) or, in a more direct sense, are these memories of previously having been physically warm.

Research on these topics should address the possibility that positive feelings of any sort increase one's resilience to physiological discomfort. This could be achieved by introducing additional, stringent control conditions. Recent studies, for instance, have contrasted nostalgic memories with memories of positive future (Vess, Arndt, Routledge, Sedikides, & Wildschut, in press) and positive past (Stephan et al., in press) events. Routine assessments of PA, using a combination of explicit and implicit measures, will also help to establish the unique contribution of nostalgia, above and beyond positive emotionality. Such lines of inquiry may further establish nostalgia as a remarkable adaptation built on the human capacities to think temporally and self-reflectively (Routledge, & Arndt, 2005; Sedikides, Skowronski, & Dunbar, 2006), an adaptation that provides an exquisite mechanism to anchor the organism in prior felicitous states.

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Correction to Zhou et al. (2012)

In the article, "Heartwarming Memories: Nostalgia Maintains Physiological Comfort," by Xinyue Zhou, Tim Wildschut, Constantine Sedikides, Xiaoxi Chen, and Ad J. J. M. Vingerhoets (*Emotion*, Advanced online publication. doi: 10.1037/a0027236), the last sentence was incorrect. It should read:

Such lines of inquiry may further establish nostalgia as a remarkable adaptation built on the human capacities to think temporally and self-reflectively (Routledge & Arndt, 2005; Sedikides, Skowronski, & Dunbar, 2006), an adaptation that provides an exquisite mechanism to anchor the organism in prior felicitous states.

All versions of this article have been corrected.

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