Social Psychological and Personality Science
2015, Vol. 6(1) 84-91

DOI: 10.1177/1948550614542344
spps.sagepub.com

Ray of Hope: Hopelessness Increases Preferences for Brighter Lighting

Ping Dong[1], Xun (Irene) Huang[2], and Chen-Bo Zhong[1]

Abstract

Does bright lighting seem more desirable when people feel hopeless? Common parlance such as "*ray of hope*" depicts an association between hope and the perception of brightness. Building on research in embodied cognition and conceptual metaphor, we examined whether incidental emotion of hopelessness can affect brightness perception, which may influence people's preference for lighting. Across four studies, we found that people who feel hopeless judge the environment to be darker (Study 1). As a consequence, hopeless people expressed a greater desire for ambient brightness and higher wattage light bulbs (Studies 2 and 3). Study 4 showed the reversal of the effect—being in a dimmer (vs. brighter) room induces greater hopelessness toward the perceived job search prospects. Taken together, these results suggest that hopeless feeling seems to bias people's perceptual judgment of ambient brightness, which may potentially impact their electricity consumption.

Keywords

hopelessness, emotion, conceptual metaphor, ambient brightness, electricity consumption

In 2011, about 461 billion kilowatt of electricity was used for lighting by the residential and commercial sectors, equaling to about 12% of total U.S. electricity consumption (EIA report, 2013). The energy consumed by lighting alone has led world organizations such as World Wide Fund for Nature to encourage households and businesses to turn off their nonessential lights for 1 hr through the "Earth Hour" movement. The present research seeks to explore the impact of an incidental emotion on people's preference for ambient lighting. Based on the recent embodied cognition and conceptual metaphor literatures, we contend that the emotion hopelessness is connected to the sensory perception of lighting, which in turn may determine our preference for ambient lighting and potentially impact electricity consumption for lighting.

Hopelessness and Visual Perception

Hopelessness is a negative emotion characterized by the feeling that the future holds little promise or having no means to achieve one's goals (Melges & Bowlby, 1969). People experience some extent of hopelessness in almost every stage of their lives. Students may feel hopeless for a final examination that they have not prepared for after a weekend of partying; adults may experience hopelessness when facing a grim economy and suffering from major setbacks in life. Hopelessness is more prevalent among impoverished individuals. One of the most difficult problems facing American inner cities is the feeling of hopelessness about the future among adolescents living in low-income neighborhoods (Bolland, 2003).

In English, hopefulness or hopelessness is often communicated through concepts linked to light and darkness. In metaphors such as ray of hope, for example, hope is represented as the sensory perception of light and hopelessness as darkness. But can the emotion hopelessness actually trigger the sensory perception of darkness? Early models of emotion seem to suggest that this is unlikely. The semantic network models of emotion (e.g., Bower, 1981; Ingram, 1984; see Niedenthal, 2008, for a discussion of relevant models), for example, represent emotional concepts as nodes in networks of abstract information. The activation of emotional nodes may activate abstract, amodal concepts related to light or darkness but should not induce actual sensory change.

Contrary to this view, research in the embodied cognition literature suggests that emotional knowledge is grounded in modality-specific systems (e.g., Barsalou, 1999; Clore & Schnall, 2008). The processing of emotional information reactivates the neural and bodily states that occurred when people actually experienced that emotion—much like a mental simulation (Niedenthal, Winkielman, Mondillon, & Vermeulen,

[1] Rotman School of Management, University of Toronto, Toronto, Ontario, Canada
[2] Lingnan College, Sun Yat-sen University, Guangzhou, China

Corresponding Author:
Xun (Irene) Huang, Lingnan College, Sun Yat-sen University, 135 Xingang Road, Guangzhou, 510275, China.
Email: huangxun3@mail.sysu.edu.cn

2009). A large number of findings in the social psychology literature support this embodied simulation account of emotional knowledge (Barsalou, Niedenthal, Barbey, & Ruppert, 2003; Niedenthal, 2007). Chen and Bargh (1999), for example, had participants who indicate the valence of different emotional words (e.g., love and hate) either by pulling or by pushing a lever. Participants responded faster to positive words when pulling the lever toward them than when pushing it away, but were faster to respond to negative stimuli by pushing the lever than pulling it. Given that people tend to approach positive things and avoid negative things, these findings suggest that processing of the words' valence at least partially overlap with corresponding motor states associated with approach and avoidance (see also Alexopoulos & Ric, 2007; Cacioppo, Priester, & Berntson, 1993; Förster & Strack, 1997, 1998; Neumann & Strack, 2000).

However, the embodied simulation account focuses on reenactment of sensory and motor states that are part of emotional experience—associations perhaps formed in our long evolutionary past. Approach and avoidance and associated motor states, for instance, are core motivational components of emotions such as anger and fear and aid the fight or flight response (Cannon, 1929; Carver & Harmon-Jones, 2009). The visual perception of light and darkness, on the other hand, serves no similar functional purpose to the emotion hopelessness. To explain the association between emotion and seemingly distant or even unrelated modality-specific systems, we turn to the conceptual metaphor theory (Lakoff & Johnson, 1980), which maintains that abstract concepts are grounded in concrete, low-level concepts. Unlike the embodied simulation perspective, the conceptual metaphor theory primarily concerns how lower level constructs based on our direct experience and interaction with the world aid the development and comprehension of abstract constructs with which people have no direct contact (Lakoff & Johnson, 1980). Two key assumptions are important in this process. First, people grasp concrete, lower level concepts such as up and down, close and far, and clean and dirty, before they can understand higher level, more abstract concepts. Second, instead of creating completely new conceptual systems for abstract, higher level concepts, people make use of their experience with and knowledge of lower level concepts when trying to make sense of abstract concepts. Thus, the abstract concepts of happiness and sadness are mentally represented as physical concepts of up and down (Meier & Robinson, 2004), importance as physical weight (Jostmann, Lakens, & Schubert, 2009), and morality as physical cleanliness (Zhong & Liljenquist, 2006).

These conceptual overlaps are not limited to the use of linguistic metaphors such as "cheer up" or "weighty matter" but consilience between two separate conceptual domains and their associated neural, emotional, and sensorimotor systems. For example, physical temperature is often used as a metaphor such as "icy stare" or "warm welcome" to describe social inclusiveness. More importantly, the experience of social rejection triggers the sensory experience of coldness (IJzerman et al., 2012; Zhong & Leonardelli, 2008). Similarly, social proximity (as opposed to social distance) induces the sensory perception of higher ambient temperature (IJzerman & Semin, 2010). The finding that the brain area (insular cortex) that processes experience related to physical warmth is also used to process social warmth (Kang, Williams, Clark, Grey, & Bargh, 2011) provides further support for this overlap.

It is argued that this metaphorical mapping between coldness and loneliness is developed through co-occurrence of the two domains of experience in early development: During infancy, closeness to caretaker brings warmth and distance means coldness. Given toddler's reliance on the caretaker, it is not surprising that temperature concepts such as warm and cold become scaffold into their first sense of social inclusion and safety (Williams & Bargh, 2008). We suggest that a similar process may apply to the relationship between hope and light. Hopelessness concerns the prospect of achieving one's goals (Melges & Bowlby, 1969), which incorporate both a desirable end states (a destination) and the means through which goals can be completed (paths lead to the destination; Kruglanski, 1996). In darkness, people are neither able to see the destination ahead nor the road leading to the destination, known as the "night myopia" phenomenon (Koomen, Scolnik, & Tousey, 1951). The physical inability to see into the distance is analogous to the experience of feeling hopeless when people are unclear about the means (the path) to reach their goals (the destination). Therefore, we expect that the emotional experience of hopelessness may be psychologically represented as the absence of light. In other words, we expect that people experiencing hopelessness might judge the environment to be darker than it actually is. Furthermore, this perceptual bias should also lead them to prefer brighter lighting than otherwise.

Overview of Studies

Four studies tested these possibilities. In Study 1, participants who recalled a past hopeless situation were asked to estimate the brightness of the lab. Employing different manipulations of hopelessness, we then assessed participants' preference for ambient brightness in Studies 2 and 3. Study 4 investigated the reversal of the effect by exploring whether participants working in bright or dim rooms would experience different levels of hopelessness toward their future career.

Study 1

In Study 1, we set out to explore the metaphorical mapping between hopelessness and darkness by investigating whether recalling hopeless experience can darken the perceptual judgment of lighting. Additionally, we wanted to show that the effects were unique to the experience of hopelessness but not general negative emotion such as sadness. The conceptual metaphor theory suggests that the ability to look into the future may be grounded in the physical ability to see into the distance. Thus, the future orientation of hopelessness (Melges & Bowlby, 1969) may be crucial to the development of the hopelessness and darkness metaphor. Sadness, however, is now

Table 1. Coded Emotions of Events and Perceived Lab Brightness as a Function of Emotion Conditions—Study 1.

	Hopeless	Hopeful	Sad	Neutral
Hope	3.18(1.94)[a]	7.37(1.72)[b]	3.89(1.14)[c]	4.72(1.13)[d]
Happiness	3.22(1.83)[a]	7.24(2.24)[b]	1.96(1.07)[c]	5.02(2.51)[d]
Brightness of the lab	5.38(2.24)[a]	6.74(1.83)[b]	6.22(1.66)[b]	6.43(1.94)[b]

Note. Cells with different superscripts differ at $p < .05$. For the hope measure (the event described is 1 = *hopeless*, 9 = *hopeful*); for happiness (the event described is: 1 = *sad*, 9 = *happy*).

focused (Lerner, Li, & Weber, 2013) and is a temporary lowering of mood. Therefore, we expected that a sense of having a gloomy future, but not just feeling sad, may be psychologically represented as darkness.

Method

One hundred and eighty-three undergraduates (74 males, $M_{age} = 20.20$) from a major North American university participated voluntarily for course credit. They were randomly assigned to one of the four conditions (hopeless, hopeful, sad, and neutral) in a between-subjects design.

Upon arrival, participants first signed a consent form and were then instructed that the researchers were interested in collecting information about life events in general and the types of events they would be surveyed were selected randomly by the computer. Participants in the *hopeless/hopeful/sad* conditions were asked to spend 8 min to recall and describe a situation in which they felt hopeless/hopeful/sad in a detailed and vivid way; those in the *neutral* condition wrote about a typical school day experience.

Afterward, participants proceeded to an ostensibly unrelated task, in which they evaluated the lab room for the building management office along three dimensions: lighting (1 = *dim*, 9 = *bright*), comfortableness (1 = *uncomfortable*, 9 = *comfortable*), and temperature (1 = *cold*, 9 = *warm*). The lighting evaluation was our main dependent variable. Finally, participants provided demographic information. They were then thanked and funnel debriefed. None of the participants suspected the link between the two tasks.

Results and Discussion

Manipulation Checks

All participants followed our instruction and wrote down relevant experiences. Following Fishbach and Labroo (2007), we asked a judge, who was unaware of our hypothesis, to code each participant's description of the event in terms of the extent to which it induced hope or happiness on a 9-point Likert-type scale. The results (see the first two rows of Table 1) confirmed that our manipulation was indeed successful.

Main Results

As expected, participants who recalled a hopeless situation reported the room as dimmer than those in hopeful, planned contrast $t(179) = 3.37$, $p = .001$, Cohen's $d = 0.66$; sad, $t(179) = 2.08$, $p = .039$, $d = 0.43$; or neutral conditions, $t(179) = 2.62$, $p = .01$, $d = 0.50$ (see the last row of Table 1 for means and *SD*s). The latter three conditions did not differ from each other—hopeful vs. sad: $t(179) = 1.30$, $p = .20$, $d = 0.30$; sad vs. neutral: $t(179) = .54$, $p = .59$, $d = 0.12$; hopeful vs. neutral: $t(179) = .76$, $p = .45$, $d = 0.16$. The main effect of emotion on perceived brightness of the lab was significant, $F(3, 179) = 4.16$, $p = .007$, $d = 0.53$. On the other hand, our manipulation did not have any influence on comfortableness, $F(3, 179) = 1.04$, $p = .38$, $d = 0.26$, or temperature ratings, $F(3, 179) = .25$, $p = .86$, $d = 0.13$. Repeated measure analyses with participants' judgments on brightness, comfortableness, and temperature of the room as within-subjects factors and emotion condition as between-subjects factor yielded a marginally significant interaction, $F(3, 179) = 2.56$, $p = .057$, $d = 0.41$. These findings provide initial evidence for the proposed metaphorical mapping between hopelessness and reduced lighting. More importantly, sadness did not seem to have the same effect as hopelessness.

Study 2

Study 2 explores whether the visual bias as a result of feeling hopeless would motivate people to prefer brighter ambient lighting. To get a better sense whether this can transfer into potential electricity use, we took pictures of an actual light fixture installed with incandescent bulbs with varying wattages and asked participants to indicate their ideal lighting ambience.

Method

Two-hundred participants (97 males; $M_{age} = 33.47$ years) from the Mechanical Turk online panel participated voluntarily in exchange of payment of US$1. Only participants living in the United States were qualified to participate. They were told that the survey concerns about various aspects of social experiences and combines several unrelated surveys by different researchers. As a screening question, participants first indicated whether they were employed or not at the time of survey.

Participants then proceeded to the first task (''Economic Assessment Survey'') and were told that the researchers were interested in people's feelings about the economy. They first completed 9 items measuring their hopelessness toward the economy and their future jobs (reverse-coded and averaged to form an index of ''hopelessness toward the economy and career prospect,'' $\alpha = .92$; see Supplemental Materials).

Table 2. Correlations Between Hopelessness and Preference—Study 2.

	Hopeless Measures	
	Hopelessness About the Economy	SES Measure
Lighting preference		
Choice of lamp picture	.21***	.11
Choice of bulb watts	.21***	.25***
Ideal ambient brightness	.16**	.13*
Z-scored lighting preference	.23***	.20***
Other measures		
Softness of sofa	−.07	−.08
Size of wall painting	−.09	−.10

Note. SES = socioeconomic status.
***$p < .01$. **$p < .05$. *$p < .10$.

After filling out the survey, they were then exposed to an ostensibly unrelated ''Indoor Decoration Survey,'' in which they answered several questions related to indoor decoration. Of interest to our research are the lighting preference questions. Specifically, they indicated (a) the picture that resembled their ideal lighting from five pictures of a desk lamp varying in brightness (see Supplemental Materials), (b) the ideal wattage of the bulb for their living room (1 = 30 W, 9 = 110 W, with a 10 W interval), and (c) the ideal lighting ambience of their living room (1 = *very dim*, 9 = *very bright*). These three measures were Z-transformed and averaged ($\alpha = .77$) to form an index of ''preference for light'' (see Table 2 for results of individual measures). To establish discriminate validity, participants also indicated their preference for softness of sofa (1 = *very soft*, 9 = *very hard*) and the size of wall painting (1 = *very small*, 9 = *very large*).

In the third part, participants answered questions about themselves. They first filled out the subjective socioeconomic status (SES) scale adopted from Griskevicius, Tybur, Delton, and Robertson (2011). We also included the ladder measure of SES (the MacArthur Scale of Subjective Social Status), asking participants to indicate on a 10-rung ladder (1 = *the lowest*, 10 = *the highest*) where would they place themselves. Afterward, participants reported demographic information. None of the participants suspected there was a connection between the financial situation measures and the lighting preference items.

Results and Discussion

Hopelessness and Lighting Preferences

As expected, the preference for lighting index was positively correlated with the hopelessness about the economy and career prospect index ($r = .23$, $p = .001$). Further, the magnitude of this correlation was comparable for employed participants ($r = .22$, $p = .008$, $N = 143$) and unemployed participants ($r = .24$, $p = .075$, $N = 57$). The correlation between employment status and the preference for lighting index was not statistically significant ($r = .08$, $p > .24$). These results suggest that the more hopeless participants feel about the current economy, the more they prefer bright lighting.

SES and Lighting Preferences

Given that people in poverty are more likely to experience hopelessness compared to those who are better off (Gallup-Healthways Well-Being Index, 2011), we used the SES measures as a proxy for general hopelessness. We reverse-coded the 6 items of SES scale and the single-item ladder measure of SES, then we Z-transformed and averaged them to form a composite score of SES ($\alpha = .83$). The higher the score, the lower their SES is. We found that the preference for lighting index was positively correlated with the combined SES measure ($r = .20$, $p = .006$), suggesting that participants of lower SES in general preferred bright lighting. This finding further corroborates the results based on participants' self-reported hopelessness about the economy and career. To test whether the effects of SES were indeed driven by people's hopelessness feeling, we examined whether hopelessness about the economy and career prospect mediated the relationship between SES and lighting preference. Mediation analyses using the bootstrap method (Preacher & Hayes, 2008) indicated that participants' hopelessness about the economy and career prospect indeed mediated the effect of SES on preference for bright lighting based on 1,000 bootstrap resamples (95% confidence interval CI: [.0038, .2548]). The alternative mediation model—SES as a mediator for the relationship between hopelessness and preference for bright lighting—was not supported (95% CI: [−.0474, .0861]).

Taken together, the results of this study supported our prediction in a highly relevant and real-life situation. We demonstrated that people's hopelessness about the economy and career prospect increased their preferences for ambient brightness. No significant correlations were found between hopelessness toward the economy and preference for softness of sofa ($r = -.07$, $p = .35$) or size of wall paintings ($r = -.09$, $p = .21$). This finding is important because it shows that hopelessness about the economy and job prospect can lead people to spend more on electricity, which would ironically worsen their financial situation. To quantify the potential cost of hopelessness on electricity consumption, we regressed the preference of the ideal wattage for a ceiling fixture onto the hopelessness scale and found that it costs participants on average 20.6% more electricity to feel 1 point less hopeful toward the economy and career prospect.

Study 3

Study 2 examined the correlation between hopelessness feeling and lighting preference using an MTurk sample. In Study 3, we seek to investigate the causality of this relationship in a controlled laboratory setting. Additionally, recent work has shown that sadness leads people to prefer immediate over delayed reward (Lerner et al., 2013). It is possible that hopeless people might prefer brighter lighting because they care less about

Table 3. Preference as a Function of Emotion Conditions—Study 3.

	Emotion Condition		
	Hopeless	Hopeful	Neutral
Hopelessness feeling	4.85(2.04)[a]	6.59(1.39)[b]	5.56(1.74)[c]
Lighting preference			
Choice of lamp picture	3.21(1.05)[a]	3.00(0.98)[a]	3.14(1.00)[a]
Choice of bulb watts	5.91(1.73)[a]	4.79(1.55)[b]	5.17(1.57)[b]
Ideal ambient brightness	6.31(1.24)[a]	5.86(1.19)[b]	5.94(1.15)[b]
Z-scored lighting preference	0.23(0.88)[a]	−0.19(0.72)[b]	−0.05(0.75)[b]
Other measures			
Z-scored size of fish tank	0.15(1.05)[a]	0.05(1.06)[a]	−0.17(0.87)[a]
Z-scored temperature	0.17(0.95)[a]	−0.09(1.14)[a]	−0.05(0.91)[a]
Z-scored softness of sofa	−0.02(1.08)[a]	−0.01(0.99)[a]	0.04(0.94)[a]
Z-scored size of wall paintings	0.05(1.05)[a]	−0.04(0.98)[a]	−0.01(0.96)[a]

Note. Cells with different superscripts in each row differ at $p < .05$. For hopelessness feeling, 1 = *hopeless*, 9 = *hopeful*.

conserving for the future, which holds less value for them compared to individuals who are hopeful. If that were the case, however, we would expect that hopeless individuals to be more wasteful in general compared to hopeful people. To test this, we measured participants' preference related to other types of energy consumption (e.g., water and heat), in addition to lighting.

Method

Two hundred and seven undergraduates (60 male, $M_{age} = 20.45$ years) from a major University in Hong Kong participated voluntarily for course credit. They were randomly assigned to one of the three emotion conditions (hopeless, hopeful, and neutral) in a between-subjects design. Participants were instructed that the lab session consisted of two unrelated tasks.

As in Study 1, participants were asked to spend 8 min to recall and describe a situation in which they felt hopeless or hopeful in a detailed and vivid way and those in *neutral* condition wrote about their typical school day experience. Afterward, participants were presented with the ''Indoor Decoration Survey'' that we used in Study 2 with the only addition that we also asked participants to indicate their preference for the size of a fish tank (1 = *very small*, 9 = *very large*) and the ideal room temperature (1 = *very cold*, 9 = *very warm*). These two additional measures were added to test whether participants' incidental hopelessness would make people become more wasteful and thus consume more energy in general (water for the fish tank and heat for room temperature).

Finally, as manipulation check, participants reported how they felt when they were writing about the daily life experience in the beginning of the study (1 = *hopeless*; 9 = *hopeful*) and reported demographic information. None of the participants suspected the connection between the emotion recall task and the lighting preference items.

Results

Manipulation Checks

Three participants did not follow our instructions in the emotion recall task and wrote down nonsensical things and were excluded from further analysis, leaving 204 participants for further analysis (including them did not change the pattern of the results, see Supplementary Materials). Participants reported feeling more hopeless in hopeless conditions than those in hopeful, $t(201) = 5.76$, $p < .001$, $d = 0.99$ and neutral condition, $t(201) = 2.37$, $p = .019$, $d = 0.37$ (see Table 3 for means and *SD*s).

Main Results

Following Study 2, we Z-transformed and averaged the 3 items ($\alpha = .70$) pertaining to lighting preference to form an index of ''lighting preference.'' As expected, participants who recalled a hopeless event expressed a greater desire for brighter lighting, compared with those who recalled a hopeful, planned contrast, $t(201) = 3.04$, $p = .003$, $d = 0.52$, or neutral event, $t(201) = 2.07$, $p = .04$, $d = 0.34$ (see Table 3). The main effect of emotion on the preference for light index was significant, $F(2, 201) = 4.82$, $p = .009$, $d = 0.44$. This replicates findings of Study 2.

Additionally, participants across three conditions did not differ in their preference for softness of sofa, $F(2, 201) = .07$, $p = .93$, $d = 0.06$, and size of wall painting, $F(2, 201) = .14$, $p = .87$, $d = 0.06$, as in Study 2. Further, they also did not differ for size of fish tank, $F(2, 201) = 1.83$, $p = .16$, $d = 0.27$, and living room temperature, $F(2, 201) = 1.29$, $p = .28$, $d = 0.23$, (see Table 3). This suggests that hopeless participants did not express preferences that could influence water (fish tank) and heat (room temperature) consumption.

Repeated measure analyses with the index of lighting preference, the Z-score for each of the other four additional measures as within-subjects factors, and emotion condition as between-subjects factor yielded a marginally significant interaction, $F(2, 201) = 2.39$, $p = .094$, $d = 0.31$. The marginal interaction may be due to preference on water and heat consumption sharing the same-direction trend as light preference even though they did not reach statistical significance. This suggests that hopelessness' effects on lighting preference may indeed be entangled with its effects on future discounting at some level. Nevertheless, given the consistent effects of hopelessness on lighting preference in both Studies 2 and 3, combined with the finding of Study 1 that hopelessness alter perceptual judgment of ambient lighting, we may infer with confidence that hopelessness indeed involves sensory perceptions related to ambient lighting and that future discounting cannot completely explain the effects of hopelessness on lighting preference.

Study 4

We have demonstrated that hopelessness can darken people's perception of ambient light (Study 1) and increase their preference for bright lighting (Studies 2 and 3). These findings fit well with the conceptual metaphor theory, which suggests that abstract knowledge is often represented using concrete and physical constructs (Lakoff & Johnson, 1980). But would experiencing darkness exacerbate people's feeling of hopelessness? Study 4 empirically tested this proposition by manipulating the ambient lighting of a room where undergraduates indicated their prospects of job search. We expected that ambient darkness would decrease participants' perceived hope in this future goal.

Method

One hundred and six students (32 male, 1 unreported, M_{age} = 20.58 years) not in their final year (who would have finished job searching by the time of the survey) from a University in Hong Kong participated voluntarily in exchange for payment of HK$40 (approximately US$5). They were randomly assigned to a room that is either dim or bright (see Supplementary Materials). In the bright-lit condition, we turned on all lights (19 peripheral bulbs plus the light in the suspended ceiling), whereas in the dim-lit condition, we kept only four peripheral ceiling lamps on. Once seated, participants were instructed that the researchers were interested in college students' thoughts about their future and indicated how they feel about the prospect of successfully joining their most desired company and how they feel about the prospect of finding a well-paying job in the future, both on a 9-point Likert-type scale (1 = *very hopeless/very unpromising/very depressed*, 9 = *very hopeful/very promising/very encouraging*; reverse-coded and averaged to form an index of participants' hopelessness about job search, $\alpha = .92$; the higher the score, the more hopeless participants perceived their job search prospect). We also included two additional measures asking participants about their prospect of getting into a graduate school and life satisfaction along the same scales (see Supplementary Materials).

After that, participants responded to the SES scale as used in Study 2 ($\alpha = .84$), manipulation check questions ("how do you feel about the lab room?" 1 = *very dim/very cold/very dirty*, 9 = *very bright/very warm/very clean*), and demographic information including age, gender, cumulative grade point average (GPA), internship experience, when will they start to search for jobs, and plan to apply graduate school.

Results and Discussion

Manipulation Checks

Participants in the bright condition rated the lab as brighter ($M = 6.60$, $SD = 1.05$) than those in the dim condition ($M = 4.20$, $SD = 1.33$), $t(104) = 10.26$, $p < .001$, $d = 2.00$. Their ratings of the temperature and cleanliness of the lab were not affected (ps > .29).

Main Results

As expected, participants seated in a dimmer room ($M = 4.53$, $SD = 1.47$) indeed felt more hopeless about their job search prospect than those seated in a brighter room ($M = 3.95$, $SD = 1.32$), planned contrast $t(104) = 2.15$, $p = .034$, $d = 0.42$. The effect still holds after controlling for SES, internship experience, when they would start job search, and cumulative GPA, $F(1, 99) = 7.43$, $p = .008$, $d = 0.55$.

However, lighting did not affect the two additional measures. On graduate school application, only 35 of the 106 participants indicated that they had some plan to apply to graduate school. Thus, it is not surprising that lighting did not influence hopelessness toward graduate school application ($p > .88$). Also, lighting did not affect participants' prospect of their life satisfaction ($p > .71$). Repeated analyses with room condition as between-subject variable and hopelessness measures (the index of hopelessness about job search and the average of the two additional measures, $r = .52$, $p < .001$) as a repeated measure variable yielded a significant two-way interaction, $F(1, 104) = 6.58$, $p = .012$, $d = 0.51$.

The nonsignificant findings on general life satisfaction are potentially interesting, as it suggests a possibility that the effect of ambient darkness on hopelessness may apply only to situations where tangible goals are salient in mind, whereas life satisfaction is a more subjective and abstract state or experience. This boundary condition deserves future research.

To sum, this study shows that not only hopeless people perceive the environment to be darker, but a subtle environmental factor (i.e., darkness of the room) can reduce people's perceived likelihood of finding a satisfactory job in the future. Taken together, these evidences suggest that hopelessness and ambient darkness are integrated and accessible in people's mind.

General Discussion

The present research adds to our knowledge by showing that hopelessness, a common emotional status, can darken people's visual perception of brightness (Study 1), which increases their desire for ambient brightness (Studies 2 and 3). In addition, the reverse of the effect also holds—staying in a dim (vs. bright) environment induced greater sense of hopelessness toward job search prospect, suggesting that the effect between hopelessness and darkness is bidirectional (Study 4). More importantly, sadness does not show the same effect as hopelessness in affecting people's perceptual judgment of ambient brightness (Study 1), and the effects of hopelessness on light preference cannot be fully explained by future discounting (Study 3).

This research contributes to the literature in three important aspects. First, our finding that feeling hopeless can affect visual perception of brightness advances the embodiment literature by showing that two conceptual domains (i.e., hopelessness and

visual perception of darkness) are metaphorically linked, and the activated hopelessness can alter the visual perception of ambient brightness and vice versa. This finding enriches an emerging body of recent research that investigates the effects of people's psychological states on sensory perceptions. For instance, nostalgia increases perceived ambient temperature and enhances tolerance to physical coldness (Zhou, Wildschut, Sedikides, Chen, & Vingerhoets, 2012), feeling powerless leads to overestimated weight judgment (Lee & Schnall, 2014), violations of interpersonal justice elicits moral disgust that triggers stronger taste and smell reactions to gustatory and olfactory stimuli (Skarlicki, Hoegg, Aquino, & Nadisic, 2013), and suspicious feeling enhances the correct labeling of a fishy smell (Lee & Schwarz, 2012).

Second, this article represents the first attempt, to the best of our knowledge, to show that incidental feeling of hopelessness can affect people's preference for ambient brightness and may influence their electricity consumption for lighting. This finding contributes to the effects of specific emotions (beyond valence of emotion) on people's judgment and decision making and suggests that people's metaphorical thinking can unconsciously affect their preference and consumption behaviors.

Third, the present work contributes to the energy conservation literature by offering a new perspective that emotional factors such as hopelessness can potentially affect electricity (lighting) use. Previous research mainly focuses on demographic factors such as political view (Feinberg & Willer, 2013), race, and age as well as socioeconomic factors (Anderson & Cunningham, 1972; Webster, 1975) in predicting people's environmental protection behavior. Our research thus expands the scope of possible factors (e.g., incidental emotions) that could influence people's tendency to act pro-environmentally and explains why people who live at the foot of the social ladder are less likely to engage in energy conservation activities, as evidenced in Webster (1975).

Finally, the results of our studies have clear implications for policy makers. It is worth noting that the ambient brightness may be an effective strategy to light up the hope for people's future. Thus, during economic recession, increased ambient lighting in public places may rekindle people's optimism toward the prospect of the economy. In addition, campaigns to raise awareness of energy conservation should take into account people's emotional state when thinking about the effectiveness of campaign strategies. Because of the link between hopelessness and visual perception, such campaigns should not be considered isolated trials that focus exclusively on educating people about the importance of conserving energy but a concerted effort designed to improve the economy in general.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Authors' Note

We would like to thank Melanie Huang and Hiu-Ching Chan for their excellent research assistance. We report how we determined our sample size, all data exclusions (if any), all manipulations, and all measures in the study. The details on data collection and analyses were reported in the paper and the supplemental online materials.

Funding

This research was partially funded by a startup funding from the Sun Yat-sen University (10000-3321306) awarded to the second author.

Supplemental Material

The online data supplements are available at http://spp.sagepub.com/supplemental.

References

Alexopoulos, T., & Ric, F. (2007). The evaluation-behavior link: Direct and beyond valence. *Journal of Experimental Social Psychology*, *43*, 1010–1016.

Anderson, W. T., & Cunningham, W. H. (1972). The socially conscious consumer. *Journal of Marketing*, *36*, 23–31.

Barsalou, L. W. (1999). Perceptual symbol systems. *Behavioral and Brain Sciences*, *22*, 577–660.

Barsalou, L. W., Niedenthal, P. M., Barbey, A. K., & Ruppert, J. A. (2003). Social embodiment. *Psychology of Learning and Motivation*, *43*, 43–92.

Bolland, J. M. (2003). Hopelessness and risk behavior among adolescents living in high-poverty inner-city neighborhoods. *Journal of Adolescence*, *26*, 145–158.

Bower, G. H. (1981). Mood and memory. *American Psychologist*, *36*, 129–148.

Cacioppo, J. T., Priester, J. R., & Berntson, G. G. (1993). Rudimentary determinants of attitudes II: Arm flexion and extension have differential effects on attitudes. *Journal of Personality and Social Psychology*, *65*, 5–17.

Cannon, W. B. (1929). *Bodily changes in pain, hunger, fear, and rage*. Boston, MA: Branford.

Carver, C. S., & Harmon-Jones, E. (2009). Anger is an approach-related affect: Evidence and implications. *Psychological Bulletin*, *135*, 183–204.

Chen, M., & Bargh, J. A. (1999). Consequences of automatic evaluation: Immediate behavioral predispositions to approach or avoid the stimulus. *Personality and Social Psychology Bulletin*, *25*, 215–224.

Clore, G. L., & Schnall, S. (2008). Affective coherence: Affect as embodied evidence in attitude, advertising, and art. In G. R. Semin & E. R. Smith (Eds.), *Embodied grounding: Social, cognitive, affective, and neuroscientific approaches*. New York, NY: Cambridge University Press.

EIA Report. (2013). How much electricity is used for lighting in the United States? Retrieved May 13, 2013, from http://www.eia.gov/tools/faqs/faq.cfm?id=99&t=3

Feinberg, M., & Willer, R. (2013). The moral roots of environmental attitudes. *Psychological Science*, *24*, 56–62.

Fishbach, A., & Labroo, A. A. (2007). Be better or be merry: How mood affects self-control. *Journal of Personality and Social Psychology*, *93*, 158–173.

Förster, J., & Strack, F. (1997). Motor actions in retrieval of valenced information: A motor congruence effect. *Perceptual and Motor Skills*, *85*, 1419–1427.

Förster, J., & Strack, F. (1998). Motor actions in retrieval of valenced information: II. Boundary conditions for motor congruence effects. *Perceptual and Motor Skills*, *86*, 1423–1426.

Gallup-Healthways Wellbeing Index. (2011). Gallup Wellbeing. Retrieved May 13, 2013, from http://www.gallup.com/poll/158417/poverty-comes-depression-illness.aspx

Griskevicius, V., Tybur, J. M., Delton, A. W., & Robertson, T. E. (2011). The influence of mortality and socioeconomic status on risk and delayed rewards: A life history theory approach. *Journal of Personality and Social Psychology*, *100*, 1015–1026.

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

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

Ingram, R. E. (1984). Toward an information-processing analysis of depression. *Cognitive Therapy and Research*, *8*, 443–478.

Jostmann, N. B., Lakens, D., & Schubert, T. W. (2009). Weight as an embodiment of importance. *Psychological Science*, *20*, 1169–1174.

Kang, Y., Williams, L. E., Clark, M. S., Grey, J. R., & Bargh, J. (2011). Physical temperature effects on trust behavior: The role of insula. *Social Cognitive and Affective Neuroscience*, *6*, 507–515.

Koomen, M., Scolnik, R., & Tousey, R. (1951). A study of night myopia. *Journal of Optical Society of America*, *41*, 80–83.

Kruglanski, A. W. (1996). Goals as knowledge structures. In P. M. Gollwitzer & J. A. Bargh (Eds.), *The psychology of action: Linking cognition and motivation to behavior* (pp. 599–618). New York, NY: Guilford Press.

Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago, IL: University of Chicago Press.

Lee, E. H., & Schnall, S. (2014). The influence of social power on weight perception. *Journal of Experimental Psychology: General*. doi:10.1037/a0035699

Lee, S. W. S., & Schwarz, N. (2012). Bidirectionality, mediation, and moderation of metaphorical effects: The embodiment of social suspicion and fishy smells. *Journal of Personality and Social Psychology*, *103*, 737–749.

Lerner, J. S., Li, Y., & Weber, E. U. (2013). The financial costs of sadness. *Psychological Science*, *24*, 72–79.

Meier, B. P., & Robinson, M. D. (2004). Why the sunny side is up: Associations between affect and vertical position. *Psychological Science*, *15*, 243–247.

Melges, F. T., & Bowlby, J. (1969). Types of hopelessness in psychopathological process. *Archives of General Psychiatry*, *20*, 690–699.

Neumann, R., & Strack, F. (2000). Approach and avoidance: The influence of proprioceptive and exteroceptive cues on encoding of affective information. *Journal of Personality and Social Psychology*, *79*, 39–48.

Niedenthal, P. M. (2007). Embodying emotion. *Science*, *316*, 1002–1005.

Niedenthal, P. M. (2008). Emotion concepts. In M. Lewis, J. M. Haviland-Jones, & L. F. Barrett (Eds.), *The handbook of emotion* (3rd ed., pp. 597–600). New York, NY: Guilford Press.

Niedenthal, P. M., Winkielman, P., Mondillon, L., & Vermeulen, N. (2009). Embodiment of emotion concepts. *Journal of Personality and Social Psychology*, *96*, 1120–1136.

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*, 879–891.

Skarlicki, D. P., Hoegg, J., Aquino, K., & Nadisic, T. (2013). Does injustice affect your sense of taste and smell? The mediating role of moral disgust. *Journal of Experimental Social Psychology*, *49*, 852–859.

Webster, F. E. (1975). Determining the characteristics of the socially conscious consumer. *Journal of Consumer Research*, *2*, 188–196.

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

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

Zhong, C.-B., & Liljenquist, K. (2006). Washing away your sins: Threatened morality and physical cleansing. *Science*, *313*, 1451–1452.

Zhou, X.-Y., Wildschut, T., Sedikides, C., Chen, X., & Vingerhoets, A. J. (2012). Heartwarming memories: Nostalgia maintains physiological comfort. *Emotion*, *12*, 678–684.

Author Biographies

Ping Dong is a doctoral student of marketing at Rotman School of Management, University of Toronto, Canada. She can be reached at ping.dong12@rotman.utoronto.ca.

Xun (Irene) Huang is an assistant professor of marketing at Lingnan College, Sun Yat-sen University, China. She can be reached at huangxun3@mail.sysu.edu.cn.

Chen-Bo Zhong is an associate professor of organizational behavior and human resource management at Rotman School of Management, University of Toronto, Canada. He can be reached at chenbo.zhong@rotman.utoronto.ca.