Getting through a COVID-19 winter: Physical coldness increases the perceived risk of coronavirus disease

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A B S T R A C T

What factors influence how people perceive the risk of getting COVID-19? Extending beyond features of general health conditions, media coverage, and genetic susceptibility to disease, the present research investigates whether the immediacy of experience with temperature, a subtle yet pervasive environmental factor, can affect people's estimation of contagion probability. According to the attribute substitution model, people may rely on the visceral experience of coldness, a far easier quantity to evaluate, to estimate the contagion probability of the new coronavirus disease. Study 1 found that Chinese university students who perceived the indoor temperature to be lower believed that the coronavirus was more infectious. To provide causal evidence for the effect, Study 2 randomly assigned participants to different conditions. The results showed that participants in the cold condition reported a higher likelihood of contracting the coronavirus than participants in the control condition. Overall, these findings are consistent with the attribute substitution model: people tend to recruit simpler and more accessible information (e.g., local temperature) in place of more diagnostic but less tangible information (e.g., scientific data) in assessing the risk of disease transmission. Theoretical contributions and the significance of this research for policy makers are discussed.

1. Introduction

The new coronavirus disease (COVID-19) is continuing its spread across the world and caused an international crisis. Since World Health Organization (WHO) announced this outbreak a pandemic on March 12, 2020, different government and organizations groups have initiated awareness programs to educate the public to become advocates for disease prevention and control (Dhanani & Franz, 2020; Jones et al., 2020; Li, 2022). Though scientists and laypersons are aware of the pattern of COVID-19 contagiousness, some surveys suggest that knowledge toward COVID-19 was markedly lower in some individuals (Nooh et al., 2021; Rousseau & Deschacht, 2020). For instance, many demographic characteristics are significantly associated with participants' awareness, such that lower-income and less educated individuals displayed a lower awareness level of the current pandemic compared to other categories across different national contexts (Alahdal et al., 2020). In addition, as "fake news" proliferates, misinformation about COVID-19, such as summer rays stopping the coronavirus from circulating, may lead people to underestimate the seriousness of situation which they are facing with (Pennycook et al., 2020).

According to aforementioned ideas and findings, it appears that people's beliefs about the COVID-19 pandemic are malleable and flexible, influenced by a rich variety of factors (Li, 2021; Li & Cao, 2022; Serpas & Ignacio, 2021). Thus, a good knowledge of the risk of contagion may require integrating a complex structure of many diverse and even contradictory inputs (Anderson et al., 2020; Clark et al., 2020). Yet, numerous studies have shown that people tend to rely on less relevant but accessible information when answering complex scientific questions (Akerlof et al., 2013; Risen & Critcher, 2011). For instance, Li et al. (2011) found that participants who perceived the current day's weather to be warmer than usual expressed more worries about the threat of global warming and were prone to donate more money to a climate change charity. In explaining the underlying psychological mechanism, researchers used the attribute substitution model in the cognitive heuristic literature (Kahneman, 2003; Kahneman & Frederick, 2002). Attribute substitution as a mental error occurs in the mental decision-making process when humans find it difficult in measuring an attribute, criterion, or parameter using a single metric (Slimak & Dietz, 2006; Smith & Bahill, 2010). Therefore, individuals may unconsciously substitute a simpler element and make intuitive judgments in a complex

decision-making situation.

Based on this model, Zaval et al. (2014) proposed that people's sensitivity to the weather on the current day is recruited through a process of attribute substitution in their beliefs in global warming. Specifically, when asked about sets of complex questions related to natural environment changes, respondents may make best use of simple and more easily accessible information (e.g., daily temperature) in place of more diagnostic but intangible information (e.g., a long-term change in the average weather patterns). Such findings suggest that perceived personal experience of climate change, an irrelevant environmental feature, seems to heighten individuals' perception of the risks.

Here, we applied the attribute substitution model to the problem of the perceived risk of the new coronavirus disease. In particular, we extended this research stream by investigating the potential influence of feeling cold on people's perceived risk of the COVID-19 pandemic. Though anecdotal and medical evidence suggests that cold and dry air may help spread respiratory viruses, accurately predicting the prospect of a COVID winter is a difficult question which is full of substantial complexity and uncertainty (Bashir et al., 2020; Price et al., 2019). For instance, almost all viruses survive longer and are transmitted more easily when they are in a cold setting (Killerby et al., 2018). However, a temperature of 4 °C may be the most appropriate average temperature for the new coronavirus according to the UK's Scientific Advisory Group for Emergencies ("Coronavirus: How bad will winter really be?", 2020). In actuality, this is difficult for most laypersons since they have limited understanding of the transmission of pathogens and cannot accurately measure the temperature with different types of thermometers at any time. Therefore, most people may substitute a simple attribute, such as current day's temperature or visceral state, for managing the mental decision-making process in disease-risk estimation.

Since the essence of attribute substitution is the collapse of attention from a broad and complicated question to a narrow and more easily answered one (Daryanto et al., 2022; Smith & Bahill, 2010), we expect that the attribute substitution based on recent and local temperature could skew estimation of coronavirus contagion probability. To examine this notion, we conducted two studies that asked diverse samples of respondents about their concern for contagious diseases. Study 1 involved a survey exploring whether individuals' estimation of room temperature is related to their perceived risk of COVID-19. By employing a more diverse sample, Study 2 used an experimental design to test whether experiencing coldness can causally slant risk perceptions of the new coronavirus disease.

2. Study 1

2.1. Method

2.1.1. Participants

A total of 204 university students (109 women; age: $M = 19.9$ years, $SD = 2.8$) took part in this study in exchange for a small monetary reward. No participants reported that they were suffering from the COVID-19 or other contagious diseases when the study took place. Our survey was administered on September, 12, 2020. There were no new confirmed cases for 14 consecutive days reported by the National Health Commission of China during the study. Live statistics and coronavirus news tracking data showed that there had been 576 confirmed cases of COVID-19, including 6 deaths. To exclude the possibility that self-reported risk of coronavirus might vary substantially with date due to virus situations, testing of subjects took place in a single day. To minimize the biasing influence of researcher degrees of freedom, we did not perform any statistical analysis before terminating data collection. Our post-hoc power estimation shows that the observed power derived from the current study is 0.99. Thus, it is unlikely that inadequate power (e.g., power < 0.80) poses a threat to the internal validity.

2.1.2. Materials and procedure

After arriving at the experimental room and providing a consent form, participants were asked to estimate the indoor temperature by writing down the centigrade to help researchers set the air conditioner's temperature properly. The temperature of the experimental room was kept constantly (approximately 22 °C) during the investigation. Next, participants responded to an unrelated filler task regarding time management survey. Participants were then asked to estimate the risk of getting six different types of diseases (i.e., coronavirus, high blood pressure, diabetes, gout, colorectal cancer, and hyperthyroidism) by indicating the percentile from 0 (*impossible*) to 100 (*certain to happen*). We provided a short description of each disease to help participants understand the disease. For example, in addition to coronavirus associated to a virus/pathogen, all other diseases are hereditary or linked to lifestyle factors. Finally, participants were debriefed about the true purpose of the study and thanked for their participation.

2.2. Results and discussion

Debriefing responses indicated that no participant issued any suspicion about the main hypothesis and thus no data were excluded from analyses. We found that subjectively experienced temperature ($M = 23.75$, $SD = 3.70$) was significantly related to their perceived risk of coronavirus disease ($M = 17.29$, $SD = 17.08$), $r = 0.433$, $p < .001$, 95% CI = [0.3143, 0.5383]. Thus, participants who thought that the indoor temperature was much lower believed that the coronavirus was more infectious. However, there was no relationship between temperature and perceived risk of other noncontagious diseases ($ps > .52$; see Table 1).

Overall, Study 1 reveals a striking relationship between the sensation of temperature and the probability estimate of contracting the coronavirus. However, we cannot establish causality in these observational data. It might be possible that people who reported a higher likelihood of catching the virus tended to underestimate the indoor temperature. In addition, the sample was restricted to university students which may limit the generalizability of results. To address these concerns, we randomly assigned non-student participants to do the survey either in a cool room or in an identical non-cooled room.

3. Study 2

3.1. Method

3.1.1. Participants

Participants were recruited via Chinese social media postings (e.g., Weibo, Wechat, QQ). A total of 140 participants (75 women; age: range = 20–56 years; $M = 42.7$ years, $SD = 6.9$) took part in this study in exchange for a financial reward. They were self-identified as non-students. No participants reported that they were suffering from the COVID-19 or other contagious diseases when the experiment took place. We conducted the experiment on September, 28, 2020. There were no new confirmed cases for 14 consecutive days reported by the National Health Commission of China during the study. Live statistics and coronavirus news tracking data showed that there had been 576 confirmed cases of COVID-19, including 6 deaths. The experiment was carried out in a single day to exclude the possibility that perceived risk of coronavirus may vary as a function of date due to the changing virus situations. To minimize the biasing influence of researcher degrees of freedom, we did not perform any statistical analysis before terminating data collection. Our post-hoc power estimation shows that the observed power derived from the current study is 0.81. Thus, it is unlikely that inadequate power (e.g., power < 0.80) poses a threat to the internal validity.

3.1.2. Materials and procedure

Participants were randomly assigned to either the cold workstation or the control workstation. Of note, participants in the two conditions

Table 1
Correlations between study variables.

	1	2	3	4	5	6	7
1. Temperature	/						
2. Coronavirus	−0.433*	/					
3. High blood pressure	−0.045	0.007	/				
4. Diabetes	0.020	−0.096	−0.024	/			
5. Gout	0.038	−0.038	−0.037	0.017	/		
6. Colorectal cancer	0.012	−0.033	−0.036	0.027	−0.041	/	
7. Hyperthyroidism	−0.032	−0.042	−0.125	0.123	−0.075	−0.039	/
Mean scores	23.75	17.29	14.38	22.91	16.74	15.37	17.99
Standard deviation	3.70	17.08	10.00	24.03	12.50	8.18	14.63

* $p < .001$.

did not differ in their gender and age ($ps > .31$). In the cold workstation, participants completed the survey in a cold room (approximately 18 °C) which was cooled by the air conditioner for 20 min prior to participants' arrival. In the control condition, participants completed the survey in an identical non-cooled room (approximately 25 °C). Next, participants were asked to respond to the same questionnaires regarding perceived risk of (non-)contagious diseases and the same time management survey as Study 1. Subsequently, participants responded to a manipulation check item about their perceptions of the experimental room's temperature on a nine-point Likert scale (1 = *very cold*, 9 = *very warm*). Finally, participants completed the Positive and Negative Affect Schedule (Watson et al., 1988). They were asked to indicate their current feeling of 10 positive affective states and 10 negative affective states on a 5-point Likert scale ranging from 1 (*very slightly*) to 5 (*extremely*) (positive affect: $\alpha = 0.86$; negative affect: $\alpha = 0.90$).

3.2. Results and discussion

Debriefing responses indicated that no participant who issued any suspicion about the main hypothesis and thus no data were excluded from analyses. As expected, participants in the cold condition perceived the room as colder (cold: $M = 3.26$, $SD = 1.75$; control: $M = 5.49$, $SD = 1.92$), $t = 7.18$, $p < .001$, Cohen's $d = 1.22$, 95 % confidence interval (CI) = [−2.8440, −1.6160]. Such findings suggest that the manipulation of coldness was indeed successful.

In line with our predictions, participants in the cold condition ($M = 28.79$, $SD = 28.31$) reported a higher likelihood of getting the coronavirus than participants in the control condition ($M = 18.29$, $SD = 20.29$), $t = 2.52$, $p = .01$, Cohen's $d = 0.43$, 95 % confidence interval (CI) = [2.2685, 18.7315]. Since there were no significant differences in the perceived risk of getting noncontagious diseases ($ps > .25$; see Table 2), we averaged participants' risk assessment of noncommunicable diseases to create a composite score. A mixed analysis of variance (ANOVA) with disease type as the within-subjects factor (coronavirus vs. other) and coldness condition as the between-subjects factor yielded a significant Disease Type × Coldness interaction effect, $F(1, 138) = 8.01$, $p = .005$, $\eta^2 = 0.06$. No significant differences between the two conditions were obtained regarding the positive affects and negative affects, $Fs < 1$. Thus, mood states cannot explain the relationship between the visceral

Table 2
Summary of results — Study 2.

Variables	Cold-room condition	Normal-room condition	Comparison	
	M (SD)	*M (SD)*	*F*	*p*
Coronavirus	28.79 (28.31)	18.29 (20.29)	6.36	.013
High blood pressure	20.80 (14.27)	18.17 (13.38)	1.26	.263
Diabetes	17.60 (12.58)	19.30 (15.79)	0.50	.482
Gout	23.77 (22.09)	21.13 (20.61)	0.54	.466
Colorectal cancer	22.83 (20.49)	26.29 (24.35)	0.83	.365
Hyperthyreosis	14.26 (8.98)	16.00 (8.89)	1.33	.251

experience of coldness and perceived risk of coronavirus disease.

4. General discussion

In examining people's perceived risk of contagious diseases, researchers have primarily focused on biological characteristics of humans and general health conditions (Duncan et al., 2009; Gabanelli et al., 2022; Johnson & Tversky, 1983). We investigated a new idea that incidental situational factors can also influence people's assessment of risks and promote their heightened concerns about coronavirus disease. In both correlational and experimental studies, participants who had the experience of coldness estimated a higher risk of catching coronavirus disease than those who had no experience of coldness. This pattern of results suggests that people may resort to intuitive decisions and judgments based on recent bodily experience in probability estimates, which renders them to become susceptible to cognitive biases. In addition, we ruled out affect as an explanation of the observed effects and attenuated concerns about reverse causality between coldness and perceived risk of communicable diseases.

Although the relationship between physical coldness and the perceived risk of coronavirus disease was consistent across both studies, the observed effect sizes appeared be comparatively small. This is not surprising because the perceived risk of communicable diseases is influenced by a broad set of factors and bodily experience may have only a mild modulatory effect on it (He et al., 2021; Li, 2021; Schmidt et al., 2021). Since 2011, psychological sciences have been struggling with the replication crisis (Derksen & Morawski, 2022; Francis, 2012). The fact that the current research data were consistent with the stated hypothesis across multiple populations (student and community adults) and mixed methods (correlational and experimental) establishes the robustness of the impact of coldness on perceived risks of infectious diseases. Several psychologists have determined that replicating a preliminary effect across different populations and contexts can be considered as providing convincing evidence for a large effect (Li & Shen, 2020; Lu et al., 2017; Prentice & Miller, 1992). Nevertheless, independent replication with a high statistical power in future studies is necessary before the research findings can be considered as conclusive.

Our study contributes to the literature in several ways. First, the current inquiry represents the first attempt to show that even the visceral experience of coldness can directly deflate probability estimates of contagion risk. We argued that physical coldness may lead people to overestimate the risk of coronavirus disease due to attribute substitution errors. Mounting evidence suggests that individuals' beliefs about a complex issue (e.g., economic decision making and systems engineering) are conditioned by the specific moment-by-moment contexts, because knowledge of the truly desired attribute of interest may be too complicated to be acquired (Kahneman, 2003; Kahneman & Frederick, 2002). For example, people tended to use daily weather information in place of scientific data when asked about questions about global warming (Zaval et al., 2014, but see Klein et al., 2018 for failed replications). Extending these findings from the contexts of climate change to public health, we found that people may resort to personal experience with temperature in

comparison to more diagnostic but nontangible statistical information provided by infectious disease specialists in estimation of contagion probability. This is because a lay understanding of transient temperature variation as a metric for predicting virus infection is more vivid and accessible.

An alternative possibility is that physical coldness may activate the concept of fever, a typical symptom of COVID-19. Thus, the impact of coldness on perceived risk of contagion disease may be partly explained by the priming effect. Note, however, that the two explanations regarding information-processing shortcuts and physical temperature effects should not be deemed as mutually exclusive. Kahneman and Frederick (2002) argued that a highly accessible heuristic attribute is either because it is assessed automatically in normal perception or because it has been primed. In other words, the priming effect also represents reasoning errors in terms of cognitive heuristics. Feeling cold and chills are actually not restricted to COVID-19 but are common symptoms of many other infectious illnesses, such as colds and flu. In addition, not dressing warm enough can also lead to physical coldness in healthy people. Accurate and reliable testing for coronavirus requires a rapid lateral flow test or a polymerase chain reaction (PCR) test. Thus, equating the visceral experience of coldness with fever and even COVID-19 contraction can be considered as a form of substituting a more accessible and easily calculated heuristic attribute in solving a computationally complex problem, such as COVID-19 diagnostic testing. In future studies, scholars should investigate whether physical coldness can also affect a host of infectious diseases which do not have the symptom of cold and shivering, such as skin warts.

Second, the present work contributes to the embodiment literature by revealing a new psychological outcome of temperature. Our findings that physical coldness is linked with a higher estimation of perceived risk of coronavirus disease transmission support the idea that higher mental processes are grounded in physical environment, in line with the hypothesis of embodied cognition (Landau et al., 2010; Wang et al., 2019). For example, Li (2021) found that participants who experienced physical instability expressed greater concern about the COVID-19 pandemic than participants in a stable workstation. Such findings suggest that irrelevant physical experiences can influence people's perceptions of the current pandemic. Yet, previous research has typically focused on the relationship between particular levels of temperature and interpersonal affect, such as personality judgment and social exclusion (IJzerman et al., 2012; Williams & Bargh, 2008; Zhong & Leonardelli, 2008). We provided the first correlational and experimental evidence that the visceral experience of coldness can also lead to biased judgment about the risk of contagion in the context of COVID-19 pandemic.

Finally, current findings have strong implications for organizations and policymakers. The low temperature not only enables the coronavirus to survive longer, but skews people's perceptions of contagion probability. Thus, keeping warm in freeze weather might be a simple method to nudging people, especially those working in public service (e. g., cinema, pub, and hospitals), to have a reasonable estimation of contagion probability. However, spending more time indoors may facilitate the spread of respiratory virus and increase the risk of transmission and infection (Lu et al., 2020). Thus, using a room heater in winter could be a double-edged sword. Since people's beliefs about the COVID-19 pandemic appear to be constructed at the moment of elicitation, governments and policy makers may be well advised to provide more accurate and cognitively accessible information to the general public.

Several potential limitations should be noted. First, despite our research revealing people's assessment of risk is swayed by short-lived temperature, the underlying mediating mechanism regarding how or why this effect emerges has not been fully explored. Future research should explore the psychological process underlying the observed effects. Second, though we sampled a broad cross-section of society in terms of age, gender, occupation, and many other demographics, we did not use the probability sampling method to obtain a diverse population

and therefore the nature of the data should not be considered truly nationally representative. Third, our evidence is restricted to China and thus the generalizability of the findings should be tested elsewhere in the world. Finally, it is unclear whether enhanced scientific knowledge can eliminate the effect of perceived temperature on the overestimation of contagion probability. Future research revealing possible nudges that can debias this robust effect would be valuable.

CRediT authorship contribution statement

Heng Li: Conceptualized the study, developed the methodology, generated the writing, original draft, revising, review, and editing, data curation and validation.

References

Akerlof, K., Maibach, E. W., Fitzgerald, D., Cedeno, A. Y., & Neuman, A. (2013). Do people "personally experience" global warming, and if so how, and does it matter? *Global Environmental Change, 23*(1), 81–91.

Alahdal, H., Basingab, F., & Alotaibi, R. (2020). An analytical study on the awareness, attitude and practice during the COVID-19 pandemic in Riyadh, Saudi Arabia. *Journal of Infection and Public Health, 13*(10), 1446–1452.

Anderson, E. L., Omenn, G. S., & Turnham, P. (2020). Improving health risk assessment as a basis for public health decisions in the 21st century. *Risk Analysis, 40*(S1), 2272–2299.

Bashir, M. F., Ma, B., Komal, B., Bashir, M. A., Tan, D., & Bashir, M. (2020). Correlation between climate indicators and COVID-19 pandemic in New York, USA. *Sci. Total Environ., 138835*.

Clark, A., Jit, M., Warren-Gash, C., Guthrie, B., Wang, H. H., Mercer, S. W.Jarvis, C. I., … (2020). Global, regional, and national estimates of the population at increased risk of severe COVID-19 due to underlying health conditions in 2020: A modelling study. *The Lancet Global Health, 8*(8), e1003–e1017.

Coronavirus: How bad will winter really be?. Retrieved from. (2020, July). BBC https://www.bbc.com/news/health-53515077.

Daryanto, A., Song, Z., & Soopramanien, D. (2022). The COVID-19 pandemic as an impetus for pro-environmental behaviours: The role of causal attribution. *Personality and Individual Differences, 187*, Article 111415.

Derksen, M., & Morawski, J. (2022). Kinds of replication: Examining the meanings of "conceptual replication" and "direct replication". *Perspectives on Psychological Science. *, Article 17456916211041116. https://doi.org/10.1177/17456916211041116. In press.

Dhanani, L. Y., & Franz, B. (2020). Why public health framing matters: An experimental study of the effects of COVID-19 framing on prejudice and xenophobia in the United States. *Social Science & Medicine, 269*, Article 113572.

Duncan, L. A., Schaller, M., & Park, J. H. (2009). Perceived vulnerability to disease: Development and validation of a 15-item self-report instrument. *Personality and Individual Differences, 47*(6), 541–546.

Francis, G. (2012). The psychology of replication and replication in psychology. *Perspectives on Psychological Science, 7*(6), 585–594.

Gabanelli, P., Monzani, D., Fiabane, E., Quaquarini, E., Frascaroli, M., Balletti, E., & Gorini, A. (2022). Perceived risk, illness perception and dispositional optimism related to COVID-19 among oncologic outpatients undergoing in-hospital treatments and healthy controls. *Psychology & Health*, 1–17.

He, S., Chen, S., Kong, L., & Liu, W. (2021). Analysis of risk perceptions and related factors concerning COVID-19 epidemic in Chongqing,China. *Journal of Community Health, 46*(2), 278–285.

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*(3), 283–288.

Johnson, E., & Tversky, A. (1983). Affect, generalization, and the perception of risk. *Journal of Personality and Social Psychology, 45*(1), 20–31.

Jones, J., Sullivan, P. S., Sanchez, T. H., Guest, J. L., Hall, E. W., Luisi, N.Siegler, A. J., … (2020). Similarities and differences in COVID-19 awareness, concern, and symptoms by race and ethnicity in the United States: Cross-sectional survey. *Journal of Medical Internet Research, 22*(7), Article e20001.

Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American Psychologist, 58*(9), 697–720.

Kahneman, D., & Frederick, S. (2002). Representativeness revisited: Attribute substitution in intuitive judgment. In T. Gilovich, D. Griffin, & D. Kahneman (Eds.), *Heuristics and biases* (pp. 49–81). New York: Cambridge University Press.

Killerby, M. E., Biggs, H. M., Haynes, A., Dahl, R. M., Mustaquim, D., Gerber, S. I., & Watson, J. T. (2018). Human coronavirus circulation in the United States 2014–2017. *Journal of Clinical Virology, 101*, 52–56.

Klein, R. A., Vianello, M., Hasselman, F., Adams, B. G., Adams, R. B., Jr., Alper, S., … Sowden, W. (2018). Many labs 2: Investigating variation in replicability across samples and settings. *Advances in Methods and Practices in Psychological Science, 1*(4), 443–490.

Landau, M. J., Meier, B. P., & Keefer, L. A. (2010). A metaphor enriched social cognition. *Psychological Bulletin, 136*(6), 1045–1067.

Li, H. (2021). Living in turbulent times: The embodied effect of physical instability on opinions about the COVID-19 pandemic. In *, 19*(2). *Review of cognitive linguistics* (pp.

548–562). Published under the auspices of the Spanish Cognitive Linguistics Association.

Li, H. (2022). To vaccinate or not: The relationship between conscientiousness and individual attitudes toward vaccination in real-life contexts. *Scandinavian Journal of Psychology*. https://doi.org/10.1111/sjop.12816

Li, H., & Cao, Y. (2022). Rules we live by: How religious beliefs relate to compliance with precautionary measures against COVID-19 in tibetan buddhists. *Journal of Religion and Health, 61*(2), 1671–1683.

Li, H., & Shen, S. (2020). A clearer sense of self: Relationship between bilingualism and overconfidence bias. *Journal of Multilingual and Multicultural Development*, 1–14.

Li, Y., Johnson, E. J., & Zaval, L. (2011). Local warming: Daily temperature change influences belief in global warming. *Psychological Science, 22*(4), 454–459.

Lu, J. G., Quoidbach, J., Gino, F., Chakroff, A., Maddux, W. W., & Galinsky, A. D. (2017). The dark side of going abroad: How broad foreign experiences increase immoral behavior. *Journal of Personality and Social Psychology, 112*(1), 1–16.

Lu, J., Gu, J., Li, K., Xu, C., Su, W., Lai, Z., & Yang, Z. (2020). COVID-19 outbreak associated with air conditioning in restaurant, Guangzhou, China, 2020. *Emerging Infectious Diseases, 26*(7), 1628–1631.

Nooh, H. Z., Alshammary, R. H., Alenezy, J. M., Alrowaili, N. H., Alsharari, A. J., Alenzi, N. M., & Sabaa, H. E. (2021). Public awareness of coronavirus in Al-Jouf region, Saudi Arabia. *Journal of Public Health, 29*(5), 1107–1114.

Pennycook, G., McPhetres, J., Zhang, Y., Lu, J. G., & Rand, D. G. (2020). Fighting COVID-19 misinformation on social media: Experimental evidence for a scalable accuracy-nudge intervention. *Psychological Science, 31*(7), 770–780.

Prentice, D. A., & Miller, D. T. (1992). When small effects are impressive. *Psychological Bulletin, 112*(1), 160–164.

Price, R. H. M., Graham, C., & Ramalingam, S. (2019). Association between viral seasonality and meteorological factors. *Scientific Reports, 9*(1), 1–11.

Risen, J. L., & Critcher, C. R. (2011). Visceral fit: While in a visceral state, associated states of the world seem more likely. *Journal of Personality and Social Psychology, 100* (5), 777–793.

Rousseau, S., & Deschacht, N. (2020). Public awareness of nature and the environment during the COVID-19 crisis. *Environmental and Resource Economics, 76*(4), 1149–1159.

Schmidt, A., Brose, A., Kramer, A. C., Schmiedek, F., Witthöft, M., & Neubauer, A. B. (2021). Dynamic relations among COVID-19-related media exposure and worries during the COVID-19 pandemic. *Psychology & Health, 1–15*. https://doi.org/10.1080/08870446.2021.1912345

Serpas, D. G., & Ignacio, D. A. (2021). COVID-19 fear mediates the relationship between perceived risk and preventive behaviors: The moderating role of perceived effectiveness. *Psychology & Health*, 1–14.

Slimak, M. W., & Dietz, T. (2006). Personal values, beliefs, and ecological risk perception. *Risk Analysis, 26*(6), 1689–1705.

Smith, E. D., & Terry Bahill, A. (2010). Attribute substitution in systems engineering. *Systems Engineering, 13*(2), 130–148.

Wang, H., Yan, X., Cao, S., Li, L., & Kritikos, A. (2019). Interfering ACE on comprehending embodied meaning in action-related Chinese counterfactual sentences. *Language and Cognition, 11*(3), 479–498.

Watson, D., Clark, L. A., & Tellegen, A. (1988). Development and validation of brief measures of positive and negative affect: The PANAS scales. *Journal of Personality and Social Psychology, 54*(6), 1063–1070.

Williams, L. E., & Bargh, J. A. (2008). Experiencing physical warmth promotes interpersonal warmth. *Science, 322*(5901), 606–607.

Zaval, L., Keenan, E. A., Johnson, E. J., & Weber, E. U. (2014). How warm days increase belief in global warming. *Nature Climate Change, 4*(2), 143–147.

Zhong, C. B., & Leonardelli, G. J. (2008). Cold and lonely: Does social exclusion literally feel cold? *Psychological Science, 19*(9), 838–842.