Proceedings of the 3rd International Conference on Green Energy, Environment and Sustainable Development (GEESD2022), X. Zhang et al. (Eds.)

doi:10.3233/ATDE220350

Disaster Anthropomorphism: A Novel Method for the Conflicts Between Disaster Prevention and Sustainable Development Based on a Mechanism Description

Hao CAI[1], Shan LI[2] and Shoujiang ZHOU[3]
Business School, Sichuan University, Chengdu, Sichuan, China

Abstract. Conflicts between disaster and sustainable development broadly exist in the world, with lack of methods and techniques about disaster prevention. In this study, a new method for disaster mitigation is described, i.e., anthropomorphism of disasters. Anthropomorphism on natural disasters was not deeply studied in the previous research and it may have impact on the intentions of preventive behaviors among ordinary people due to stronger risk perception. Therefore, three studies are conducted to verify our hypothesis. This paper has verified the positive influence from anthropomorphism on the intention of preventive behaviors (Study 1) and have confirmed the mediating role of risk perception (Study 2). Finally, results in Study 3 showed when disaster is severe, the anthropomorphism will have positive impact on the preventive behaviors, whereas when the severity is low, the anthropomorphism will decrease the preventive behaviors. These findings might have broad applications in the field of disaster prevention.

Keywords. Sustainable development, disaster prevention, anthropomorphism, risk perception

1. Introduction

Natural disasters are occurring in higher severity due to climate warming and more frequent geological and human activities. Large-scale natural disasters have caused serious damage to personal life safety. For example, in 2021, around 3 million people were stricken in Typhoon In-Fa, which caused 398 people's death in the Henan Rainstorm. Therefore, it is extremely urgent for us to find a new method aimed at mitigating the contradiction between the more frequent disasters and high-speed development of humans. At present, China's natural disaster prevention measures and schemes are inadequate, which might result from the lack of disaster prevention awareness. Due to heavy social pressure and seemingly "infrequent" disasters, governments or enterprises are usually indifferent to carry out disaster prevention measures. Therefore, this study is aimed at designing a new method of disaster prevention to fill the gap of relevant research.

[1] Corresponding Author, Hao Cai, Business School, Sichuan University, Sichuan University, No.24 South Section 1, Yihuan Road, Chengdu, China, 610065; Email: edwardtsaii@qq.com.
[2] Email: lishan@scu.edu.cn
[3] Email: zhoushoujiang@foxmail.com

When people encounter disasters, negative emotions, such as depression, anxiety, powerlessness, etc., will emerge [1]. Generation of these emotions will urge people to search for new psychological sustenance. For instance, many people would resort to religion or superstition when suffering from disasters, in which disasters might be anthropomorphized as deities who want to punish humans [2, 3]. Even now, anthropomorphism still exists in disasters, and the most typical example is the naming system for tropical cyclones (e.g., a hurricane landed on the U.S. in 2021 named as Ida). Many studies have shown that hurricanes with male names cause less damage, because masculine names increased people's perception of risk and thus encouraged preventive behaviors [4]. Hence, anthropomorphism on disasters may be an effective approach for boosting the intentions of disaster prevention behaviors, which could apply in many fields. From the perspective of mechanism model, this research is aimed at seeking a novel and effective way of disaster prevention.

2. Conception and Hypothesis

2.1. Disaster

Disasters were recognized as sudden and uncontrolled events inducing a large scale of destruction and severe economy loss [5]. Hewitt [6] proposed vulnerability, a powerless, dependent and passive situation of individuals or groups when suffer damage, as a crucial factor of disasters. Thus, the disaster could be regarded as a phenomenon about an outcome of the vulnerability of humans and hazards, leading a great depression of the regional economy. We can briefly conclude the relation as "Disaster = Vulnerability + Hazard", from which we could learn that reduce the vulnerability of victims is a key point of decrease the damage form a natural hazard. Thus, prevention behaviour intentions can effectively reduce people's vulnerability to disasters, mitigating the disaster loss.

2.2. Anthropomorphism

Anthropomorphism means regard nun-human objects with human characteristics including both physical characters (i.e., appearance) and mental capacities (i.e., consciousness). The Three-Factor Theory proposed by Epley summarized anthropomorphism happens due to three crucial factors (i.e., Elicited-Agent Knowledge, Effectance Motivation and Sociality Motivation) [7]. In previous research, it was found that ordinary people have a tendency to regard nature as "mother nature" [8], which could promote people's pro-environmental behaviors, due to a relative positive appearance "mother" in their brain. Reversely, anthropomorphism on disasters might have a negative impact that people will prevent disasters more in an anthropomorphic situation, because disasters were usually humanized as evil appearance. This may help the application of anthropomorphism on the disaster prevention education.

2.3. Risk Perception and Preventive Behaviors of Natural Hazard

Risk perception is subjective judgement individually drawn from the perceived scale of risks. Risk perception has been studied in the field of natural hazard [9], which, however, merely relies on individuals feelings sometimes even irrationally [10]. For example, large quantities of people are anxious about the health risks originated from electromagnetic radiation of some electronic devices such as mobile phones, while tend to keep smoking, which, in contrast, is the most usual inducement of the cancer. This absurdity may be due to the unobstructibility and uncontrollability of these events, which make it easier for people to perceive risk without voluntary participation. Thus, the more exposure people feel to risks, the more risks they will perceive, which may promote loss-mitigation behaviors accordingly and helps implement of disaster prevention education.

In view of the above deduction, we propose the following hypothesis:

H1: Anthropomorphism of natural disaster will increase people's awareness of preventive behaviors.

H2: Risk perception plays a mediating role between anthropomorphism and natural disaster prevention behaviors.

2.4. Severity

Severity usually reflects the scale and intensity of the disaster. In meteorology, the severity of disasters is usually expressed by the disaster level (i.e., the earthquake magnitude of 0-9 M). In highly severe natural disasters, victims feel more powerless, depressed, anxious, fragile, and often have long-term post-traumatic stress disorder (PTSD) [11], so increased severity may elevate a person's sense of loss of control, which in turn reduces an individual's perception of power. Perception of power has been proved to influence the relationship between humans and anthropomorphic non-human objects. Hence, we propose the severity-to-power path could have effects on the relation between humans and anthropomorphic objects. Therefore, we proposed hypothesis that:

H3: Severity acts a moderate role in the relation between risk perception and the intention of the disaster preventive behaviors.

H3a: In low severity, anthropomorphism will lead to decreased perceived risk and less intention of preventive behaviors before natural hazard occurs.

H3b: In high severity, anthropomorphism will lead to increased perceived risk and more preventive behaviors before natural hazard occurs.

3. Studies

We carried out three studies to confirm our three hypotheses. Study 1 tested the relationship between anthropomorphism and preventive behaviors, Study 2 verified the mediating role of perceived risk between anthropomorphism and preventive behaviors, and Study 3 finally tested the moderating role of severity. All studies were used modified questionnaires originated from some previous studies of other researchers [12-15]. The final goal of these studies is finding a proper model to decipher the secret of the relationship between anthropomorphic disasters and preventive intentions, and finally to evaluate whether it can be used in disaster prevention education.

3.1. Study 1: The Anthropomorphism Effect of Natural Hazard on Prevention Behaviours

In Study 1, we tested the main effects of the anthropomorphic natural disasters on people's intentions of preventive behaviors. We chose typhoon as our study object, because typhoon is a usual natural hazard being anthropomorphized due to a naming system in Asian country (i.e. Nida, Shanshan).

3.1.1. Method

Participants. We hired some college students and gathered them in a disaster prevention class, and 91 research subjects were collected. There were 39 students in the non-anthropomorphic group (NAG) (16 males, 23 females, M_{age} = 19.29, SD = 1.37) and 52 ones in the anthropomorphic group (AG) (25 males, 27 females, M_{age} = 19.32, SD = 1.26).

Anthropomorphism Manipulation. We manipulated (non-)anthropomorphism by utilizing different expressions to the students. In non-anthropomorphism group, the typhoon was showed via a picture and a third-person description (i.e., "It"), whereas in AG, typhoon was exhibited by a picture with eyes and following descriptive paragraphs are written in first-person narrative (i.e., "I"). The paragraphs were phrased below:

NAG: "This is typhoon, and it will land on the coastal areas in China every summer, causing damage on the dwellers. To prevent the damage from typhoon, we need to learn more knowledge about typhoon prevention."

AG: "I am typhoon, and I will come to the coastal areas in China spoiling everything and bringing damage on the dwellers. To prevent the harm of me, you should learn some prevention knowledges about me."

For more details, see Appendix (Table 1).

Preventive Behaviors Scale. The Preventive Behavior Scale was modified from the scale in prior studies [12, 13]. The scale measured students' intention of preventive behaviors from three different aspects: information acquisition, psychological prevention, and material prevention (α=0.841, 7-point Likert Scale).

Procedure. We printed several teaching pictures, on which some are anthropomorphic typhoon and the others are non-anthropomorphic ones, respectively. In class, we distributed these pictures to the hired college students and asked them to watch the pictures several minutes. After that, we asked them to complete questionaries which contains some basic information and the Preventive Behavior Scale. We collected all the answer sheets except the data from 22 students who failed at our attention detection items (19.47%). All output data were analysed by IBM SPSS 26.0.

3.1.2. Results

Demographics. No significant difference was shown in terms of gender (F(1, 89) = 0.36, p = 0.509), education level (F(1, 89) = 0.36, p = 0.466), knowledge about disasters (F(1, 89) = 0.36, p = 0.839), disaster frequency in living regions (F(1, 89) = 0.36, p = 0.514) between the two conditions (non-anthropomorphism/ anthropomorphism).

Preventive Behaviors. We executed a one-way ANOVA with conditions (anthropomorphic and non-anthropomorphic) as fixed factor, preventive behaviors as dependent variable and demographics as covariables. The results manifested a significant positive impact of typhoon anthropomorphism on intentions of preventive behaviors (F(6, 84) = 7.97, $p < 0.05$, η_p^2 = 0.09), i.e., participants in AG tend to have

the intention of preventive behaviors (M = 4.77, SD = 0.80), compared to those in NAG (M = 4.31, SD = 0.96).

3.1.3. Discussion

Study 1 initially tested our Hypothesis 1: anthropomorphizing natural disasters could effectively promote people's motivation to engage in preventive behavior in response to the threats of potential natural disasters.

3.2. Study 2: Mediating Role of Risk Perception

Study 2 serves two goals: 1) replicate Study 1 to see if the findings are sustainable. 2) explore whether risk perception could act as a mediated role. For universality, we chose another disaster, earthquake, as our target.

3.2.1. Method

Participants. Like Study 1, we selected college students as our study subjects. At last, a total of 133 valid samples were gathered, including 61 participants from the NAG (35 males, 26 females, M_{age} = 23.82, SD = 2.12) and 72 ones from the AG (45 males, 27 females, M_{age} = 24.42, SD = 3.23).

Risk Perception Scale. The scale of risk perception comes from Walpole and Wilson [14], in which Risk Perception Scale contains 4 parts: Affect Subscale (α = 0.861, 3 items), Susceptibility Subscale (α = 0.858, 3 items), Exposure Subscale (α = 0.899, 2 items), and Extent Subscale (α = 0.859, 2 items), all of which are 7-point Likert scales (1 = *not at all* and 7 = *very much*). Other research materials like anthropomorphism manipulation method and the Preventive Behavior Scale (α=0.908) are similar to Study 1.

Procedure. The study process is similar to Study 1, but we added an anthropomorphism check item by asking "To what extent do you think the earthquake in this picture looks like human". Finally, we collected 133 questionnaire answer sheets and removed data from 52 participants who failed at our attention detection items (28.11%). All outputs were analysed by IBM SPSS 26.0.

3.2.2. Results

Demographics. No significant difference was shown in terms of age (Mann-Whitney U Test, p = 0.246) and gender (F(1, 131) = 0.36, p = 0.551) between the two conditions.

Manipulation Check. As we predicted, students in the AG perceive earthquake as more anthropomorphic (M = 4.76, SD = 1.59) than ones in the NAG (M = 2.91, SD = 1.67; F(1, 131) = 42.95, p < 0.01, η_p^2 = 0.25). Our manipulation is indicated as a success.

Preventive Behaviors. The data analysis is similar to that in Study 1. A significant main effect of earthquake anthropomorphism has shown in the result (F(1, 131) = 14.28, p < 0.01 , η_p^2 = 0.10) that students in the AG have more intentions of preventive behaviors (M = 5.24, SD = 0.80), compared to NAG (M = 4.61, SD = 1.12).

Risk Perception. Similarly, a one-way ANOVA was carried out with condition (anthropomorphic/non-anthropomorphic) as fixed factor and risk perception as outcome variable. Our results manifested that participants in AG (M = 4.64, SD = 0.84) presented greater risk perception than those in NAG (M = 5.07, SD = 0.68; F(1, 131) = 10.67, p < 0.01 , η_p^2 = 0.08).

Mediation Process. We finally tested our hypothesized model by Macro SPSS PROCESS Model 4 of Hayes, 2013. As a result, anthropomorphism has a direct positive effect on preventive behaviors ($B = 0.32$, $SE = 0.14$, $p < 0.05$), shown in Figure 1. More essentially, significant indirect positive effect of anthropomorphism on preventive behaviors through risk perception was shown ($B = 0.31$, $SE = 0.12$, $p < 0.001$, 95% $CI = (0.11, 0.56)$), verifying the mediation.

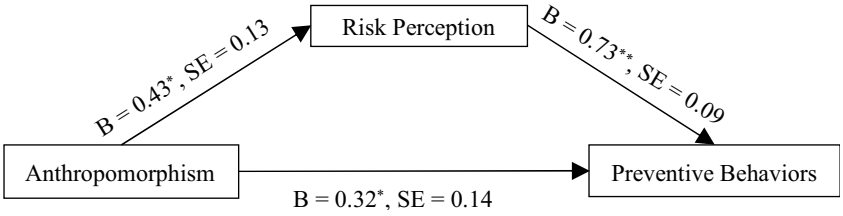

Figure 1. Mediation models.

Note: Significance levels are denoted by *p<0.05 **p<0.01.

3.2.3. Discussion

In Study 2, we successfully manipulated the anthropomorphism of earthquakes, and anthropomorphism significantly increased preventive behaviors. In addition, we found that perceived risks played a significant mediating role between anthropomorphism and earthquake prevention behaviors. In Study 3, we manipulated the severity of a natural disaster in order to find out whether severity acted as a moderating role.

3.3. Study 3: The Moderating Role of Hazard Severity

In Study 3, we manipulated the severity of natural hazard to verify its moderating role on the anthropomorphism and preventive behaviors. Besides, we confirmed effective mediating role of risk perception when moderating variable, severity, was introduced in.

For universality again, we chose another new study object, smog. Smog is classified into different severities via Air Quality Index (i.e., Great, Normal, Unhealthy, Hazardous), so its severity can be easily presented. Therefore, we designed a 2(anthropomorphism/non-anthropomorphism) × 2(low severity/high severity) between-participants experiment to verify our hypothesis.

3.3.1. Method

Participants. In Study 3, participants were divided into four groups (i.e., anthropomorphism/low severity, non-anthropomorphism/low severity, anthropomorphism/high severity, and non-anthropomorphism/high severity). 200 valid samples were collected (86 males, 114 females, $M_{age} = 18.94$, $SD = 1.04$).

Anthropomorphism and Severity Manipulation. Method of anthropomorphism manipulation is similar to that in Studies 1 and 2. Besides, we use different words (i.e., "light" vs. "heavy") and expressions (i.e., "induce some airway diseases" vs. "induce lung cancer") to achieve severity manipulation. Participants in different groups read following words, respectively.

NAG: "This is smog which could cause light/heavy air pollution. It can cause light/heavy air pollution. What's more, smog could have a serious impact on human

health, causing some respiratory diseases/lung cancer. If you want to prevent yourself from getting hurt, you should learn something about smog prevention."

AG: "I am smog who can induce light/heavy air pollution. I am culprit of light/heavy air pollution. What's more, I can cause a lot of trouble to your health, causing some respiratory diseases/lung cancer. If you want to prevent yourself from getting hurt, you should know more about how to prevent me."

For more details, see Appendix (Table 1).

Risk Perception and Preventive Behaviors. The Risk Perception Scale ($\alpha = 0.89$) and Preventive Behaviors Scale ($\alpha = 0.84$) are similar to Study 1&2.

Procedure. The procedure is identical to the Study 1&2. We gathered 256 questionnaire answer sheets and removed the data from 56 *participants* who failed at our attention detection items (28.0%). All result data were analysed by IBM SPSS 26.0.

3.3.2. Results

Demographics. No significant difference was shown in age, gender, disaster frequency and disaster knowledge (all $p>0.05$) among four groups.

Manipulation Check. We successfully manipulated the anthropomorphism in the two groups, i.e., in AG, students perceived more anthropomorphism of smog (M=4.73, SD=1.69), while ones in NAG felt less (M=3.69, SD=1.39; $F(1,198)=22.82$, $p<0.001$, $\eta_p^2 = 0.10$). Besides, we applied power perception to verify severity manipulation [15], i.e., less power perception implied higher severity. As we predicted, participants in higher severity group felt more powerless (M=3.10, SD=0.96), whereas ones in lower severity group felt more powerful (M=3.77, SD=0.96; $F(1,198)=24.96$, $p<0.01$, $\eta_p^2 = 0.11$).

Preventive Behaviors. Like Studies 1 and 2, we executed a one-way ANOVA, of which the results showed that higher severity caused more preventive behaviors (M=4.45, SD=0.87) than lower severity (M=3.87, SD=0.92) regardless of whether anthropomorphism happened ($F(1,198)=21.55$, $p<0.001$, $\eta_p^2 = 0.10$). In the contrary, however, anthropomorphism had inverse impact on the intentions of preventive behaviors depending on the severity extent. Specifically, in lower severity group, students showed less awareness of preventive behaviors in AG (M=3.73, SD=1.06) than those in non-anthropomorphic one (M=4.00, SD=0.75), though not significantly ($F(1,91)=2.08$, $p=0.153$, $\eta_p^2 = 0.02$), whereas in higher severity group, anthropomorphism would significantly positively affect the intentions of preventive behaviors (M=4.68, SD=0.89) compared to that in non-anthropomorphism (M=4.23, SD=0.79; $F(1,105)=7.63$, $p<0.01$, $\eta_p^2 = 0.07$), which confirms our Hypotheses 3a and 3b.

Mediation Process and Moderation Process. In order to verify if risk perception mediates the moderating effect of severity and the main effect of anthropomorphism on preventive behaviors, we conducted a mediated moderation analysis via macro–SPSS PROCESS Model 7 Hayes, 2013. The output data revealed a significant effect of the moderating role of severity (b=-0.72, SE=0.25, $p<0.01$), a significant mediating role of risk perception on preventive behaviors (b=0.48, SE=0.052, $p<0.01$), and a significant interaction effect between severity and anthropomorphism on risk perception (b=-0.54, SE=0.28, $p<0.05$). The interaction between severity and anthropomorphism has no significant direct influence on preventive behaviors (b=-0.041, SE=0.11, $p=0.71$). The overall model is shown in Figure 2.

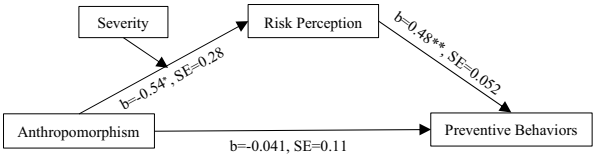

Figure 2. Moderated mediation model.

Note: Significance levels are denoted by *p<0.05 **p<0.01.

3.3.3. Discussion

Study 3 presented that (1) positive impact of anthropomorphism on intentions of preventive behaviors only showed in groups with high rather than low severity, and (2) risk perception substantially mediated the anthropomorphism effects.

4. Conclusion and General Discussion

4.1. Conclusion

This study verified the relation between natural disaster anthropomorphism and intentions of preventive behaviors through three studies, i.e., in the face of severe disasters, people generally feel powerless and have a higher risk perception, which increases the intention of preventive behaviors. In addition, we found that participants felt more powerful when faced with low-severity hazards, in which anthropomorphism reduced their disaster risk perceptions and thus decrease the intention of preventive behaviors.

4.2. General Discussion

To conclude, in this study, we provide a novel direction for disaster prevention, i.e., the application of anthropomorphism in disaster prevention and mitigation management. There are three main contributions to our research: (1) the operation of this method, anthropomorphizing disasters, is relatively concise. Different from lengthy disaster prevention and mitigation programs previously, disaster anthropomorphism is very simple and efficient, just by changing the appearance of the disaster, which has a very positive impact on people's psychological preparedness for disaster prevention. (2) We illustrate the mechanism of our method. We describe the mediating variables and moderating variables of the model. The comprehensive model would make our method relatively steadily applied in realistic. (3) We point out a novel orientation for future research on sustainable development of disaster prevention and mitigation. In the past, approaches to disaster prevention and mitigation have been too general and complex to implement, while our approach can provide a very specific implementation to help reduce the cost of disasters.

Acknowledgements

This research was in part supported by a National Natural Science Foundation of China (No. 7217020709) awarded to Prof. Shan Li. This funding source was not involved in influencing any aspect of this research project.

References

[1] Cuddy AJC, Rock MS, Norton MI. Aid in the aftermath of Hurricane Katrina: Inferences of secondary emotions and intergroup helping. Group Processes & Intergroup Relations. 2007;10(1):107-18.
[2] Vasconcelos AF. The effects of prayer on organizational life: A phenomenological study. Journal of Management & Organization. 2010;16(3): 369-81.
[3] Schuster MA, Stein BD, Jaycox LH, et al. A national survey of stress reactions after the September 11, 2001, Terrorist Attacks. New England Journal of Medicine. 2001;345(20):1507-12.
[4] Jung K, Shavitt S, Viswanathan M, et al. Female hurricanes are deadlier than male hurricanes. Proceedings of the National Academy of Sciences of the United States of America. 2014. p. 8782-7.
[5] Fritz CE. Disaster. In: RK Merton and RA Nisbet, Eds. Contemporary Social Problems. New York, Harcourt. 1961. p. 651-94
[6] Hewitt K. Interpretations of Calamity from the Viewpoint of Human Ecology. London. 1984.
[7] Epley N, Waytz A, Cacioppo JT. On seeing human: A three-factor theory of anthropomorphism. Psychological Review. 2007;114(4):864-86.
[8] Sacchi S, Riva P, Brambilla M. When mother earth rises up anthropomorphizing nature reduces support for natural disaster victims. Social Psychology. 2013;44(4):271-7.
[9] Bonaiuto M, Alves S, De Dominicis S, et al. Place attachment and natural hazard risk: Research review and agenda. Journal of Environmental Psychology. 2016;48:33-53.
[10] Siegrist M, Arvai J. Risk Perception: Reflections on 40 years of research. Risk Analysis. 2020;40:2191-206.
[11] Beaglehole B, Mulder RT, Frampton CM, et al. Psychological distress and psychiatric disorder after natural disasters: Systematic review and meta-analysis. British Journal of Psychiatry. 2018;213(6):716-22.
[12] Spittal MJ, Walkey FH, Mcclure J, et al. The earthquake readiness scale: The development of a valid and reliable unifactorial measure. Natural Hazards. 2006;39(1):15-29.
[13] Ter Huurne E, Gutteling J. Information needs and risk perception as predictors of risk information seeking. Journal of Risk Research. 2008;11(7):847-62.
[14] Walpole HD, Wilson RS. A yardstick for danger: Developing a flexible and sensitive measure of risk perception. Risk Analysis. 2021;41(11):2031-45.
[15] Morrison EW, See KE, Pan C. An approach-inhibition model of employee silence: The joint effects of personal sense of power and target openness. Personnel Psychology. 2015;68(3):547-80.

Appendix

Table 1. The (non-) anthropomorphic versions of natural hazard in Studies 1-3.

Item	Study 1	Study 2	Study 3
Non-anthropomorphism			
Anthropomorphism