Response to anonymous referee #2

We gratefully thank the anonymous referee #2 for your time spend making their remarks and useful suggestion, which has significantly raised the quality of the manuscript and has enable us to improve the manuscript. Each suggested revision and comment, brought forward by referee #2 was accurately incorporated and considered. Below the comments of the referee #2 are response by point and the revision are indicated.

General Comments:

This is an interesting paper asking the question of how we explain people's intentions to limit the impacts of flooding. Overall, I think the paper took several sensible choices. One top of the previous reviewers comments (many of which I also agree with), I would add the following (in no order of importance):

1. Comments: What is the research gap that this paper is trying to fill? I ask because there is a large amount of research on behavior intentions, and it is unclear in what direction the paper seeks to advance this literature. Is it for example is it, the application of this model to China [1, 2], or the application of a structural model of PMT to urban residents [3]? I raise this last paper as a comparison, as I think you follow a similar approach to those authors in that you start with PMT as a baseline model but greatly extend it into one that can start to be seen as moving towards the PADM [4], or other studies extending PMT [5].

1. Response: The main objective of the study is to investigate what factors influence the implementation of pluvial flooding precautions by urban residents in the context of a top-down disaster response model in China. And how do these factors interact with each other? It is clear that there are numerous factors that influence the implementation of flood adaptation measures by residents, and this has been mentioned many times in previous studies. But even so, we can still start the study with the currently available models

of human behavior. As mentioned by the reviewer, we followed a similar approach to these authors and used PMT as the baseline model while conducting an expanded study. In fact, at the initial stage, another model framework for this study is the Theory of Planned Behavior (TPB). However, this study introduced trust and affective factors on top of these two models, and we do not refer to this theoretical framework in the main text for ease of explanation. In addition, we rewrote the research purpose of this paper in the penultimate paragraph of the introduction to better understand the intention of this paper.

TPB was originally proposed by Ajzen (1991) to explain individuals' behavioral intentions and behavioral decisions. This theory is developed from the rational behavior theory (Fishbein et al., 1975), which proposes the factor of perceived behavioral control based on the retention of attitudes and subjective norms, and adds a path of interaction between the three (Fig. 1). In the context of flood risk, attitudes express individuals' perceptions of adopting flood damage mitigation measures. The subjective norm describes the personal impact of whether family, friends, etc. take flood damage mitigation measures. Perceived behavioral control indicates the subjective perception of an individual's personal ability to perform flood damage mitigation behaviors. TPB has been widely used in studies of climate change (Allred and Gary, 2019; Jacob et al., 2021), pro-environmental behavior (Martin et al., 2017; Wang et al., 2019), etc., to help researchers understand the factors that drive adaptive behavior.
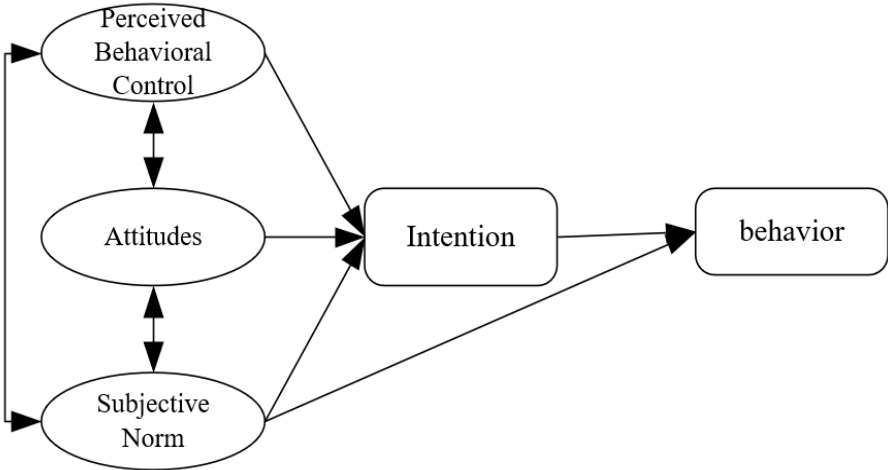
Fig. 1. Basic framework of TPB model.

2. Comments: Similarly, as the model contains more variables than the commonly used version of PMT used, is it that surprising that it has a better predictive capability? It would be strengthened if you could validate how much of a better predicative capability your proposed model has, and if the increased survey complexity is worth this trade-off?

2. Response: Thank you for your comments. Typically, the R^2 of the model increases with the addition of new explanatory variables relative to the commonly used version of PMT. However, from a modeling perspective, it is not better to have more variables, we need to make a trade-off between the significance and complexity of the model. For example, we added the additional variable of flood experience in the initial construction of the model, and after PLS-SEM calculation, we found that the R^2 value is 0.361, which is lower than the R^2 of the model proposed in this paper. In addition, due to the limited sample size, if there are too many variables, it will result in too small a sample size at a particular level, which will affect the precision and significance; it may also make the model over-fit. Our core purpose is causal inference, focusing more on the significance of the explanatory and explained variables. According to Occam's razor principle, we control the number of explanatory variables as much as possible while ensuring significance and predictive power, which is a trade-off from the model perspective.

3. Comments: The statement made on page 3, lines 81-82. This is quite a strong statement to make, especially as you state that you can model the heterogeneity as differences in risk coping attitude, as you define from data collected in your survey. I would think this raises the question of how this can deal with the heterogeneity in a more complete way than previous studies, as are not the different responses to the questions also looking at heterogeneity in the respondents?

3. Response: Thank you so much for your valuable comment. As the reviewer mentioned, our use of the concept of heterogeneity is indeed inappropriate. In order to avoid unnecessary conceptual confusion, we have revised this part according to the reviewers' suggestions and removed the expression of

heterogeneity from the manuscript.

4. Comments: The argumentation on page 4, I think this section needs more nuance introduced into it. This is because the relationship can also be explained by the temporal dynamics of adaptive actions being mismatched with the cross-sectional nature of the data commonly connected [6-13], which when accounted for can explain the relationships seen to be missing. This could also be seen as explaining the positive relationships with coping approval as people can increase their perceived coping appraisal after successfully implementing measures as well.

4. Response: Thank you for the above suggestion. We totally understand the reviewer's concern. In fact, this problem was also identified during our literature research and review. Cross-sectional surveys have been used in much of the previous literature, but differences in the timing of the surveys have led to ultimately different conclusions, which is where we find contradictions in our review. In fact, we tried to conduct a longitudinal study when we initially addressed the question to compensate for the current lack of research work in China in this part of the study. However, I have to state that the strict epidemic prevention and control policies in China made it difficult to carry out this work due to COVID-19, so we abandoned this operation and instead used an online questionnaire. The advantage of online surveys is the wide range and speed of the survey, but the disadvantage is also obvious, that is, we are difficult to do further surveys on the same sample.

Here, we need to be more clear that our investigation was conducted shortly after the flood disaster. This point was also mentioned in our discussion, although we did not explicitly state it in the hypotheses section of the model, which we will also further state in the revised manuscript. In addition, we chose to conduct the survey in the immediate aftermath of the flood with the aim of implementing policies that promote adaptive behavior by determining the most influential influences while people still have a high level of concern about the matter. This helps motivate residents to prepare for the next flood disaster.

5. Comments: The findings in relation to trust and social norms can also have additional nuance. This is because trust/social normal can impact multiple avenues of PMT both positively and negatively [14-17]. This has two further comments:

(1) Be more careful in using the word "trust" as you are explicitly talking about trust in governmental investment in protective measures.

(2) Given that there is a literature explaining potential interconnections between "trust" and other social factors to coping appraisals, why is it not connected in your model as well?

5. Response: We gratefully appreciate for your valuable comment. In the manuscript, we drew on Abrahamse and Steg (2013) to define social norms as the social pressure that people feel to act in a certain way. This social pressure comes from two main sources: one is informal social networks (neighbors, friends or relatives), and the other is from government-related policies. Therefore, we designed three questions to measure how well social norms bind the respondents: (1) What influence does your family have on your implementation of flood protection measures? (2) What influence do your neighbors, friends or relatives have on your implementation of flood protection measures? (3) What is the impact of government policies on your implementation of flood prevention measures? Moreover, the degree to which people sometimes perceive risk may not originate from the risk itself, but indirectly influence their production of adaptive behavior or protective actions by shaping the perception of social norms, as also confirmed in the article by Lo (2013). Meanwhile, we have also added and revised the content of social norms in the revised manuscript.

(1) In the manuscript, the "trust" we were referring to was the confidence and reliance of residents on public flood protection measures. To avoid confusion with trust in the concept of social capital, we have revised the wording in the revised version (Lo et al., 2015): **revise "trust" to "trust in public flood protection".** We designed three questions to measure respondents' trust in public flood protection measures: (1) I am confident that the flood defenses are maintained well. (2) I have confidence in the technological skills of flood risk managers. (3) I rely heavily on the local flood control facilities. Each

item measured was administered on a five-point Likert scale.

(2) The main objective of this paper is to identify the factors that influence the implementation of flood protection measures by urban residents in China. Therefore, in order to reduce the complexity of the model, we considered direct effect effects as much as possible, without fully validating the potential interconnections between the factors. This is what we need to add to our future work. In addition, the study of socio-economic factors will be a focus of future work as well.

6. Comments: Could you place the 9.50 RMB incentive for completing the survey in the social context– is this a large incentive, was it reasonable to assume it would help people answer the survey.

6. Response: Thank you for your comment. In 2022, the average monthly minimum wage in Henan Province will be 1800RMB and the average hourly minimum wage will be 17.6RMB[1]. Therefore, the 9.5RMB is very effective incentive for a questionnaire that takes a maximum of 8 minutes to complete. In addition, 9.5RMB can cover the cost of lunch for a normal adult in a small to medium sized city in China, and even in a large city like Beijing, 9.5RMB can cover the cost of lunch for a college student.

7. Comments: Following the information presented on the living conditions of the respondents described on page 10, I think you should mention the type of measures directly studied on the survey into the main paper itself. This is because if all the measures being asked for are not reasonable for employment by the households surveyed, I would question the fundamental validity of their stated intentions to employ the measures.

7. Response: Thank you for the above suggestion. In the revised manuscript, we added to the specific adaptation measures in the second paragraph of subsection 3.1, and described the statistical results in subsection 4.1.

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[1] 《Henan Provincial People's Government on the adjustment of the minimum wage in Henan Province notice》 https://www.henan.gov.cn/2021/12-20/2367979.html

We focus on five types of adaptation measures, categorizing them into structural, nonstructural, and risk transfer measures (Poussin et al., 2014; Dillenardt et al., 2021). The subjects of this study are urban residents, and in China, most urban residents live in buildings where the right to build houses is in the hands of real estate developers. Therefore, there is less freedom for residents to implement structural measures. Residents who are able to implement structural measures are mainly concentrated in low-floor or urban villages (villages formed when rural land is fully or partially expropriated during the process of rapid urban development and expansion, and villagers still live in villages formed by spontaneous construction based on the original villages.). The structural measures directly studied in this paper are the reinforcement of houses or /and construction of water retaining walls. Non-structural measures fall into three main categories: low, medium, and high-cost. Low-cost measures include participation in emergency drills or / and learning about flooding. Medium-cost measures include the preparation of sandbags, life jackets and other emergency supplies. High-cost measure is moving the shelter to a safe area away from flooding. Finally, the risk transfer measure is the purchase of flood-related insurance.

We conducted a frequency analysis of the five adaptation measures mentioned in this study, as shown in Fig. 3. About 45% of respondents were unwilling or unsure to implement structural measures, which was largely in line with our expectations, with urban residents more likely to blame housing developers for the implementation of structural measures. Of the non-structural measures, the low-cost measures were the most attractive, with about 83% of respondents expressing a clear willingness to participate in emergency drill activities or learn about flooding. In addition, for medium-cost measures such as the purchase of emergency items, nearly 70% of respondents said they were willing to implement them, a result that far exceeded expectations and should be related to the timing of the survey we chose. People had just experienced a flood caused by a 100-year heavy rainstorm, and were impressed by the disastrous consequences of the flood and the shortage of supplies, so most residents began to pay attention to the stockpiling of emergency supplies. At the same time, we also found that 62% of respondents were unwilling or unsure about moving their homes out of the floodplain, which was strongly related to the

cultural influence. Finally, on the issue of flood insurance, 53% of the respondents had the intention to purchase it. This survey also revealed that although the current prevalence of catastrophe insurance in China was low, residents had a high willingness to purchase it, which could provide an opportunity for the development and improvement of flood insurance mechanism in China.
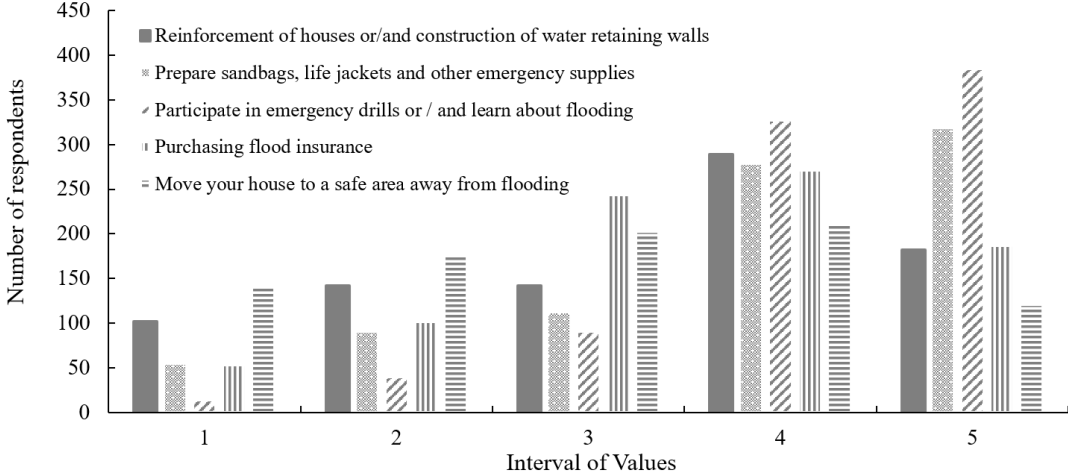

Fig. 3. Results of frequency analysis of five adaptive measures. 1=strongly unwilling, 2=unwilling, 3=undecided, 4=willing, 5=strongly willing.

8. Comments: I might be missing but for table 4, I only see that one of the variables has been defined elsewhere in the text.

8. Response: Thank you so much for your careful check. We mentioned the abbreviations in Table 4 in Table S1 of the Supplement document, but we forgot to mark them in the Manuscript, which was our negligence. This problem has been revised in the manuscript.

Table 4

Results of GoF, R^2 and Q^2.

Model	GoF	R^2					Q^2				
		IN	W	PC	PL	AT	IN	W	PC	PL	AT
PMT	0.412	0.312					0.175				
Proposed model	0.371	0.372	0.145	0.019	0.018	0.010	0.206	0.096	0.013	0.016	0.009

Note: IN: Intention; W: Worry; PC: Perceived consequence; PL: Perceived likelihood; AT: Attitude.

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