RESPONSE

We would like to sincerely thank the Reviewers for their constructive comments. With their help we managed to improve the overall quality of our work. Their contribution was valuable. We hope that the revised text meets the Journal's standards and that the replies to the Reviewers provide clear and adequate answers. To help the Reviewers and Editor, we list the **most important changes** made to the revised article:

1. We rearranged the article's sectioning and structure according to the suggestions.
2. We paid special attention to literature review. Quotations are written in a more direct and structured way.
3. We pinpoint more precisely the innovative aspects of our work. We particularly emphasize the value of a model that covers the limitations of existing literature and, more specifically, that includes relationships between variables that have not been modeled until now.
4. We enriched Sections Methods and Results with more Tables and Figures to make the article more attractive.

Answers to the Reviewers

Reviewer 1

1. The topic of the paper "HOW AWARENESS AND CONFIDENCE AFFECT FLOODRISK PRECAUTIONARY BEHAVIOUR OF GREEK CITIZENS: THE ROLE OF PERCEPTUAL AND EMOTIONAL MECHANISMS" is interesting but in the current form the article is not very attractive. I suggest to the Authors a shorter, clear and direct way to organise the article, especially because the topic is slightly outside of the expertise of usual readers of NHESS.

Following the Reviewer's suggestions we made significant changes to the structure of the paper and the presentation of methods/measures/results. Specifically,

1. Introduction: Short presentation of the subject significance and the focus of the study (main issue, area addressed and why, general contribution).
2. Theory and expectations
    - 2.1 *Factors influencing flood preparedness*: Literature review with the inclusion of literature findings that were initially only mentioned in terms of references.
    - 2.2 *The role of perceptual and emotional factors*: same changes as for 2.1.
    - 2.3 *Aims of the study*: specific objectives, literature gaps/concerns addressed, and specific contributions.
    - 2.4 *Model specification and hypotheses* (the inclusion of this paragraph in the theoretical sections was requested by Reviewer 2): The model specifications are explained clearly, using bullets. A Table (Table 1) has been added, reporting the model variables, their definitions, and indicative references about the effects of the model predictor variables on flood preparedness. A paragraph has been added that further explains the model's dependent variables, current preparedness and preparedness intention, and how the model addresses their interrelation. We consider the modelling of both the current preparedness and preparedness intention and the examination of their relationship important theoretical contribution.
3. We then rearranged the Methods section, specifically the 'Measures' section 3.3 in which we present all the information related to the constructs. For each of the multi-item variables, namely current preparedness, risk communication, risk perception, we added a table (Tables 3-5) reporting the respective survey question(s), the items, the mathematical equation used for the synthesis of the variable and the adjusted weights where applicable (for current preparedness and risk communication). It is now clear how the variables are measured. Relevant methods in literature are cited. Sub-paragraphs for each variable or set of variables have been created.
4. Section 4 Results has been restructured as requested. Sub-paragraphs have been created as follows:

4.1 Mediation effects

4.2 Direct effects
4.3 Correlation between current preparedness and preparedness intention
4.4. Effects of demographics.

Hypotheses results are listed with bullets. We also included the SEM estimates (stand. coefficient) of the effects in the text to enhance the scientific presentation and quality of the text. The effects are also reported all together in the Revised Table 7. We consider major improvement the model results illustration in the new Figure 4.

5. The Theoretical implications of Discussion have been revised. Two sub-paragraphs discussing separately the results related to the main objectives have been created (Perceptual and emotional mechanisms of preparedness; The link between current preparedness and preparedness intention)
6. Conclusions have been revised as requested, using bullets to highlight the main ones.

I suggest focusing on the following points:

1. There is no clear border between the literature and the work done for the paper. The Authors should quote the previous studies mainly into literature review. Currently it is very difficult to understand and distinguish the literature from the Authors opinions and elaborations. It is not to expect that the reader goes through the quoted literature: the article must supply the basic information to follow the discussion.

We took into serious consideration the Reviewer's comment. Therefore, the new Section 2. 'Theory and expectations' provides a detailed literature review and quotes the main findings. We have tried to make it clear this time which variables have been previously examined as for their effect on preparedness and which variables need to be examined. For example, in what concerns the concepts of risk communication and vulnerability awareness, which are introduced in our model, we added the following text to support why we introduce them as predictor variables:

"…Grothmann and Reusswig (2006) …The authors also argue that effective risk communication can motivate people to step up their efforts to prevent damage, especially those that were never directly affected by a flood. As Thieken et al. (2006) denote, flood hazards and mitigation strategies should be better communicated to encourage precautionary measures. The SREX IPCC report (Cardona et al., 2012) emphasizes the critical value of risk communication for effective adaptation and disaster risk management. Despite, however, the arguments about the importance of communicating risk to citizens in order to alert them, the impact of relevant actions on precautionary behavior has not been adequately addressed. Neither has the individual awareness of vulnerability - particularly the exposure-related vulnerability- examined as to the impact on precautionary behavior. However, researchers agree that the impact magnitude of floods on humans and their property depends strongly on the level of vulnerability due to exposure to hazard (Cardona et al., 2012)"

In addition, we added a new Table (Table 1) reporting clearly the model variables, their definitions, and indicative references about the effects of the model predictor variables on flood preparedness.

2. The paper needs to be rearranged in a more scientific way, introducing definitions of all the variables and clarifying the meaning of each variable in this specific article. This should be applied for example to page 2, line 35-40. Authors should talk of the two entities separately, not using a prosaic comparison and writing their name more than once (Current preparedness= xxx. Preparedness intention= yyy).

We believe that the new structure of the article and the added Tables and Figure (illustrating the modelling results) have greatly improved the presentation of the variables involved, the literature sources and the way they are calculated.

Especially with respect to preparedness variables, in the revised text we have emphasized the value of examining the two behaviors (Introduction), we have clarified them (Model specification), while the result paragraph (now called 'Interaction between current preparedness and preparedness intention') has been enriched with Table 8 that reports the average preparedness intention among the respondents who applied and the ones who did not apply flood-precautionary measures, depending on the cost level needed for the implementation.

3. Structure and graphic design of tables and figures currently are scarce and this affect the global quality of the paper.

We believe that the 5 new Tables give the article clarity, helping the reader throughout the text. We also believe that revised Figure 1, which presents the model graphically, follows the standards of models' conceptual illustration, as seen e.g. in Poussin et al. (doi:10.1016/j.envsci.2014.01.013), 2014 and Wachinger et al., 2013 (doi:10.1111/j.1539-6924.2012.01942.x).

We consider the new Figure 4 - illustrating the modeling results (in particular all the direct effects, since the indirect cannot be easily illustrated, nor is this a good practice) - major improvement of the overall results presentation.

4. Introduction needs a concise and direct description of paper objectives, because currently is difficult to comprehend.

In order to better communicate the objectives of our study, we first reformulated the introduction, which has become smaller and focused on the general theme, what motivates the study, the region and the people it is addressed to, and what has been done so far to cover Greece, a flood-prone Mediterranean area, in terms of the study of citizens' preparedness against floods. The Introduction ends with an overview of the expected contribution. We believe that this first contact of the reader with the reasons that led us to this study will facilitate the understanding of the specific objects of our scientific interest. Therefore, the second we did was to introduce a separate chapter which includes the literature review (2 paragraphs referring to *Factors influencing flood preparedness* and *The role of perceptual and emotional factors)*, the specific objectives of our own study and our empirical and theoretical contribution (1 paragraph called *Aims of the study*). These paragraphs have been rewritten to highlight the major findings of the literature and the gaps identified, as well as to unfold the main subject and the specific objectives of the study.

5. The abstract is not very explicative and in the current form, it is not easy to understand if the results obtained are consistent or not.

Following the reviewer's suggestion, the abstract contains more explicative information. In particular, apart from the mediating effects of risk perception and worry on preparedness variables – which are the main objectives- we included information about the direct effects of the predictor variables (awareness-raising and confidence-related factors) on preparedness. We believe that the reference to the structural equation modelling (SEM analysis) is an adequate proof of the overall scientific quality of the study.

6. Sections 2.2 and 2.3. If Authors eliminate the repetitions and go straight to the sense of the variables, the reader can understand the meaning. The Authors should make an effort to find a clear DEFINITION of each of the variables, moving the exaggerate number of reference in a specific column.

We believe that the new structure of the article and the added Tables have greatly improved the presentation of the variables involved, the literature sources and the way they are calculated. Specifically, Table 1 presents the variables and respective definitions and gathers indicative references for literature findings with respect to the effects of the predictors on preparedness. In addition, we specifically refer to the variables of preparedness in a separate paragraph, to highlight the contribution of the model in examining 2 behaviors (the existing and the intention) and their interaction.

As the literature sources and the concepts of the variables have already been fully formulated in the introduction and presentation of the model, a special reference to their composition and their calculation is made in the subchapter "Measures", where information is given about the way they have been calculated in previous studies. We would like to stress, however, that while the variables used in the literature, including the present study, are based on common concepts, there is no common or homogeneous way of calculating the measures of the variables. Therefore we present the sources with which we think we have the most common approach.

7. Authors should describe variables and model separately. Currently, the model has no name and I did not found a paragraph describing it in an exhausting way.

The section 'Model specification and hypotheses' has been revised to more clearly explain the conceptual framework and to provide specific definitions of readiness, which is the main issue. We left in the same chapter the presentation of the structure of the model, but adding Table 1 that we think facilitates the understanding of model variables. We named the model FPB, 'flood-risk precautionary behavior' model.

8. The core of the paper is the appendix 1, that the Authors. It is not homogeneous, contains formulas "described", questions, a lot of inverted commas and references, without reporting the meaning of the different values that the variables can assume. How the reader can understand the results if these elements are missing? For page 3 and for the appendix, I suggest a clear and definite table. It must be clear when the Authors: a) used a definition existing in literature, b) when they modified it and (above all) c) what is the definition, possibly using a scheme repeating for each variable.

In the revised text, the appendix Table has been removed. Following the previous comments, we transferred all the required information about the synthesis of variables and their calculations in section 3.3. *'Measures'*. In this section we included dedicated paragraphs for the model variables, explaining in detail their measurement, while we added explicative Tables for the multi-item variables, making the section more attractive. We also revised the texts to make clear in which sources we based the methods for measuring the variables. Descriptive statistics are included in Table 6.

Finally, we would like to assure the Reviewer that we accepted all the specific comments included in the supplementary material (submitted pdf with annotations and highlighted text). Most of these comments concerned the structure and attractiveness of the article, thus the answers have been provided in the above. In the revised manuscript, the Reviewers can find comments explaining all the revisions made according to the suggestions. Some of them deserve further clarifications:

We propose the Questionnaire to be added as a supplementary material. The Reviewers can find it attached to the submitted revised article.

Figure 1 that depicts the research model (named FPB, flood-risk precautionary behavior) has been improved as suggested. Arrows show all the predicted effects and hypotheses are symbolized and attached to the picture. To help the reader better understand the paths of the FPB (predicted effects) we included in the list of hypotheses also the predicted direct effects. Thus, section Results has been revised accordingly. Figure caption has been revised as: *Figure 1. Model of flood-risk precautionary behavior (FPB) and hypotheses. Dashed and straight arrows depict predicted mediation (indirect) and direct effects respectively.*

Path analysis was enriched with more information regarding the mediation (indirect) and direct paths. However, we should note that other published studies that apply the SEM-path analysis method are limited to quoting the statistical method (e.g. Terpstra 2011).

The rev. Table 7, showing statistical results for causal relationships, has been fully revised as requested. We believe it is now friendlier to the reader.

The use of a bullet list describing results for each of the issue analysed will be adopted, according to the suggestion.

Reviewer 2

The paper addresses a significant issue, in the general spectrum of flood risk perception and behavior. The authors examine hypotheses on whether risk perception and worry can mediate the effects of awareness raising and confidence-related factors. Overall, the paper is meaningful and provides novel results useful in the field. Scientific methods and assumptions are outlined clearly (although the manuscript would benefit from a few improvements in this sector).

1. Overall, the manuscript would benefit from making clear the boundaries between the introduction - problem presentation - literature review on one hand and approach-methodology-model used on the other. In the way it is currently presented, parts of literature are included in the model specifications and hypotheses (chapter 2) which seems more as an important part of the methodology. In other words, the numerous citations and the literature findings mentioned in chapter 2 can go in the introduction chapter, and the rest of the model and variables description can be part of the methodology.

In order to better communicate the objectives of our study, we first reformulated the introduction, which has become smaller and focused on the general theme, what motivates the study, the region and the people it

is addressed to, and what has been done so far to cover Greece, a flood-prone Mediterranean area, in terms of the study of citizens' preparedness against floods. The Introduction ends with an overview of the expected contribution. We believe that this first contact of the reader with the reasons that led us to this study will facilitate the understanding of the specific objects of our scientific interest. Therefore, the second we did was to introduce a separate chapter (Section 2, *Theory and expectations*) which includes the literature review (2 paragraphs referring to *Factors influencing flood preparedness* and *The role of perceptual and emotional factors)*, the specific objectives of our own study and our empirical and theoretical contribution (1 paragraph called *Aims of the study*). These paragraphs have been rewritten to highlight the major findings of the literature and the gaps identified, as well as to unfold the main subject and the specific objectives of the study.

Taking into account the suggestions of both Reviewers, we included a detailed literature review in (new) Section 2 '*Theory and expectations'*. Literature findings have been clearly and directly quoted to help the reader better understand empirical results. In addition, as we proposed in the initial review stage, the model specification and hypotheses are still a separate paragraph (2.4), however included in Section 2 '*Theory and expectations'* as suggested by Reviewer 2. In this section (2.4), a new Table (Table 1) has been added, reporting the model variables, their definitions, and indicative references about the effects of the model predictor variables on flood preparedness. Following the above rearrangements, we removed the sub-paragraphs that previously described the model variables and literature, reducing considerably the text.

In the revised text, the appendix Table has been removed. Following the previous comments, we transferred all the required information about the synthesis of variables and their calculations in section 3.3. '*Measures'.* In this section we included dedicated paragraphs for the model variables, explaining in detail their measurement, while we added explicative Tables for the multi-item variables, making the section more attractive. We also revised the texts to make clear in which sources we based the methods for measuring the variables. Descriptive statistics are included in Table 6.

2. I also suggest to the authors, although it is not necessary, to compile a figure that portrays the conceptual model of the study. Visualization would greatly benefit the manuscript. I believe it could facilitate the readers in appreciating the concept of the study more easily. The above steps would clarify significantly the steps followed.

We believe that Figure 1, which presents the model graphically, follows the standards of models' conceptual illustration, as seen e.g. in Poussin et al. (doi:10.1016/j.envsci.2014.01.013), 2014 and Wachinger et al., 2013 (doi:10.1111/j.1539-6924.2012.01942.x). However, Figure 1 has been improved. Arrows show all the predicted effects and hypotheses are symbolized and attached to the picture. Figure caption has been revised as: *Figure 1. Model of flood-risk precautionary behavior (FPB) and hypotheses. Dashed and straight arrows depict predicted mediation (indirect) and direct effects respectively*

Minor issues

All of them have been taken into account, as explained in the initial letter to the reviewers. Some of them deserve further clarifications:

1. page 2, line 13-14: The use of Bubeck et al 2012 references is not clear. If they suggest the same thing please state this in the phrase.

In his review paper, Bubeck et al. deal (2012) with the perception of risk and precautionary behavior, drawing attention to the differences that arise when the behavior concerns measures already taken (that is current preparedness) and the intention to undertake measures (that is preparedness intention). The authors propose several ways to address the interdependence between current preparedness and preparedness intention. Finally, from an exhaustive list of references, they show that studies have so far studied the relationship between risk perception and either current preparedness or future intentions. They also highlight the low correlations found between risk perception and current preparedness. In our study we decided to study in depth the mediating impact of risk perception on both the current preparedness and the intention to invest in future measures, precisely to compare and evaluate these two different relationships.

As the above was not clear in the text, we added the following text to explain the examination of both the current preparedness and preparedness intention: (2.4 *Model specification and hypotheses)*: "The FPB

model also specifies and tests the relationship between the outcome variables (Y1, Y2). The existing literature has pointed out the need to examine whether the existing individual flood preparedness at the time of the behavioral survey relates to the intention of the individual to take precautions (Bubeck et al., 2012, Poussin et al., 2014). To our knowledge, however, no concrete empirical evidence exists regarding the direction and significance of this relationship. While it seems likely that the existence of protective measures will make further precautionary behavior less necessary, it is equally likely that the proven effectiveness of measures already in place will enhance precautionary behavior. Thus, we cannot a priori specify the relationship between Y1 and Y2 in our model. Instead, we investigate the type and significance of this relationship."

2. page 7, line 1: how much is the marginal positive effect?

The SEM coefficient for the effect of age on current preparedness is 0.02 (SE=0.006, p <.05). The effect on preparedness intention is statistically insignificant (p>.05), based on the threshold set for p-value. We added the information in the revised text.

4. page 8, line 3-4: family status was also associated in the literature. I believe should be mentioned here to strengthen this finding. (See: Thieken A.H. , H. Kreibich, M. Muller, B. Merz, Coping with floods: preparedness, response and recovery of flood-affected residents in Germany in 2002, Hydrol. Sci. J. 52 (2007) 1016–1037. Zaalberg R., C. Midden, A. Meijnders, T. McCalley, Prevention, adaptation, and threat denial: flooding experiences in the Netherlands, Risk Anal. 29 (2009) 1759–1778. Dooley D., R. Catalano, S. Mishra, S. Serxner, Earthquake preparedness: Predictors in a community survey, J. Appl. Soc. Psych. 22 (1992) 451–470. Papagiannaki et al. (2017) and Diakakis et al. (2018) for Greece findings agree with the family status results).

References have been added to strengthen this finding according to suggestions.

Marked-up manuscript

How awareness and confidence affect flood-risk precautionary behavior of Greek citizens: the role of perceptual and emotional mechanisms

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Abstract. This study examines the mechanisms of flood-risk precautionary behavior among the Greek citizens. To that end, we specify and test a mediation model in which awareness-raising factors and confidence attitudes influence the citizens' current flood preparedness and preparedness intention through perceptual and emotional processes. Raw data were obtained via an online survey that received 1,855 responses. Causal relations were tested by means of structural equation modeling (SEM). Overall, results indicate that risk perception and worry are significant drivers of preparedness intention. In particular, they act as mediating variables, explaining how flood experience, access to more risk information, vulnerability awareness, and trust in authorities affect citizens' intention to invest in precautionary measures. Especially trust was found to have a negative effect on worry, leading to lower preparedness levels. Worry was also found to have a significant role in explaining the current preparedness levels. Interestingly, citizens who had already undertaken precautionary measures in the past appear to be more willing to invest in more measures. Implications for improving flood-risk management in Greece are discussed.

Keywords: flood preparedness, risk perception, worry, mediation, flood-risk management, Greece

Comment [k1]: The abstract has been revised to better communicate the results of the study.

1 Introduction

Floods are among the most costly and life-threatening weather-related hazards, causing serious concerns among societies worldwide (Barredo, 2007). Moreover, the observed increase in European flood losses is largely due to the growing exposure of assets (Barredo, 2009). Emphasis is therefore given to the need to address societal causes of the increasing flood risk (Treby et al., 2006). During the last two decades, flood-risk management has undergone a gradual shift, moving from the investment in costly structural measures to non-structural measures and related policies that promote the enhancement of communities' resilience to floods (Nye et al., 2011; Cardona et al., 2012; Rambonilaza et al., 2016). In this effort, public authorities and citizens share the responsibility for the consequences of flooding (Lave and Lave, 1991; Fatti and Patel, 2013). Given a basic level of protection by the managing authorities, individuals' decisions may affect their exposure to flood risk and effectively contribute to the reduction of material losses (Kron, 2005).

Individual precautionary behavior is a crucial element of a community's preparedness against flood risk. As reported by the United Nations International Strategy for Disaster Reduction (UN/ISDR, 2009), individual preparedness contributes to the effective anticipation, response and recovery from the effects of disasters. Kreibich and Thieken (2008) showed that flood losses can be considerably reduced when private precautionary measures are undertaken. Therefore, a better understanding of the determinants of individual preparedness can help policy makers to improve communication and flood-risk management.

This article focuses on flood-risk precautionary behaviors of the Greek citizens. The general objective is to survey and better understand the factors that drive individual flood precautionary behavior in an area that has been poorly addressed.

Comment [k2]: The revised introduction contains a part of the original introduction, enriched with an ending paragraph that provides a brief insight into the motivation of work, the area targeted and the specific literature, and the general purpose.

Only recently Diakakis et al. (2018) surveyed the flood-risk perception of citizens of Attica, the region of Greece most affected by floods, and provided evidence of low levels of trust in the authorities, low levels of knowledge of protection actions and awareness regarding floods, as well as low levels of preparedness. An earlier study on individual emergency response to flash-floods in Attica (Papagiannaki et al. 2017) showed that precautionary behavior is associated with deeper feelings of worry or fear for flood hazard. Factors that can influence flood-risk perception and precautionary behavior have been the subject of surveys for different regions, with the aim of highlighting the most important ones. The articles by Bubeck et al. (2012) and Kellens et al. (2013) provide overviews of empirical findings of current literature showing that the array of flood preparedness drivers remain controversial. Thus far, however, the underlying causes of flood-precautionary behavior have not been sufficiently studied. This study therefore investigates within a structured context the mechanisms driving precautionary behavior, focusing on perceptual and emotional processes. Practical implications of the findings are related to the potential to inform on tailored approaches to risk management efforts in a region that is characterized by inadequate flood preparedness and risk communication.

2 Theory and expectations

2.1 Factors influencing flood preparedness

A growing number of researches investigate the extent to which citizens undertake flood mitigation measures and the factors that drive precautionary behavior, which can be grouped into two meaningful categories. The first category includes factors that may influence the level of citizens' awareness of flood-related issues. According to the review of current empirical literature conducted by Bubeck et al. (2012), personal flood experience and risk communication locally are among the main awareness-raising factors that influence the level of preparedness. Specifically, except for Takao et al. (2004) and Thieken et al. (2007), all the studies examined by Bubeck et al. (2012) show that negative flood experience is statistically related to higher degrees of preparedness. Moreover, Grothmann and Reusswig (2006) find a statistically significant relationship between the severity of damage suffered and flood mitigation behavior. The authors also argue that effective risk communication can motivate people to step up their efforts to prevent damage, especially those that were never directly affected by a flood. As Thieken et al. (2006) denote, flood hazards and mitigation strategies should be better communicated to encourage precautionary measures. The SREX IPCC report (Cardona et al., 2012) emphasizes the critical value of risk communication for effective adaptation and disaster risk management. Despite, however, the arguments about the importance of communicating risk to citizens in order to alert them, the impact of relevant actions on precautionary behavior has not been adequately investigated. Neither has the individual awareness of vulnerability - particularly the exposure-related vulnerability- examined as to the impact on precautionary behavior. However, researchers agree that the impact magnitude of floods on humans and their property depends strongly on the level of vulnerability due to exposure to flood hazard (Cardona et al., 2012).

The second category of potential drivers of flood preparedness includes factors related to one's confidence in the management authorities' coping capacity and in their own personal judgment and coping capacity. Feelings of trust in authorities have been found to discourage precautionary behavior (Terpstra, 2011) and to promote passive behavior (Poussin et al., 2014). Wachinger et al. (2013) argue that the lack of trust is likely to activate people who believe there is no other choice. Thieken et al. (2007) interviewed flood-affected inhabitants of Germany and concluded that knowledge about self-protection could positively influence the extent and type of private precautions and the ability of residents to perform mitigation measures.

The role of demographic variables has also been investigated, although the results are particularly contradictory on the extent to which such factors have a significant impact on precautionary behavior. Demographics are occasionally found to have only a marginal effect on preparedness (Terpstra and Lindell, 2013; Wachinger et al., 2013). According to the review of

Comment [k3]: This is a new section, composed from parts of the original Introduction and Model specifications.

Comment [k4]: New sections 2.1 and 2.2 provide a detailed literature review and quote the main findings about the drivers of preparedness so far.
We have divided theory into 2 subsections, presenting the exogenous factors (2.1) and those factors we consider as mediators (2.2).
Revisions intend to make clear what has been done previously and what has not been adequately addressed.

Kellens et al. (2011), homeowners appear to be more worried and better prepared; employment and income are associated with preparedness intention; and people that live in a less urbanized area appear to perceive higher flood risk (Scolobig et al., 2012).

2.2 The role of perceptual and emotional factors

In addition to the aforementioned variables, behavioral studies suggest that perceptual and emotional factors may also influence individual decision-making and attitude change. The perception of risk is shaped by the conceptual understanding of the expected threat (Glatron and Beck, 2008). According to the protection motivation theory (PMT) introduced by Rogers (1975; 1983) in the field of psychology, if the individual does not appraise an event as severe or likely to occur, no protection motivation, and thus no behavioral change, is expected. The studies of Botzen et al. (2009) and Terpstra (2011) suggest that risk perception may influence preparedness intention, even though their results were based on different constructs of risk perception.

It is nevertheless clear that risk perception alone is not a sufficient condition for the promotion of precautionary behavior. For example, as Kellens et al. (2013) argue, flood risk may be differently perceived as a result of the level of human exposure to floods. Kreibich and Thieken (2008) found a positive correlation between risk perception and the adoption of precautionary measures among people who were affected by a recent flood event in their area. Wachinger et al. (2013) in their review of studies on risk perception in connection with natural hazards, show evidence that if experience arises from low-severity events, it may have a negative impact on precautionary behavior due to overestimation of individual coping capacity. This is enhanced by the findings of Ruin et al. (2007), which show that a person without flood experience tends to underestimate danger. In addition, risk communication may influence risk perception, especially when there is a lack of personal flood experience (Wachinger et al., 2013). In this case, effective communication of risk may help people to better perceive the potential negative consequences. On the other hand, feelings of security associated with trust in authorities may be associated with reduced risk perception (Poussin et al., 2014). According to Wachinger et al. (2013), trust is even more important in shaping risk perception if individual knowledge about the hazard is low. Apart from the perceptual factors, prior empirical work shows that emotions, such as worry and fear of floods, are also likely to trigger precautionary behavior (Miceli et al., 2008; Bradford et al., 2012). As Raaijmakers et al. (2008) point out, the need for risk reduction is determined by the level of worry about the risk, as long as the individual does not ignore the risk.

2.3 Aims of the study

Comment [k5]: This paragraph became a sub-section of theoretical Section 2. It was revised to better communicate the primary and secondary objectives.

Drawing on the above, the present study adopts an integrated approach to examine perceptual and emotional mechanisms of flood-risk precautionary behaviors in the social context of Greece. The aim of the study is to explore and understand within a structured context the underlying causes of individual preparedness and to offer new evidence for the implementation of awareness-raising campaigns targeted at citizens to promote individual precautionary behavior. To that end, we first specify a research model following the hypothesis that risk perception and feelings of worry mediate the effects of key-predictors on flood precautionary behavior. The examined key-predictors are related to awareness-raising factors and confidence-related attitudes. As previously discussed, these factors have been identified either empirically or theoretically as potential preparedness stimuli. The extant literature, however, has not yet addressed simultaneously how perceptual and emotional mechanisms link these factors with precautionary behaviors. Thus, significant unmodeled relationships may have been omitted, which may result in either a partial understanding of the entire process or even misleading statistical findings.

Secondly, in the context of the research model we further investigate the relationship between two sides of precautionary behavior, specifically of preparedness at the moment of the survey and preparedness intention. As the need for increased resilience of societies to floods is ongoing, a continuous individual preparedness and renewal of protection measures is also

required. Therefore, the objective is to examine whether precautionary behavior is discouraged when the person has already adopted some risk-management measures.

To collect relevant data, we utilized an original internet-based survey targeting Greek citizens. The questionnaire was launched by the most trusted Greek meteorological site, which is also among the five most visited websites of general interest in Greece. A significant number of valid responses (1,855) was received. Structural equation modeling is applied to examine the derived hypotheses.

2.4 Model specification and hypotheses

The conceptual framework of the present model of flood-risk precautionary behavior -hereinafter FPB- has been built upon existing theories of individual attitude change, namely the initial PMT (protection motivation theory) and its revised version (Rogers, 1975; 1983). In PMT, cognitive processes facilitate fear-appeal components to stimulate behavioral change. It has been used by Bubeck et al. (2013), Grothmann and Reusswig (2006), and Zaalberg et al. (2009) to examine human attitudes against flood risk. The focus of PMT is on the cognitive appraisal of the risk rather than emotions; protection motivation is mainly due to cognitive processes. Poussin et al. (2014) applied an extended framework of PMT with additional components that literature has identified as potential predictors of flood damage mitigation behavior. Within this model, exogenous variables, such as flood experience and the provision of financial incentives, are examined for their direct effect on preparedness. The FPB hypothetical model – illustrated in Fig 1- extends alternative aspects of the mechanisms of self-protection behavior. It examines whether mechanisms that encompass both cognitive and emotional processes facilitate or discourage a person's precautionary behavior depending on the level of awareness and the confidence attitude this person has. More specifically, risk perception and feelings of worry are considered to act as mediators, thus to filter the effects of individual awareness and confidence on current preparedness and preparedness intention. A mediation process, X-M-Y, occurs when the influence of a given predictor variable X to a given response variable Y is carried through a third variable (mediator, M). Therefore, Fig. 1 illustrates our conceptualization of the Awareness/Trust- Perception/Emotion-Precautionary behaviors model, from a mediating process perspective.

Table 1 introduces the constructs, their definitions and indicative references that provide empirical or theoretical evidence of a positive, negative, or insignificant effect of exogenous variables on flood preparedness. In accordance with the definitions of the EU Civil Protection and Humanitarian Aid Operations (EC, 2019), preparedness refers to measures taken by individuals to prepare for, and mitigate the impact of flood events. Current preparedness refers to initiatives already taken, while preparedness intention refers to the intention of individuals to invest in measures in the near future.

On the basis of the above specifications, the FPB model hypotheses tested (Fig. 1) are the following:

- H1a. Risk perception (M1) mediates (dashed array) the effects of the predictor variables (X1-X5) on current preparedness (Y1).
- H1b. Risk perception (M1) mediates (dashed array) the effects of the predictor variables (X1-X5) on preparedness intention (Y2).
- H2a. Worry (M2) mediates (dashed array) the effects of the predictor variables (X1-X5) on current preparedness (Y1).
- H2b. Worry (M2) mediates (dashed array) the effects of the predictor variables (X1-X5) on preparedness intention (Y2).
- H3a-H3b. Awareness and confidence (X1-X5) have direct effects (continuous arrows) on risk perception (H3a) and worry (H3b).
- H4a-H4b. Awareness and confidence (X1-X5) have direct effects (continuous arrows) on current preparedness (H4a) and preparedness intention (H4b).

Comment [k6]: This was originally a separate Section. Following one of the Reviewers' suggestion we added it to the theoretical Section 2.
The content has been revised to better explain the conceptualization. The model was named flood-risk precautionary behavior -hereinafter FPB, as suggested by the Reviewers.

Comment [k7]: This new Table was built to provide clear definitions and relevant literature for each construct, according to the suggestions of the Reviewers. It also indicates literature findings related to the effects of the examined variables on preparedness.

Comment [k8]: We included hypotheses on the resulted direct effects (originally hypotheses focused on mediation effects; however judging from the comments we decided to include also hypotheses on the direct effects to help the reader understand all the model paths. Actually direct effects were already provided in the original version as part of the path analysis results. SEM produces estimates for all the causal effects, direct, indirect and total).

Based on literature findings (Table 1), predictor variables are expected to have positive effects on mediating and outcome variables, except for trust in authorities (X4) that has been found to negatively affect risk perception and preparedness intention (Terpstra, 2011). The FPB model also considers that there is a significant correlation between the outcome variables (Y1, Y2). The existing literature has pointed out the need to examine whether flood preparedness at the time of the behavioral survey relates to the intention of the individual to take precautions (Bubeck et al., 2012; Poussin et al., 2014). To our knowledge, however, no concrete empirical evidence exists regarding the direction and significance of this relationship. While it seems likely that the existence of protective measures will make further precautionary behavior less necessary, it is equally likely that the proven effectiveness of measures already in place will enhance precautionary behavior. Thus, we cannot a priori specify the relationship between Y1 and Y2 in our model. Instead, we investigate the type and significance of this relationship. Finally, demographic attributes that previous research has identified as potential antecedents of individual precautionary behavior (Y) act as control variables (C).

3 Method

3.1 Data collection

Greek citizens were approached via an online questionnaire launched by the www.meteo.gr website, which provides weather, wave, lightning, and dust forecasts produced by the weather forecasting group at the Institute for Environmental Research, National Observatory of Athens (IERSD/NOA) (Lagouvardos et al., 2003; Lagouvardos et al., 2017). This website is the most trusted Greek meteorological website and among the five most visited websites of general interest in Greece. The average number of daily unique visitors of the website exceeds 350,000. Surveys related to weather hazards are systematically posted with a very strong public response.

Our questionnaire was posted on 23 October 2016 and received 1,855 valid responses within a 5-day period. It contained 41 questions and aimed to examine preparedness in the country through the perspective of citizens and investigate drivers of preparedness in the face of flood threats or following a flood disaster. It was structured in the following order:

- Section A. Flood experience;
- Section B. Perceived risk and concern about predefined flood-related hazards and feelings of worry;
- Section C. Precautionary measures taken and intention to invest in such measures;
- Section D. Means of risk communication, information sources, confidence attitudes, and perceived causes of flood occurrence; and
- Section E. Settlement type, exposure attributes, and demographics.

The full questionnaire is available as a supplementary material.

Comment [k9]: We submitted the questionnaire as requested by the Reviewer.

3.2 Sample profile

Demographics

Table 2 provides the demographic characteristics of the respondents. Sixty eight percent of the respondents were males. Their ages ranged from 15 to 86 years. Compared to the last national census in 2011, the middle age category (31-60 years old) is overrepresented in the sample (74% compared to the 43% in the census), while older people (61-86 years old) are underrepresented (6% compared to the 23% in the census). These percentages probably reflect the low use of internet by the elderly. Twenty percent (n=370) of the survey population had been affected by floods. The majority of the affected respondents (67%) lived in urban areas of the country.

Comment [k10]: We called this paragraph Demographics, and subtracted literature, as it was suggested.

Comment [k11]: Table 2 has been revised to show also the coding of demographic variables.

Issues related to the flood-affected participants

Comment [k12]: We gave a title to the following analysis in order to separate it from demographics. We consider this analysis an extra proof of the on-line survey reliability.

Figure 2 contains information on the spatial and temporal distribution of the flood events recorded in the survey. Figure 2a shows the flood distribution of the questionnaire in the 51 prefectures of Greece in relation to the distribution of the total damaging floods recorded in the high-impact weather events database (HIWE) developed by the Institute for Environmental Research and Sustainable Development of the National Observatory of Athens - IERSD/NOA (Papagiannaki et al., 2013). The HIWE database is available online and is constantly updated to include the latest events (NOA, 2019). Both distributions correspond to the period of 2000-2016, for which HIWE provides a complete flood inventory. The largest proportion of floods in both distributions is attributed to the prefecture of Attica, which is the most densely populated and urbanized area in the country. Moreover, a statistically significant and positive correlation was estimated for the two distributions (Spearman's rho=0.50, p< .001). The estimated correlation shows a good representation of the country flood profile, thus enhancing the validity of the questionnaire responses and the reliability of the model analysis. Figure 2b shows the annual distribution of the survey flood record. One quarter of the experiences were related to floods that occurred during the most recent year (2016); however, the events reported cover a long period of time, which shows that the interest of the survey participants was not only driven by a very recent flood experience.

To assess the objectivity of the respondents about flood experience severity, the reported flood events were identified and evaluated based on the HIWE database. Each recorded flood was then attributed to the maximum 24 h rainfall observed in the corresponding municipality where the flood event occurred. This was feasible for 281 (76%) out of the 370 reported flood events. The correlation between the 24 h rain and the flood severity was positive and statistically significant (Spearman's rho=0.21, p< .001). This indicates that people more adversely affected by floods in their residential area were more likely to report a stronger flood impact. Thus, there is consistency between the rainfall hazard and the reported impact severity.

3.3 Measures

Measures for the FPB model variables were developed based on an in-depth literature review. Where necessary, the measures were adapted to better reflect the concepts of the model.

3.3.1 Current Preparedness

Various indicators have been used in recent literature to measure individual preparedness across different regions. Bradford et al. (2012) measured the self-assessed levels of personal preparedness in six European countries with a simple Likert-scale question. Miceli et al. (2008) developed a multi-item variable to measure the extent to which households in an alpine valley in Italy implemented flood damage mitigation measures. Similarly, Poussin et al. (2014) developed different multi-item variables to measure the extent of structural, avoidance, and emergency preparedness measures implemented by the citizens of three flood-prone regions in France. In the present study, current preparedness is calculated as the sum of eight dichotomous items inquiring about the flood-preparedness measures that the respondent has currently adopted. The items are weighted for their significance in relation to the relative personal effort and the cost required for their implementation. The items and adjusted weights are reported in Table 3.

3.3.2 Preparedness intention

Preparedness intention refers to the willingness of people to make private expenses to protect themselves against future floods. Hence, it shows not only the general intention of the individual to change precautionary behavior but also the extent to which the individual is willing to realize the self-reported intention. Terpstra (2011) measured the Dutch citizens' preparedness intentions, asking them questions about the extent to which they intend to take precautions. Similarly, in this

Comment [k13]: The structure of 'Measures' has been completely revised to enhance the text attractiveness.
1. sub-paragraphs for each variable or set of variables have been created.
2. for each variable we explain exactly how they are measured. Literature with same/similar approaches are quoted.
3. Tables for the multi-item variables (more than 2 items involved) have been added, to explain exactly the variable's synthesis (Table 3: Current preparedness. Table 4: Risk communication. Table 5: Risk perception)

study the participants were asked to indicate (on a 5-point scale) the extent to which they intend to invest in precautionary measures.

3.3.3 Awareness-raising variables

Similar to Grothmann and Reusswig (2006), to measure the experience severity the participants were asked to recall their most recent flood experience and to indicate (on a 5-point scale) the severity of the damage they suffered. Grothmann and Reusswig (2006) introduced the construct of threat experience appraisal in an extended version of the PMT model and found that it motivates protective responses.

Vulnerability awareness results from the synthesis of two elements related to a) the level of perceived exposure and b) actual exposure, meaning the hazard proximity (the distance from the closest hazardous water source). Similar to previous studies (Thieken at al., 2007), to measure the level of the perceived exposure to risk, participants were asked to rate their exposure based on objective reasons (e.g. staying in a flood-prone area suffering from frequent floods, or staying in an old/vulnerable house). To measure the actual exposure, participants were asked whether the distance of their residence is smaller or greater than 1 km. Vulnerability awareness is constructed by dividing the perceived exposure (3-point scale) by the actual exposure level (binary item).

Risk communication, although critical to enhancing flood resilience (Cardona et al., 2012), has not been adequately examined for its impact on flood preparedness. O'Sullivan et al. (2012) showed that access to information websites is related to higher flood resilience in Finland and Italy. In the present study, risk communication is measured as the sum of six dichotomous items about the means of risk communication used by local authorities to approach and inform the citizens. The communication means are weighted to account for the penetration of flood communications. In particular, it was considered that seminars on local dangers requiring the physical presence of the citizen and visualization of risks with maps and special warning signs are more effective means of communication. Alternative weights were also tested on the basis of different estimates made by colleagues with relevant experience without affecting the results of the analysis. Table 4 reports the risk communication items and adjusted weights.

3.3.4 Confidence attitudes

The construct of trust in the authorities, introduced in Terpstra (2011), was measured by two questions that rate on a 5-point scale a) the individual's confidence in the adequacy of the preventive measures taken by local authorities and b) the individual's belief that inefficient state measures have contributed to past floods. The variable of trust included in the model is derived from the average of these two elements, the second of which was reversed as it portrays a negative attitude.

Self-confidence was measured as the average of two discrete questions about the respondent's perception of being aware a) of local flood hazards and b) of the existing protection measures. Thieken at al. (2007) surveyed flood preparedness in Germany and introduced the constructs of perceived knowledge about the flood hazard of the residence and perceived knowledge about self-protection.

3.3.5 Risk perception and worry

Risk perception has been defined as the subjective assessment of the likelihood of occurrence of a particular type of accident and of the severity of the potential consequences (Sjöberg et al., 2004). Miceli et al. (2008) suggested combining these two elements of risk perception into an overall, more comprehensive indicator. Following this concept, a single variable was included in the preparedness model. Table 5 reports the specific questions used for the synthesis of risk perception. The reliability of the risk perception indicator is high (Cronbach's alpha=.88) according to recommended thresholds (Tavakol and Dennick, 2011). Worry was measured by a question about how concerned the respondent feels about a possible future flood event. We find the same approach in Bradford et al. (2012) and Zaalberg at al. (2009).

3.3.6 Demographics

Home ownership and gender are codified as dichotomous variables. Family size and employment status are codified as ordinal variables (Table 2) and age is continuous variable. To measure the degree of urbanization, the survey participants were asked to characterize their settlement based upon urbanization criteria (cottage area, village, small town or city).

Table 6 presents descriptive statistics and correlations between the model variables. We employed the non-parametric Spearman's rank correlation method, which does not assume normality of data and is appropriate for correlating both continuous and discrete variables (McDonald, 2014; Shipley, 2016). None of the correlations is high enough (Spearman's rho < 0.40) to raise any concerns for the subsequent analysis (Gujarati, 2004).

3.4 Statistical method

Path analysis, a structural equation modeling (SEM) methodology (Hayes, 2013), was applied to test the FPB model hypotheses. The use of SEM allows for a simultaneous evaluation of the relationships in a hypothesized mediation process, the *direct* effect of the predictor variable on the outcome, and the *mediation* effect explaining how an exogenous variable affects the outcome variable through the mediator (Iacobucci, 2010). The amount of mediation is called the *indirect* effect. Mediation effect can be classified as full mediation and partial mediation. Full mediation is reported when predictor variable X does not have a direct significant impact on response variable Y, but it has a significant effect on moderator M, which also has a significant effect on outcome variable Y. In partial mediation the difference is that predictor variable X has both a direct and an indirect effect on outcome variable Y.

SEM produces parameters that indicate the nature and size of the relationship between the model variables, and information about the overall fit of the model. To address possible interdependence that could bias the path analysis results, the specification model assumes covariance between the two outcome variables (Y1 and Y2). The Stata statistical software was used for all data analysis.

Note that the main specification does not include the age variable due to many missing values (34% of the population sample). The rest of the variables had a very low number of missing values, up to 3% of the population sample. In unreported analysis, we included age as control variable (n=1,227); age had only a marginal positive effect on current preparedness (SEM standardized coefficient .02, SE=0.01, $p< .05$), while the effect on preparedness intention was statistically insignificant ($p> .05$). The results remained qualitatively the same.

4 Results

Table 7 includes the path analysis results. The direct and indirect effects size is estimated using the standardized SEM coefficients. A *p*-value of 5% or lower is considered to be statistically significant. To assess the model validity, we report multiple fit indices (Marsh et al., 2004; Iacobucci, 2010). The comparative fit index (CFI) was above the threshold of 0.9 and both the standardized root mean square residual (SRMR) and the root mean square error of approximation (RMSEA) fit indices were below the threshold of 0.10. These results indicate a very good fit of the data (Hu and Bentler, 1999; Iacobucci, 2010).

To facilitate interpretation of the mediating role of risk perception and worry, Figure 3 shows the direct and indirect effects (standardized SEM coefficients) of predictor variables (X1 – X5) on current preparedness Y1 (Fig. 3a) and preparedness intention Y2 (Fig. 3b). The overall indirect effect is divided into the mediated effects attributed to risk perception and worry. The sum of the direct and the indirect effect equals the total effect of the predictor on the outcome variable.

Comment [k14]: More information are provided according to suggestions. We believe that more details are not necessary. We would like to note that other studies that apply the SEM are limited to just quoting the statistical method (e.g. Terpstra 2011).

Comment [k15]: The section Results has been revised according to the suggestions.

1.Sub-paragraphs have been created, dedicated to:
1) the mediation effect, 2) the direct effects 3) the relationship Y1-Y2 4)effects of demographics.

2. Hypotheses results are listed with bullets.

We also included the SEM estimates (stand. Coefficient) of the effects in the text to enhance the scientific presentation and quality of the text. The effects are also reported all together in the Revised Table 7.

We consider major improvement the model results illustration in the new Figure 4 (details are following).

Comment [k16]: This table showing statistical results for causal relationships has been fully revised as requested. We believe it is now more friendly to the reader.

4.1 Mediation effects

Path analysis results (Table 7) suggest that risk perception does not mediate the effects of the awareness-raising and confidence variables upon current preparedness (H1a). Risk perception, however, was found to mediate the effects of three predictor variables, namely experience severity (.01, $p< .01$), vulnerability awareness (.02, $p< .01$) and trust in authorities (-.03, $p< .001$), on preparedness intention (H1b). As expected, indirect effects ought to risk perception were found positive for experience severity and vulnerability awareness and negative for trust in authorities.

- Hypothesis H1a is not confirmed.
- Hypothesis H1b is partly confirmed. Mediation effects on Y2 due to M1 are statistically significant for three predictor variables (X1, X2 and X4).

With regard to the emotional process, results indicate that worry mediates the effects of experience severity upon current preparedness (.04, $p< .001$) and preparedness intention (.05, $p< .001$). Worry was also found to fully mediate (i.e., no direct effect of the predictor on the outcome was found) the effect of vulnerability awareness on current preparedness (.06, $p< .001$) and the largest part of the mediated effect on preparedness intention (.08, $p< .001$). The effect of risk communication on preparedness intention was fully mediated by feelings of worry (.02, $p\leq .05$). In contrast, risk communication appeared to have only a direct effect on current preparedness without the interference of emotional process. As presumed, worry was found to mediate the effect that trust in authorities has on precautionary behavior. The effect was negative on both the current preparedness (-.05, $p< .001$) and preparedness intention (-.06, $p< .001$). Moreover, the effect of trust in authorities on preparedness intention was fully mediated by the emotional process. Finally, worry was not found to mediate any of the effects of self-confidence on the two precautionary behaviors. The above findings provide partly support to hypotheses H2a and H2b.

- Hypothesis H2a is partly confirmed. Mediation effects on Y1 due to M2 are statistically significant for three predictor variables (X1, X2 and X4).
- Hypothesis H2b is partly confirmed. Mediation effects on Y2 due to M2 are statistically significant for four predictor variables (X1, X2, X3 and X4).

4.2 Direct effects

Path modeling results, in particular the direct effects (standardized SEM coefficients), are illustrated in Fig. 4. Results supported most of the predicted direct effects of predictor variables on risk perception (H3a). Specifically, the effects of experience severity (.27, $p<.001$), vulnerability awareness (.74, $p<.001$) and trust in authorities (-1.00, $p<.001$) were statistically significant. The SEM parameter estimates for the paths between risk communication or self-confidence and risk perception were not statistically significant. In respect to the impact of predictor variables on worry (H3b), the effects of experience severity (.19, $p<.001$), vulnerability awareness (.29, $p<.001$), risk communication (.07, $p<0.05$) and trust in authorities (-.21, $p<.001$) were statistically significant. The results show a non-significant estimate ($p>0.05$) for the effect of self-confidence on worry.

- Hypothesis H3a is partly confirmed. Direct effects on M1 are statistically significant for three predictor variables (X1, X2 and X4).
- Hypothesis H3b is partly confirmed. Direct effects on M2 are statistically significant for four predictor variables (X1, X2, X3 and X4).

Results indicated that predictor variables apart from vulnerability awareness have a direct impact on current preparedness (H4a). As expected, greater experience severity (.29, $p<.001$), risk communication (.18, $p<.001$) and self-confidence (.52, $p<.001$) were found to positively affect current preparedness, while greater trust in authorities was found to have a negative

Comment [k17]: We consider this new Figure illustrating the path analysis results (in particular all the direct effects, since the indirect cannot be easily illustrated, nor is this a good practice) major improvement of the overall results presentation.

Comment [k18]: SEM coefficients have been added throughout the section to enhance the presentation of the results

effect (-.50, p<.001). Overall, results did not support the predicted direct effects of predictors on preparedness intention, with the exception of self-confidence that was found to have a positive direct effect (.13, p<.001).

- Hypothesis H4a is partly confirmed. Direct effects on Y1 are statistically significant for four predictor variables (X1, X3, X4 and X5).
- Hypothesis H4b is partly confirmed. Direct effects on Y2 are statistically significant only for one predictor variable (X5).

4.3 Correlation between current preparedness and preparedness intention

Path analysis detected a positive covariance between current preparedness (Y1) and preparedness intention (Y2) (.29, p< .001). Moreover, the Spearman's rank correlation analysis showed a positive and significant correlation between Y1 and Y2 (Table 6). Further correlation analyses also indicated the strong relationship between Y1 and Y2 among the respondents with prior flood experience. Specifically, the Spearman's rho between Y1 and Y2 was 0.40 (p< .001) for the population sample with flood experience and 0.44 (p< .001) if the experience severity was over 3 (in a scale from 0 to 5). To further investigate the nature and significance of the Y1-Y2 relationship, we assessed the correlations between Y2 and each of the items that compose Y1 (Table 3). The Spearman's rho varied from 0.11 to 0.27 (p< .001) if the precautionary measure referred to investing money for simple flood-defense measures, for insurance, or for structural changes. The correlations were also positive when accounting for the application of non-costly measures (from 0.13 to 0.23, p< .001). In contrast, the correlations between Y2 and the 'no adaptation' items (Table 3, items 7-8) were negative (from -0.14 to -0.21, p< .001). These analyses support the model results with regard to the statistically positive correlation between Y1 and Y2. Table 8 reports the average score of preparedness intention among the respondents who applied and the ones who did not apply precautionary measures, depending on the cost level needed for the implementation.

Comment [k19]: A new Table is added to better explain the outcomes and enhance the paper attractiveness.

4.4 Effects of demographics

Overall, the control variables performed as expected. They were found to influence preparedness, as presumed, except for gender. We should note that prior studies largely question the effect of gender on precautionary behavior (Wachinger et al., 2013). In contrast, home ownership and unemployment, the rates of which in the present survey are representative of the census data, have been associated with precautionary behavior (Burningham et al., 2008). Home ownership (C1) had the largest positive effect on current preparedness (.94, p< .001), as well as on preparedness intention (.19, p< .001). Employment status, on a scale of 1 for unemployed to 5 for currently employed respondents (Table 2), was found to have positive effect on both current preparedness (.15, p< .001) and preparedness intention (.06, p< .001). Family size was also found to be related to precautionary behavior. This finding is consistent with the results found in the literature by Diakakis et al. (2018) and Zaalberg et al. (2009). Specifically, greater family size is related to higher levels of current preparedness (.13, p≤ .05) and preparedness intention (.05, p≤ .05). Higher urbanization, on the other hand, was found to be related to reduced current preparedness (-.28, p< .001) and preparedness intention (-.09, p< .01), in line with the findings of Scolobig et al. (2012).

5 Discussion

Comment [k20]: This section has been revised to enhance readability. Primary and secondary objectives are clearly written and addressed. Titles have been given to the respective sub-paragraphs, while discussion parts have been rearranged.

5.1 Theoretical implications

The primary objective of this study was to advance understanding of the mechanisms that link awareness-raising and confidence-related variables with current flood preparedness and with preparedness intention. The secondary objective of the study was to investigate the relationship between the existing degree of preparedness and the intention to invest in more

669 measures. Hence, the findings may help researchers to build more comprehensive models that would better predict flood-risk
670 precautionary behavior.
671
672 **Perceptual and emotional mechanisms of preparedness**
673 Overall, the results supported the hypothesis that perceptual and emotional processes constitute mechanisms driving flood-
674 risk precautionary behavior. The emotional mediating process is stronger when compared to the perceptual one. The majority
675 of the preparedness predictors are stimulated by feelings of worry for a flood event. Risk perception at the time of the survey
676 is associated only with preparedness intention. Thus, risk perception does not answer why awareness and confidence have
677 triggered the existing level of preparedness. However, it is likely that past risk perceptions might have affected prior
678 preparedness motivations, associated with what we call 'current preparedness'. Prior experiences and a broad framework of
679 past references might have influenced the perception of risk over time. A possible time-dependent relationship between risk
680 perception and precautionary behavior could partly be the answer to the concerns raised about the paradox that high risk
681 perception does not necessarily lead to higher preparedness or that it may even lead to lower preparedness (Siegrist and
682 Gutscher, 2008; Wachinger et al., 2013). A longitudinal study could therefore provide more evidence on the impact of risk
683 perception on individual precautionary behavior.
684 Both risk perception and worry appear to trigger preparedness intention in the presence of an environment that increases
685 citizens' awareness of flood-related issues and decreases confidence on the authorities' coping capacities. The latter is in
686 agreement with Wachinger et al. (2013) findings regarding the negative impact of trust on the perception of the likelihood
687 and magnitude of floods and hence the willingness to take private measures. The severity of a prior flood experience and
688 how it relates to precautionary behavior is also associated with the stimulation of flood risk perception and feelings of worry.
689 With regard to worry, the finding is in line with Siegrist and Gutscher (2008), who suggested that flood victims might have
690 taken more precautionary measures than citizens without flood experience, due to negative emotions.
691 Together worry and risk perception were found to fully mediate the impact of all the examined predictors on
692 preparedness intention, with the exception of self-confidence. An earlier severe experience, awareness of flood-vulnerability
693 and targeted risk communication may thus motivate people to take precautions due to the intervention of perceptual and
694 emotional mechanisms. In addition, the fact that higher trust in authorities was found to reduce preparedness intention is
695 fully explained by the examined mechanisms. Higher trust is shown to relate to decreased worry, in line with Terpstra's
696 findings (2011), as well as to decreased flood risk perception. As literature has pointed out, trust brings security feelings and
697 thus may be an important cause of the reluctance of citizens to take precautionary measures (Poussin et al., 2014).
698 The only variable not filtered by either risk perception or worry is self-confidence, which appears to have only direct
699 impact on precautionary behaviors. The more confident a person feels about knowing the local flood hazards and the
700 available protective measures, the higher the level of current preparedness and the intention to adopt precautionary behavior.
701 We should note that results about the mediating emotional and perceptual processes that lead to preparedness cannot easily
702 be compared to previous findings, as the recent literature has focused on the direct relationships between the factors relating
703 to individual precautionary behaviors. However, our empirical findings support the theoretical argumentation about the
704 regulating role of emotions in the relationship between the individual and the environment (Miceli et al., 2008). The role of
705 emotion has been treated with caution in the PMT. Rogers (1975) supported that the cognitive processes may better explain
706 the effects of fear-appeal components on attitude change. Our findings show that risk perception, as a cognitive process, may
707 indeed stimulate the intention of the individual to adopt flood precautionary behavior.
708
709 **The link between current preparedness and preparedness intention**
710 An interesting finding of the study is the positive correlation of current preparedness and preparedness intention that may
711 seem paradoxical at first glance. Why do citizens that are currently more prepared appear to be more willing to invest in

712 future precautionary measures? On the basis of further analyses discussed in the previous section, we argue that people may
713 acknowledge the benefits of precautionary measures previously implemented. Furthermore, citizens who are already well
714 informed and familiar with implementing measures probably feel more willing to repeat this behavior. We should also take
715 into account that flood precaution is not a one-off action. Precautionary measures may need refreshment over time. Our
716 analysis indicates that people evaluate the final benefit independent of the resources needed for a protection measure. As
717 shown, citizens are prepared to further invest in protective measures even if they have already invested in high-cost
718 measures. On the contrary, those who have not yet taken private measures are more likely not to be willing to change their
719 attitude in the near future.

720 We also acknowledge that there may be uncertainty regarding the actual behavior that will follow one's intention to
721 adopt precautionary behavior, as argued by Schifter and Ajzen (1985). That is, people may declare willingness simply
722 because they know that is the right thing to do. However, the online survey has the advantage that it protects respondent
723 anonymity, while it removes the presence of the judge-researcher. Hence, it allows for objective rather than 'satisfactory'
724 answers and reduces potential social desirability bias (Podsakoff et al., 2003). Nevertheless, the concluding remark is that the
725 relationship between the two preparedness variables is not straightforward. Variables that could intervene in this relationship
726 might be the self-estimated effectiveness of the previously applied measures, the usefulness of each of these measures based
727 on previous flood experience, and the assessment of the cost-saving the individual achieved. In addition, further questions to
728 evaluate the 'actual' intention of the respondent could be included in a future survey.

729 **5.2 Practical implications**

730 Results show a poor performance of current preparedness and a modest performance of preparedness intention. Individual
731 preparedness among the flood-affected respondents is higher, but again the average performance is marginally close to the
732 average level, which is 5 for the current preparedness (max=12) and 2 for the preparedness intention (max=4). This indicates
733 that there is significant potential for improvement of the overall preparedness of citizens, with support from the local
734 authorities.

735 Moreover, the profile of the survey participants shows that Greek people tend to perceive low risk from flooding but not
736 due to ignorance. In fact, the path analysis does not demonstrate an association between risk communication and risk
737 perception. As Brown (2014) points out, risk perception draws on much more than facts alone. Indeed, the results show that
738 risk perception is associated with vulnerability awareness. People who appreciate their exposure to flood risk more
739 accurately may perform higher risk perception.

740 Collective findings from the present study could inform policy makers on specific options that they could support to
741 improve flood-risk management at the local level. These options are related both to raising public awareness and to
742 establishing the right relationship between citizens and local authorities. As the results show, the effectiveness of these
743 options will be significantly affected by individuals' perception and emotions against flood risk. A successful campaign
744 should therefore include the promotion of information on the level of citizens' exposure to risk are at local level on the basis
745 of objective risks and lessons learned from past flood events. This will lead to increased awareness and activation of citizens
746 due to increased concern and flood risk perception.

747 Investment in the effective communication of local flood hazards and risks should be local authorities' priority. The
748 analysis of the survey participants' profiles shows that Greek citizens are not effectively approached by flood-risk managers;
749 the vast majority of citizens never received any information about local flood hazards from the local authorities. This
750 indicates a noticeable gap in the risk communication process or a highly inefficient top-down risk management. Both cases
751 may constitute significant weaknesses of Greek communities' resilience to floods. The high frequency of catastrophic flood
752 events due to rainfall has already been demonstrated in a previous study targeting Greece (Papagiannaki et al., 2013). In
753 addition, recent studies of the individual flood emergency responses in Attica found a low degree of individual response to

flood alerts, limited knowledge of flood risks and ineffectiveness of risk communication as well as low trust in authorities (Diakakis et al., 2018; Papagiannaki et al, 2017).

According to the survey results, people in more urbanized areas are manifesting higher trust in authorities and lower vulnerability awareness. Moreover, the urban environment is associated with reduced flood precautionary behavior. These findings indicate a high dependency of urban citizens on local authorities, which in turn may conceal complacency against flood risk. Therefore, policy makers should clearly reach the public audience with the message that building resilience against flood risk at the community level needs the involvement of the citizens. Results also indicated that people owning a home are more likely to be already prepared to a certain extent, as well as to be willing to invest in more measures. Therefore, especially in the case of property owners, a successful measure could be to provide financial incentives for the implementation of protective measures. For example, Poussin et al. (2014) showed that both homeownership and incentives from insurers increase the likelihood of French citizens implementing flood-risk mitigation measures.

6 Conclusions

Comment [k21]: This section has been significantly revised to address the Reviewer concerns. Main conclusions are listed with bullets and thus highlighted for the reader.

This study examined the hypotheses that risk perception and worry mediate the effects of awareness-raising and confidence-related variables on individual precautionary behaviors against flood risk. The methodological approach meant to integrate key-explanatory variables within a model that focused on important mechanisms of self-protective behavior. In this context, we further analyzed the association between the current flood preparedness and preparedness intention to provide an overview of behavior modifications. The most important conclusions can be summarized as follows:

- The proposed model in this paper showed that risk perception and worry constitute mechanisms of the individual's flood-risk precautionary behavior. In particular, together worry and risk perception explain how awareness-raising variables and trust affect citizens' intention to invest in precautionary measures.
- Worry was demonstrated to stimulate both the citizens' current preparedness and preparedness intention. On the other hand, risk perception failed to explain the existing level of preparedness. The possibility that past risk perceptions may have affected prior preparedness motivations, associated with what we call 'current preparedness' needs to be further investigated.
- Interestingly, current preparedness and preparedness intention were found to have a positive relationship. Citizens who have undertaken preparedness measures in the past appear to be more willing to invest in new measures, probably motivated by the benefits they gained from the efforts to protect themselves in the past.
- All the awareness and confidence variables included in the model were found to influence flood precautionary behaviors. Policy makers could benefit from these findings in designing more effective flood-risk mitigation strategies. Engaging citizens in their efforts to increase resilience of communities to floods can be of great value.

To conclude, the present study extends current knowledge of the drivers of citizens' flood precautionary behavior. The research findings could help researchers to build more comprehensive models of flood-risk precautionary behavior; they could also become useful material for the local authorities.

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Table 1. Definitions of FPB model variables and indicative references.

Comment [k22]: New Table

FPB model variable	Definition	Indicative references
Flood preparedness		
Y1 Current preparedness	The extent of structural, avoidance, and emergency preparedness measures implemented by individuals.	Miceli et al., 2008; Poussin et al., 2014.
Y2 Preparedness intention	The extent to which individuals intend to invest in precautionary measures.	Terpstra, 2011.
Variables influencing flood preparedness		*(Nature of effect on preparedness in parenthesis)*
X1 Experience severity	Experience severity appraisal of the most recent flood experience.	Grothmann and Reusswig, 2006 (+); Scolobig et al., 2012 (+).
X2 Vulnerability awareness	Perceived exposure to flood risk (a) in relation to actual local exposure (b).	(a) Thieken at al. (2007) (+); (b) O'Neill et al., (2016) about 'the role of distance'. Also based on Terti et al. (2015) definitions of exposure aspects of vulnerability to flood hazard..
X3 Risk communication	Rate of risk communication achieved by the authorities. Various communication means are examined.	O'Sullivan et al. (2012) (+, under conditions).
X4 Trust in authorities	Rate of trust in local authorities;	Terpstra, 2011 (-);
	Rate of lack of trust in local authorities.	Wachinger et al., 2013 (+).
X5 Self-confidence	One's confidence in own knowledge of local flood-related hazards (a) and mitigation measures (b).	Thieken at al. (2007) (+).
M1 Risk perception	The subjective assessment of the likelihood of a future event (a) and the resulting personal and material damage (b).	Miceli et al., 2008 (+); Kreibich and Thieken, 2008 (n.s.); Terpstra, 2011 (+)
M2 Worry	Worry about flood occurrence and consequences.	Miceli et al., 2008 (+); Bradford et al., 2012 (+).

The signs +, - and 'n.s.' signify positive, negative, or not significant effect on flood preparedness (the extent of measures taken or preparedness intention) respectively.

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929 Table 2. Demographic characteristics of the survey sample and coding of the respective FPB model variables

Comment [k23]: New Table

Demographic variables and coding	Percentage (rounded off values)
Gender (binary)	
1. Female	32
2. Male	68
Age (continuous)	
15 - 30	20
31 - 60	74
> 60	6
Employment (ordinal)	
1. Unemployed	14
2. Student	4
3. Homemaker	1
4. Retired	10
5. Employed	72
Family size (ordinal)	
1. 1 member	8
2. 2 members	18
3. 3 members	25
4. 4 members	38
5. > 4 members	11
Ownership (dichotomous)	
0. Rent	21
1. Home ownership	79

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Table 3. Current preparedness: items, adjusted weights and model variable

Comment [k24]: New Table

Current preparedness measures (dichotomous items)	Weights (w)
A. Have you or any other family member taken any of the following measures to avoid negative flood-related impacts?	
	High-cost measure
1. Construction or other modifications to your home in order to prepare for a possible flood	3
2. Purchase private insurance and/or home/vehicle insurance for natural disasters	3
	Medium-cost measure
3. Preventive drain cleaning, rain gutter control of your home	2
4. Preventive pumps in the underground areas of your home, storage of a generator, sand bags	2
	Low-cost measure
5. Attending seminars or searching for flood and precautionary information	1
6. Informing family members about practical protection measures during and after a flood event	1
	No measures taken
7. None of the above, the state has taken appropriate protective measures in my area	0
8. None of the above is necessary	0
Current preparedness = Σ_i (w x A) (ordinal variable)	

Table 4. Risk communication: items, adjusted weights and model variable

Comment [k25]: New Table

Risk communication means (dichotomous items)	Weight (w)
A. Have you been approached by your local authorities with any of the following information tools?	
	Strong communication
1. Seminars to inform the local community	2
2. Panels showing maps of areas vulnerable to floods	2
3. Informative/warning road signs	2
	Light communication
4. Brochures	1
5. Posts in local media (press, internet)	1
	No communication
6. None of the above	0
Risk communication = Σ_i (w x A) (ordinal variable)	

Table 5. Risk perception: items and model variable

Comment [k26]: New Table

Risk perception items (5-point likert scale)
In case of a flood event A. how likely do you think any of the following may happen to you? B. how concerned do you feel about the impact of the following?
1. Interruption of telecommunications, electrification
2. Transport Problems
3. Serious damage to your personal belongings (eg vehicles, outdoors / residential areas)
4. Destruction partial / total of your residence
5. Injury or loss of your intimates
Risk perception $= \Sigma_i (A \times B)$ (ordinal variables)

Table 6. Descriptive statistics and correlations (Spearman's rank coefficient (rho))

Variable	Y1	Y2	M1	M2	X1	X2	X3	X4	X5	C1	C2	C3	C4	C5	C6
Y1															
Y2	0.36***														
M1	0.07**	0.24***													
M2	0.16***	0.34***	0.51***												
X1	0.21***	0.08***	0.08***	0.22***											
X2	+	+	0.17***	0.17***	0.07**										
X3	0.09***	0.08**	+	+	0.05*	+									
X4	-0.12***	+	-0.25***	-0.17***	-0.07**	-0.13***	0.23***								
X5	0.21***	0.14***	-0.07**	+	+	-0.06*	0.32***	0.19***							
C1	0.18***	0.10***	+	0.05*	0.06**	+	-0.05*	+	+						
C2	0.06**	+	-0.13***	-0.10***	+	-0.05*	0.06*	+	0.12***	+					
C3	0.09***	0.07**	+	0.05*	+	+	+	+	+	0.18***	0.05*				
C4	0.05*	0.07**	+	+	+	+	+	+	+	+	0.05*	+			
C5	-0.13***	-0.09***	-0.06**	+	-0.10***	0.06**	+	0.06*	+	-0.12***	-0.05*	-0.07**	+		
C6	0.18***	0.09**	+	0.18***	0.11***	-0.06*	-0.10***	+	0.06*	0.19***	-0.07*	+	0.08**	+	
max 24 h rain					0.21***										
year of most recent flood experience															
	+	+	+	0.18***	-0.12*	0.16**	+	-0.10*	+						
Mean	3.87	1.85	5.37	2.18	0.59	1.10	0.39	1.09	1.51	0.79	1.68	3.28	1.76	3.58	42.1
Std. Dev.	2.70	1.14	3.65	1.17	1.30	0.58	0.93	0.83	1.10	0.41	0.47	1.11	1.42	0.78	12.2
Min	0	0	0	0	1	0.5	0	0	0	0	1	1	1	1	15
Max	12	4	16	4	5	3	8	4	4	1	2	5	5	4	86

Y1:current preparedness, Y2:preparedness intention, M1:risk perception, M2:worry, X1:experience severity, X2:vulnerability awareness, X3:risk communication, X4:trust in authorities, X5:self-confidence, C1:ownership, C2:gender, C3:family size, C4:employment, C5:urbanization, C6:age

Note. The sample size (*n*) in the correlations between pairs of variables is 1,810, except for the correlations with 'age' (*n*=1,227), 'year of most recent flood experience' (*n*=368), and 'max 24 h rain' (*n*=281). The 'max 24 h rain' is the maximum 24 h rain accumulated during the flood events reported by the survey respondents. Statistical significance, *p* value, is symbolized as: +*p* > .05 (not significant), **p*≤ .05, ***p*< .01, ****p*< .001.

Table 7. Path analysis results and fit statistics.

Comment [k27]: Revised table

Variables	SEM estimates [a]		SEM estimates [a]	
Indirect effects	Y1 Current preparedness		Y2 Preparedness intention	
	Mediated by risk perception	Mediated by worry	Mediated by risk perception	Mediated by worry
Hypotheses	***H1a***	***H1b***	***H2a***	***H2b***
X1 Experience severity	+	0.04(0.01)***	0.01(0.00)**	0.05(0.01)***
X2 Vulnerability awareness	+	0.06(0.02)***	0.02(0.01)**	0.08(0.01)***
X3 Risk communication	+	+	+	0.02(0.01)*
X4 Trust in officials	+	-0.05(0.01)***	-0.03(0.01)***	-0.06(0.01)***
X5 Self-confidence	+	+	+	+
Direct effects	Y1 Current preparedness	Y2 Preparedness intention	M1 Risk perception	M2 Worry
Hypotheses	***H4a***	***H4b***	***H3a***	***H3b***
X1 Experience severity	0.29(0.05)***	+	0.27(0.06)***	0.19(0.02)***
X2 Vulnerability awareness	+	+	0.74(0.15)***	0.29(0.05)***
X3 Risk communication	0.18(0.07)**	+	+	0.07(0.03)*
X4 Trust in officials	-0.50(0.07)***	+	-1.00(0.10)***	-0.21(0.03)***
X5 Self-confidence	0.52(0.06)***	0.13(0.02)***	+	+
Direct effects of mediators and controls	Y1 Current preparedness	Y2 Preparedness intention		
M1 Risk perception	+	0.03(0.01)***		
M2 Worry	0.22(0.06)***	0.27(0.03)***		
C1 Ownership	0.94(0.15)***	0.19(0.06)**		

C2 Gender	+	+	
C3 Family size	0.13(0.05)*	0.05(0.02)*	
C4 Employment	0.15(0.04)***	0.06(0.02)***	
C5 Urbanization	-0.28(0.08)***	-0.09(0.03)**	
Covariance Y1-Y2	0.29(0.02)***		
Observations (*n*)	1,810		
Fit statistics			
Chi-square	53.96	*CFI*	0.97
d.f.	10	*SRMR*	0.02
p	0.00	*RMSEA*	0.05
cd	0.28		

Note. Statistical significance, *p* value, is symbolized as: +*p* > .05 (not significant), *$p \leq .05$, **$p < .01$, ***$p < .001$.

[a] The SEM (Structural equation modeling) estimates are standardized coefficients with standard errors in parentheses.

Table 8. Average preparedness intention between the respondents who applied and the ones who did not apply flood-precautionary measures.

Comment [k28]: New Table

Current preparedness items (grouped by cost level, as in Table 3)	Average preparedness intention (Y2[1]) (*SE*, *N*)	
	Applied	Not applied
High-cost measures	2.13 (0.04, 951)	1.79 (0.03, 1682)
Medium-cost measures	2.03 (0.03, 1287)	1.77 (0.03, 1607)
Low-cost measures	2.12 (0.05, 603)	1.80 (0.03, 1718)
No measures[2]	1.19 (0.06, 302)	1.85 (0.03, 1841)

[1] Y2 coded as 0 'no intention' to 4 'very strong intention'. [2] Respondents that did not apply any measure demonstrate lower average preparedness intention.

Figure Titles

Figure 1. Model of flood-risk precautionary behavior (FPB) and hypotheses.

Notes: 1. Dashed and straight arrows depict predicted mediation (indirect) and direct effects respectively. 2. The two-way arrow between Y1 and Y2 indicates that these variables may be correlated without any assumed direct relationship

Figure 2. (a) Number of flood events per Greek prefecture in the period 2000-2016, as recorded in the HIWE database (NOA, 2018; Papagiannaki et al., 2013) and the survey. (b) Annual distribution of the survey flood reports (1955-2016).

Figure 3. Total effects (SEM standardized coefficients) of the FPB model's predictor variables on the current preparedness (a) and the preparedness intention (b). Each total effect is further analyzed into direct effect and indirect effects mediated by risk perception and worry.

Figure 4. FPB model path analysis results.

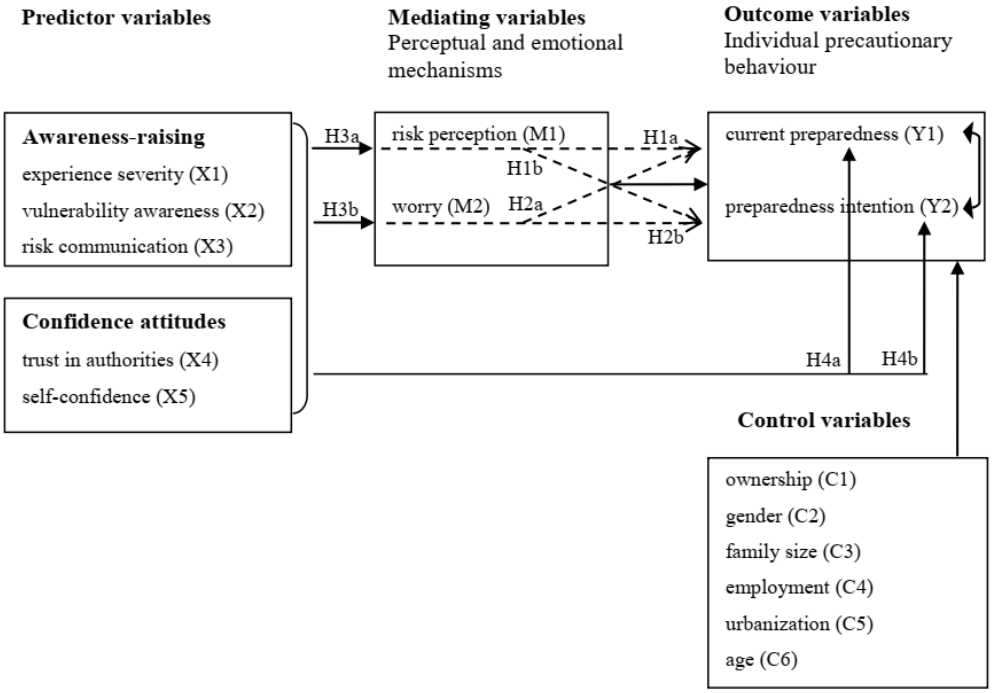
Notes: 1. Only the statistically significant direct effects (SEM standardized coefficients) are reported. 2. n = 1810. 3. $***p < 0.001$, $**p < 0.01$, $*p < 0.05$. 3. Indirect (mediated) effects are reported in Table 7 and explained in the results section. Dashed lines indicate the mediation paths.

Comment [k29]: Revised Figure

Comment [k30]: Revised Figure

Comment [k31]: Revised Figure

Comment [k32]: New Figure



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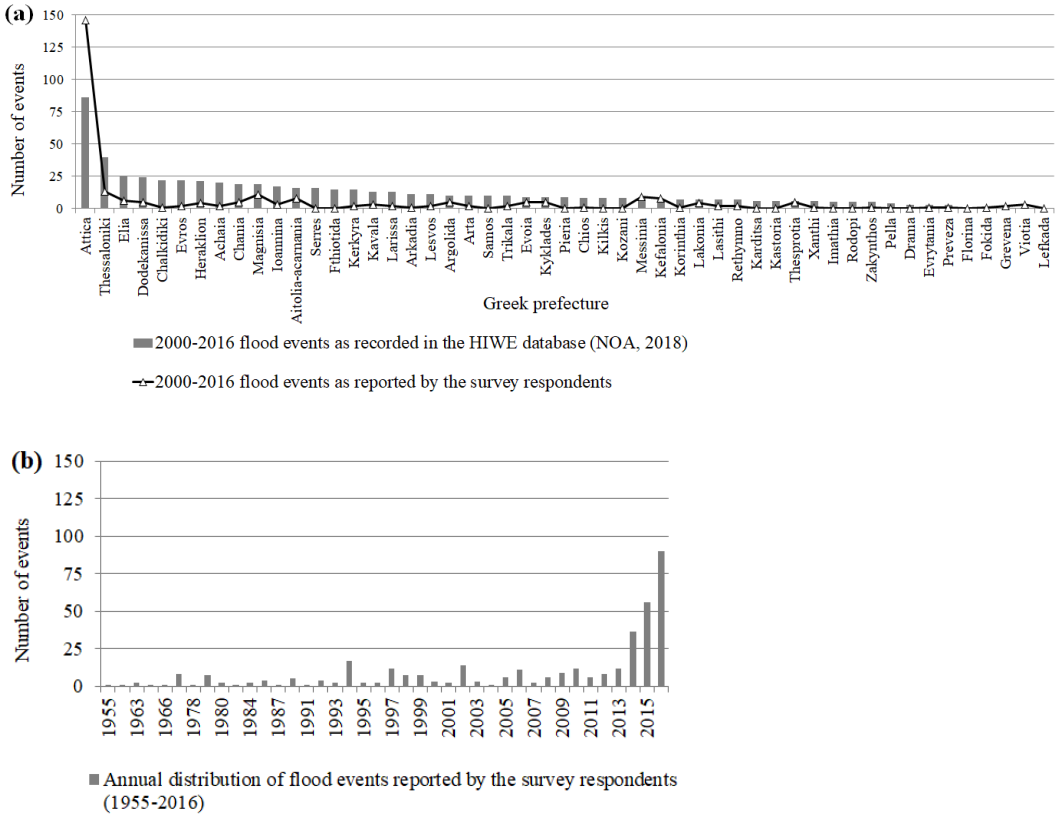

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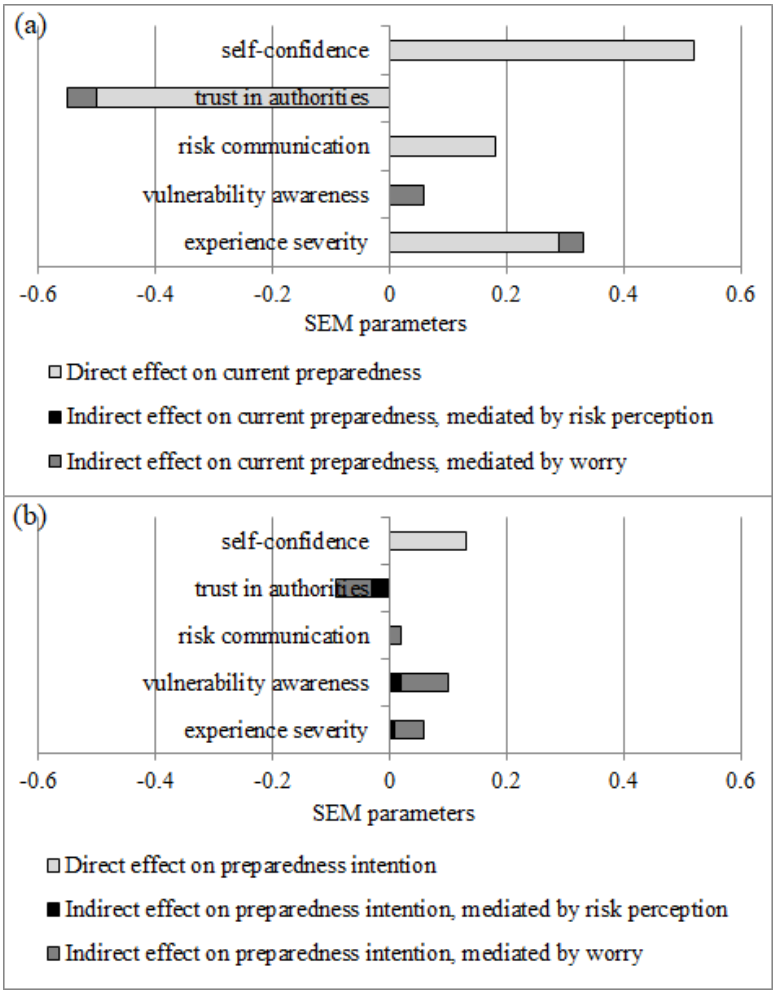

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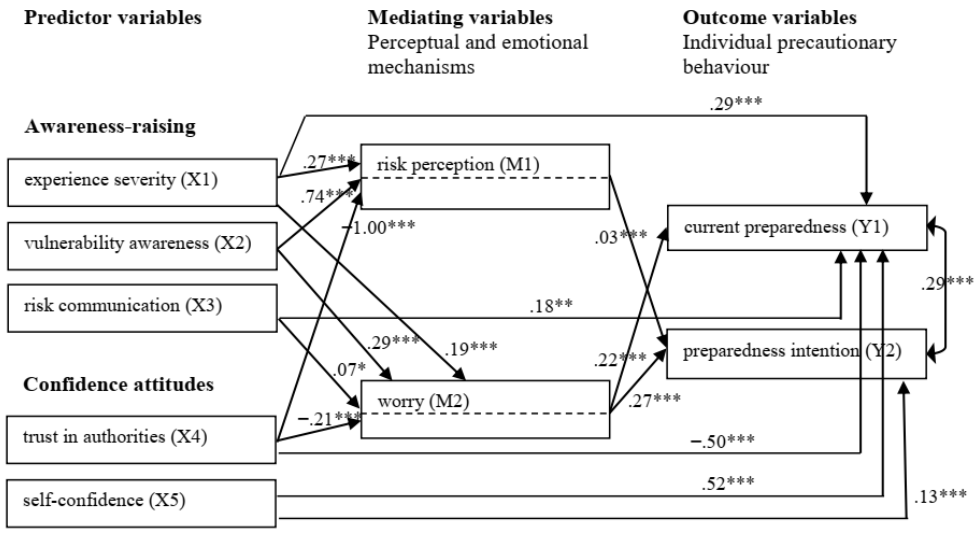

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