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Information, Experience, and Willingness to Mitigate Mental Health Consequences From Flooding Through Collective Defence

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Key Points:

- Demand for mental health risk reduction is elicited with a sequential scenario, accounting for experience and human resilience
- Demand is sensitive to information, driven by inexperience with flooding, by feelings, such as fears and worries, and by economic rationality
- Risk-averse individuals are willing to get collective flood protection in addition to self-insurance

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Abstract Demand for reducing mental health impacts from flooding through collective flood defence is elicited using a contingent valuation method with a sequential hypothetical scenario, which accounts for human resilience and experience. A two-step model fits the survey data: it combines a binary sample selection rule to distinguish protesters and participants with a Tobit model to accommodate true zero responses among participants. Results show that non-symptoms-specific information on mental health risk may bias the willingness to pay downward. Risk-averse individuals who have taken self-insurance protection measures are willing to pay for additional protection through collective defence. Feelings, such as worries and anxiety related to flooding, drive the demand, which supports the risk-as-feelings hypothesis for mental health protection from flooding. Inexperience rather than experience of flooding is found to increase demand, which indicates that individual mental resilience to flooding may increase after an event as posited by the inoculation hypothesis.

1. Introduction

The impact of flooding on mental health is being increasingly recognized. Evidence of short-term impacts on psychological morbidity (Paranjothy et al., 2011; Tapsell et al., 2002; Tunstall et al., 2006) as well as longer term impacts on wellbeing and psychological distress (S. Hu, Tan, et al., 2015) are observed. Those impacts spread beyond flooded households and are also experienced by those households on the floodplain, which were not flooded but whose activities were disrupted (Waite et al., 2017). Mental health-related impacts stem from psychological distress, post-traumatic stress (PTS) disorder symptoms, panic attacks and flashbacks, sleeplessness, lack of motivation, obsessive behavior related to flooding, depression, and anxiety (Alderman et al., 2012; Fernandez et al., 2015). Those symptoms may occur because of primary stressors, such as injuries or secondary stressors, which encompass more indirect consequences of flooding, such as dealing with insurance, living in a damaged house, or the loss of items of sentimental value (Tempest et al., 2017). Most individuals, however, do not develop a psychopathology after a disaster (Bonanno, 2004; Bonanno et al., 2010). The consequent upsetting of health status often results in a change of subjective wellbeing (Ngamaba et al., 2017) measured in terms of life satisfaction (Luechinger & Raschky, 2009; Sekulova & van den Bergh, 2016), health-related quality of life (Robin et al., 2020), or medical scores (Foudi et al., 2017; Tunstall et al., 2006), which can last from several months (Alderman et al., 2012) to some years (S. Hu, Tan, et al., 2015; Sekulova & van den Bergh, 2016) after the event.

Mental health impacts vary strongly from one individual to another as not everyone reacts similarly in the face of a stressor; the interplay of human resilience (Bonanno, 2004) and community resilience (Norris et al., 2008) affects the psychological consequences of an event. The human or individual resilience reflects the ability of individuals to maintain relatively stable health levels of psychological and physical functioning. Community resilience relates to a process, linking a set of network adaptive capacities to a positive path of functioning and adaptation in a population. Flood prevention measures, be they structural or nonstructural, public or private (Table 1), could possibly help individuals to recover an acceptable health status after flooding or prevent mental health degradation. Information on the demand for reducing mental health impacts from flooding will help to understand the interplay between community and human resilience and contribute to the understanding of socio-hydrological systems. These systems are described by dynamic processes between flooding and society (Di Baldassarre et al., 2015; Madani & Shafiee-Jood, 2020), which can explain flood risk perception and contribute to the understanding of the levee and the adaptation effects (Fuchs et al., 2017). In that sense, prior experience with flooding is expected to be an important driver of demand. The existence of a demand also informs on

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Table 1
Review of Flood Risk Reduction Programs

Study	Country	Method	Type of policy	Intervention	Type of damage	Willingness to pay per individual
Public flood policies						
Zhai et al. (2006)	Japan	CV	Structural	Sewage systems and dikes	Property	¥2,887 to ¥4,861 (mean)
			Nonstructural	Early warning system		¥1,000 to ¥2,000 (median)
Zhai et al. (2007)	Japan	CE	Generic	Not specified	Fatalities	¥4227 per year
Zhai and Suzuki (2008)	Japan	CV	Generic	Not specified	Fatalities	¥4422–7993 per year
Zhai and Ikeda (2006)	Japan	CV	Nonstructural	Evacuation inconvenience reduction	Evacuation inconvenience	¥1,030 per night
Reynaud and Nguyen (2016)	Vietnam	CE	Generic	Not specified	Financial losses	US$ 77–265
Brouwer et al. (2009)	Bangladesh	CV	Structural	Flood protection scheme	Human, property	US$ 4.3–6 (median)
Veronesi et al. (2014)	Switzerland	CE	Generic	Not specified	Health (illness)	149 CHF per year
Withey et al. (2019)	Canada	CV	Structural	Coastal defences	Generic	12-13 dollars per month
Jones et al. (2015)	England	CV	Structural	Coastal defences	Generic	£ 2–4.46 per month
DEFRA (2005)	England	CV	Structural	Flood defence	Mental health	£193–251 per year (mean)
						£115–125 per year (median)
Entorf and Jensen (2020)	Germany	CV	Structural	Retention basin and protection measures	Generic	50€/year (median)
Needham and Hanley (2019)	Scotland	CV	Structural	Managed realignment	Generic	£ 43 per year (mean)
Price et al. (2019)	Canada	CE	Structural	Green and gray infrastructures	Generic	81.8–103.24 dollars
			Nonstructural		Water services	56.95–95.55 dollars
Champonnois and Erdlenbruch (2021)	France	CV	Structural	Dikes, retention basin, and drainage network	Generic	45.92€
Fan and Davlasheridze (2016)	USA		Nonstructural	National flood insurance	Generic	US$ 179
Ghanbarpour et al. (2014)	Iran	CV	Structural	Levee	Generic	US$ 49.5
Glenk and Fischer (2010)	Scotland	CV	Structural	Soft engineering scheme	Generic	£ 41.4–45 per year
			Nonstructural	Insurance		
Private flood policies						
Brouwer and Akter (2010)	Bangladesh	CE	Nonstructural	Insurance	Property, crop, health, income	BDT 60-75 per week (crop)
						< BDT10 per week (property and health)
Botzen and van den Bergh (2012)	Netherlands	CE	Nonstructural	Insurance	Property	208–522 €/year
Botzen et al. (2013)	Netherlands	CV	Nonstructural	Elevating buildings	Generic	35–45 €/month
Brouwer et al. (2014)	Vietnam	CE	Nonstructural	Insurance	Fatality, generic	US$ 0.001–0.17 per year
Robinson and Botzen (2019)	Netherlands	CV	Nonstructural	Insurance	Property	-
Roder et al. (2019)	Italy	CV	Nonstructural	Insurance	Generic	250–800€ per year
Fahad and Jing (2018)	Pakistan	CV	Nonstructural	Insurance	Generic	US$ 0.13–0.42 per month
Reynaud et al. (2018)	Vietnam	CE	Nonstructural	Insurance	Medical costs, agricultural losses, property	1.33–1.4 million VND
Joseph et al. (2015)	England	CV	Structural	Property-level measures	Mental health, Generic	£ 179–331 (mental health)
						£ 284–440 (generic)
Champonnois and Erdlenbruch (2021)	France	CV	Structural	Property-level measures	Generic	35.89 €
Thistlethwaite et al. (2020)	Canada	CV	Nonstructural	Insurance	Generic	US$ 0.33–0.42 per month

Table 1
Continued

Study	Country	Method	Type of policy	Intervention	Type of damage	Willingness to pay per individual
Navrud and Vondolia (2020)	Ghana	CE	Nonstructural	Insurance	Crop damage	US$ 37.46
Owusu et al. (2015)	Scotland	CV	Structural	Property-level measures	Generic	£ 800
Ghanbarpour et al. (2014)	Iran	CV	Nonstructural	Insurance	Generic	US$ 33.6–51.8
Kuo (2016)	Taiwan	CV	Nonstructural	Insurance	Property, vehicle	US$ 62.07
Netusil et al. (2021)	USA	CV	Nonstructural	Insurance	Property	US$454–505 (median annual)

the appropriateness for individuals of a flood prevention measure, such as in this paper flood defence. Results provide relevant information on programs to prevent health consequences from flooding.

The elicitation of a hypothetical demand is made with a scenario of flood risk reduction thanks to a particular flood prevention program, applying a contingent valuation (CV) method. This makes it sensitive to the information contained in the scenario because demand for mental health prevention programs is expected to be influenced by experience and the ability of individuals to cope with PTS risk. A description of the scenario with no specific mental health symptoms can be more sensitive to individuals' resilience and experience on psychological distress. A description with specific symptoms reduces this sensitivity and also enables ensuring that unexperienced individuals do not overestimate their capacity to cope with flooding or underestimate the risk. Both levels of information quality are valid and complementary for the description of mental health risk since the effect of human resilience should not be excluded of the demand to obtain and characterize a closer-to-the-true demand, and over/underestimation of some of the risk should be controlled for.

In this paper, individual demand and its determinants for reducing mental health impacts of flooding thanks to a collective flood defence measure are elicited in order to evaluate the extent to which a collective flood defence can be perceived by individuals as contributing to mental health distress prevention. The identification of the determinants will inform on what motivates people to accept certain measures of flood risk reduction. Several effects on demand are analyzed: prior experience, aging, risk perception, worries, environmental stressors but also income, and other prevention measures. Particular interest is given to the effect of the information describing the scenario and more specifically the use of PTS symptoms to describe mental health risk. Two levels of information are considered: a generic description of psychological morbidity referring to stress and hassles (without specifying symptoms) and a PTS description informing about specific symptoms of psychological morbidity.

2. Previous Research and Challenges

Instruments or policies for managing flood risk can be assessed with CV methods. The policy instruments assessed for flood risk reduction are often tested with CV—a method of estimating the willingness to pay (WTP) of an individual for a good, contingent on there being a market for it—or choice experiment (CE)—a method of estimating economic values for characteristics (or attributes) of a non-market good—methods (Table 1). The instruments for flood risk reduction are structural flood protection, representing gray or green engineering interventions, such as dams, dikes, or reservoirs, and softer structural measures, such as nature-based solutions; nonstructural systems are non-engineering interventions, such as early warning system, insurance, and property-level flood risk adaptation measures, such as elevation, sand bags, and water pumps. Other policies are defined as generic, when the details of the prevention program are not presented. For most of the studies, the flood impacts are tangible impacts, which could include fatality and water-borne diseases. Few studies consider intangible impacts: they analyze the inconvenience of suffering an evacuation or more explicitly examine mental health problems. Information on the damage of flooding varies widely from one study to another. Some studies use a generic description (referring to flood damage or flood risk in general), while others describe specific impacts of flooding on health, properties, crop, or financial losses.

Implementing and analyzing a stated preferences method for flood risk reduction pose several methodological challenges related to, among others, the information bias and the treatment of zero responses. Information bias results from the quantity and quality of the information that describes the hypothetical market (Cummings et al., 1986). If there are substitute or complementary-related goods, which are not described, the valuation may be biased (Whitehead & Blomquist, 1991). Information on goods, payment mechanisms, and context also condition WTP. The quality of information provided in the description of the hypothetical market can bias the estimation of the willingness to pay (Bergstrom et al., 1990; Blomquist & Whitehead, 1998; Whitehead & Blomquist, 1991) to a point where the description of the market can be viewed as a persuasive communication to change intention to pay and attitudes (Ajzen et al., 1996). The effect of information on demand is however not always observed in studies. Some do find no effect on WTP values (Cummings et al., 1986; Loomis et al., 1994), while others reveal a bias (Bergstrom et al., 1990; Whitehead & Blomquist, 1991). There are several reasons that could explain the effect of information on valuation: the novelty of the information (Hoehn & Randall, 2002), knowledge (Needham et al., 2018; Tkac, 1998), the personal relevance and altruism dimension of the information (Ajzen et al., 1996), and education (Alberini et al., 2005). Prior experience is another reason (Cameron

& Englin, 1997; Whitehead et al., 1995). Indeed, the incompleteness of information may reinforce the effect of prior experience or familiarity with the environmental good. Thus, more complete information on the quality of the hypothetical market can reduce the bias between the quality perceived by a non-experienced user and the closer-to-the-true quality perceived by a more experienced user. In the case of intangible impacts of flooding, such as mental health symptoms, an incomplete description of the symptoms is likely to influence the way in which individuals without experience perceive the mental health impacts of flooding. Chanel et al. (2007) in an analysis of the WTP to reduce health risk owing to air pollution exposure find that providing specific information about morbidity and mortality increases the WTP. The information effect is often tested with an informed versus a non-informed scenario. In this paper, two levels of information are considered: in one, information on mental health is generic with no specific symptoms and refers to stress and hassle as consequences of direct impacts of a flood and in the other, the information specifies symptoms of psychological morbidity of the kind described in health and PTS scores, such as the General Health Questionnaire—GHQ-12 (Goldberg, 1978; Goodchild & Duncan-Jones, 1985) and PTSD (American Psychiatric Association, 2000). The sequential approach makes it possible to account for human resilience and experience effects in the valuation.

Another challenge of the CV method is how to interpret a zero WTP. The literature makes a difference between true zero and protest zero. A zero WTP is considered as a true zero when it is the consequence of an economic decision, often budget related or indicating indifference as to the provision of the amenity. When the reason reveals rather that the good is not desired for noneconomic reasons, which may be ideological or emotional, it is considered as a protest zero (Havet et al., 2012; Strazzera, Scarpa, et al., 2003). Wide heterogeneity is observed between different populations regarding these zeros and a large proportion of non-responses is often observed: 53.1% non-participation in the UK with 80% classed as protesters (Jones et al., 2015) and 60% non-participation in Bangladesh with 80% of them classed as true zeros (Brouwer et al., 2009). Other studies have a high rate of zero responses: Kriström (1997) has 77% of zero WTP, Saz-Salazar and Rausell-Köster (2008) have 79% of zero WTP. Although these values are outside the range of 20%–40% of Carson (1991), protest responses vary with the method and the nature of good (Jorgensen & Syme, 2000). The public good dimension of the intervention also influences responses (Johnson & Whitehead, 2000). The distinction between true zeros and protest zeros in CV models related to flood risk reduction is rarely modeled. Protest responses are often eliminated or different models are estimated with or without protests to test the sensitivity of the model to the inclusion of protests. Including protests as true zeros would bias the WTP downward, but eliminating them could generate a sample selectivity bias if protest respondents are correlated with the remaining sample (Strazzera, Genius, et al., 2003). Other models set out to deal with the sample selection bias due to protesting and the censored nature of WTP amounts (Cho et al., 2008; Strazzera, Scarpa, et al., 2003).

3. Method

3.1. Information Quality and Sequential Scenarios

Respondents to the survey are asked to value a collective flood defence program, which mitigates the impacts on primary (physical health) and secondary stressors (disruption of normal life and loss of items of sentimental values) of mental health. Two levels of information quality about mental health risk are combined in a sequential scenario—the answer to one scenario is conditional on having been asked for an initial scenario. This scenario is adapted and redesigned from DEFRA (2005). The change in regard to the DEFRA scenario lies in the redesign of the split-sampling to test a starting point bias, a modification of the symptoms described in the scenario and the use of a single level for the frequency of symptoms. It is assumed that the scenario with the more complete information will increase the WTP as expected from Blomquist and Whitehead (1998) and Chanel et al. (2007) and hence, the more complete information is in the second scenario of the sequence. All interviewees are asked to answer regarding the two scenarios.

The quality of the information in each scenario varies with the different measures of post-traumatic stress disorders (PTSD) (Table 2). An initial scenario—*Symptom-free*—describes general consequences of a flood on primary and secondary stressors of mental health and asks respondents to focus on the stress and hassle associated with those consequences without description of the intensity of the stress. A second scenario—*PTS*—describes some precise post-traumatic symptoms and their frequency as measured in PTSD scores (American Psychiatric

Table 2
The Two Sequencing Scenarios

Symptom-free scenario: For the purpose of the following questions, please assume that all damage to the buildings and contents of your home will be offset and that this will not result in increased insurance premiums for you. Here, we are considering the stress and hassle, which may result from other impacts of flooding, such as

- impacts on physical health: headaches, colds, injuries, etc.
- disruption to normal life
- loss of irreplaceable items: photographs, personal letters, etc.

Post-traumatic stress (PTS) scenario: Now assume that in the event of flooding, you experience the stress effects shown below. These may or may not match your experience to date but please think about how you would feel if you experienced the effects shown:

- You often feel nervous, have palpitations, or feel tense when reminded of the flood.
- You often have difficulty concentrating on tasks.
- You are often overtly alert or watchful for no reason.
- You are always reminded of the flood by triggers (such as TV programs, news, and heavy rainfall).
- You often have difficulty sleeping.
- These symptoms may cause you a lot of distress.

Flood defence is currently financed through taxation. Any money you may pay toward this improvement would not be available for your other household spending or for other public spending.

Association, 2000) or GHQ scores (Goldberg, 1978; Goodchild & Duncan-Jones, 1985) independently of the impacts on primary or secondary stressors.

Financial impacts are assumed offset in order to focus on psychological impacts resulting from non-monetary impacts. Physical and intangible damages have been shown to be a higher source of distress than material financial damage (Foudi et al., 2017).

The payment vehicle is based on taxation since the flood protection service provided by flood defences is a public good. The impact of flooding on related goods is acknowledged together with compensation for damage to those goods. It is emphasized that the flood defence will provide full protection, so no probabilistic flood protection level is used. Interviewees are asked their willingness to participate and to pay for flood defence in order to avoid the psychological impacts described in these scenarios.

The sequential approach could however be marked down by a sequencing bias (Cummings et al., 1986) or a question-order bias (Mitchell & Carson, 1989): the WTP could be biased by the order of the sequence. This bias is likely to occur for non-experienced individuals (Boyle et al., 1993) though Kartman et al. (1996) find no question-order effect for health-related risk reduction. Testing the sequencing bias lies outside the scope of this research. It is assumed that the sequencing bias would be a more significant issue for nested amenities. This paper does not consider an embedding effect or nested amenities: the same amenity—prevention of mental health problems with flood defence—is valued.

3.2. Eliciting WTP

CV methods elicit the individual reservation price for the provision of a non-market-valued good or amenity. Different methods are used to elicit this price (see Venkatachalam, 2004, for a review). An iterative dichotomous choice with three ascending bids followed by open-ended (OE) questions (Bateman et al., 1995) is used here with an initial question to learn whether interviewees are *in principle* willing to pay to reduce risk. After being informed of the Symptom-free scenario, they are asked about their willingness to participate *in principle* in the program. Those who decline to participate are asked to answer in regard to the PTS scenario. The preliminary questions of willingness to participate *in principles* are used to reduce strategic behaviors in the answers to the WTP questions. Those willing to participate are then asked the ascending iterative choice questions and a final OE question to elicit their maximum WTP (Figure 1). Respondents who answer "No" to a dichotomous choice question stop the series of choice questions are asked the OE question and then the PTS scenario. An abbreviated iteration format has been selected to make the process shorter than a double-bound format where descending iterative choice questions would have been asked. A limited number of bids (three) has been selected in order to

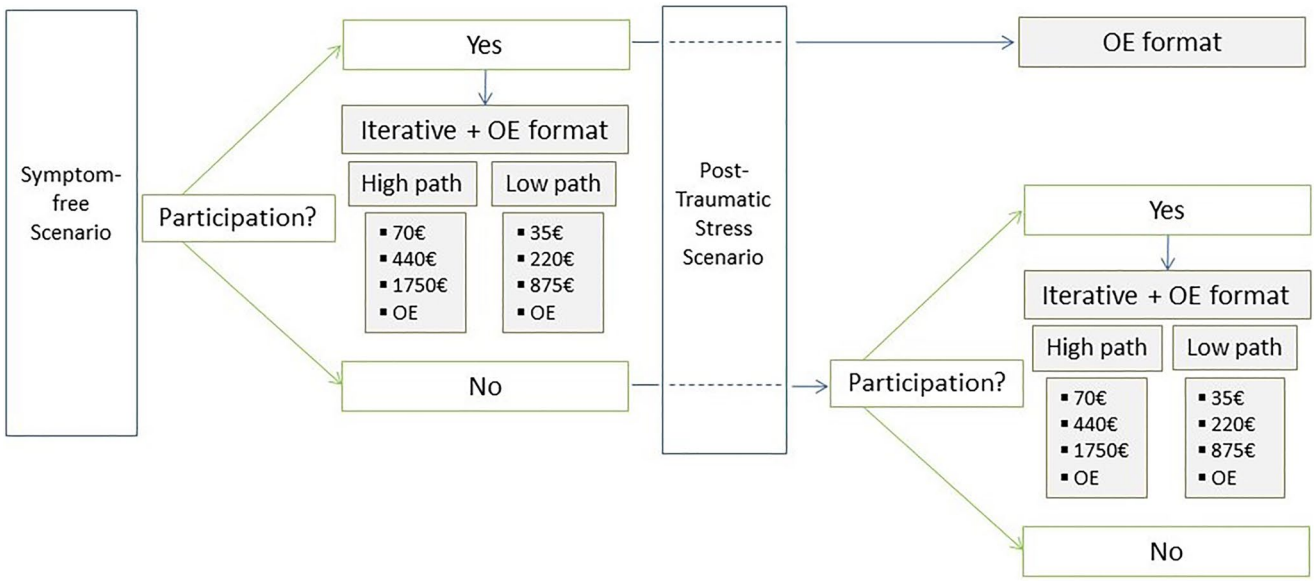

Figure 1. Pathways of the sequential elicitation of willingness to pay.

reduce the length of the sequential elicitation of WTP, avoid yea-saying behaviors (answer regardless of true preferences and motivated by expressive motivations, such as social pressure or desirability conditions) and because the model of interest is a continuous model. After participating in the Symptom-free scenario, respondents are asked to participate in the PTS scenario. If participants declare a WTP in the Symptom-free scenario, they are not asked again the iterative dichotomous choice questions in the PTS scenario but directly an OE questions since they are valuing the same intervention program in the two scenarios. Otherwise, they are asked the participation question and the iterative dichotomous choice questions ending with the OE format (Figure 1).

An iterative dichotomous choice question can lead to a starting point bias (Herriges & Shogren, 1996). That bias is generated by the amount chosen for the first dichotomous choice question, which determines an upper or lower iteration path. A split-sampling method is used here to check for this starting point bias. In the three ascending dichotomous questions, the amount of the bids was increased from €A to €B and €C with A < B < C and two different sets of WTP values, high and low, were used for A, B, and C: {35; 220; 875} for the low path and {70; 440; 1750} for the high path. The sample was divided up equally and each subsample received one of these sets.

A benefit transfer method from the DEFRA study (2005) is used for the values of the iterative dichotomous choice questions. It is considered that building the scenario on a scenario tested in a previous study by DEFRA (2005) means that there is no need to implement focus groups to discuss the programme and bid values. Bid values are converted to Euro units and adjusted for the evolution of the consumer price index for the period 2005–2014 in Spain. The proportions between bid values and between the low and high paths is maintained as in the DEFRA study.

3.3. Econometric Approaches for Contingent Valuation Models

The distinction between protest responses and true zeros is addressed with a prior question on individual willingness to participate in the hypothetical market and debriefing questions to clarify the reasons behind refusal to participate. True zero (also genuine zero) responses occur when an individual gives zero but has a preferred reservation price, which is close to zero and very small. These zeros are generated by an economic decision, such as a budget constraint, unlike protest zeros. Those individuals can also be indifferent to an increase in the provision of the good. Other respondents may refuse to participate in reaction to certain components of the hypothetical questions: the payment vehicle, the level of the tax, and the amenity itself. Distrust in institutions and government also produces protest responses or reduces the WTP; it reveals how citizens judge the capabilities of institutions in taking appropriate protection measures (Jones et al., 2015). They are classified as protests. The reason for refusal

may be emotional, ethical, or may reflect ideological positions, fairness, and trust judgment (Havet et al., 2012; Strazzera, Scarpa, et al., 2003). This suggests that respondents are not willing to pay for the good or would be willing to pay but under circumstances other than those of the scenario proposed (Carson & Hanemann, 2005). Both the predefined and open text reasons are analyzed in Table A1 in Appendix A.

Treating protest bidders as true zero bidders would bias WTP downward. For this reason, protest responses are often removed from the sample. However, this is not a fully satisfactory solution as many observations may be lost from the analysis and it is not satisfactory when the group of protesters is significantly different from the rest of the sample (Strazzera, Genius, et al., 2003). When these responses are non-random and correlated (in terms of the covariates) with the remaining subsample, a sample selection bias occurs. Sample selection methods have been developed to correct for the bias that protesters can generate. Strazzera, Scarpa, et al. (2003) model both true zeros and protest responses in a mixed model for dichotomous choices of WTP. Other approaches consider two-step models with different selection rules. Cho et al. (2008) use an ordered probit selection rule to distinguish between protest zeros, true zeros, and positive bids and assume that protest bids are undetermined bids in-between the true zero bids and the positive bids. Söderberg and Barton (2014) relax this ordering hypothesis and use a multinomial logit model as a selection rule. Alternatively, Cho et al. (2008) also combine a binary sample selection rule for protesters with a Tobit model to accommodate true zero bids among participants. This last approach is used in this paper: it considers true zeros and positive bids as decisions driven by economic rationality so the same set of variables explains the WTP values in a Tobit model and the bias generated by self-selectivity (protesting vs. participating) is corrected for, possibly with a different set of variables more closely related to protest motives. This Tobit model with a binary sample selection rule is presented below. WTP (*wtp*) is treated as a censored variable subject to a binary sample selection rule to distinguish protesters ($d = 0$) from true zeros and positive bidders ($d = 1$):

$$\begin{aligned} d &= 1 \quad \text{if } Z'\gamma + u > 0 \\ d &= 0 \quad \text{if } Z'\gamma + u \leq 0 \end{aligned} \tag{1}$$

and

$$\begin{aligned} \text{wtp} &= 0 && \text{if } Z'\gamma + u > 0 \text{ and } X'\beta + \vartheta \leq 0 \\ &= X'\beta + \vartheta && \text{if } Z'\gamma + u > 0 \text{ and } X'\beta + \vartheta > 0 \\ &= \text{unobserved} && \text{if } Z'\gamma + u \leq 0 \end{aligned} \tag{2}$$

where Z is a set of exogenous explanatory variables, X a set of explanatory variables possibly different from Z, and γ and β the vector of associated coefficients. The error terms of the two equations, u and ϑ, are distributed as bivariate normal with zero means and a finite covariance matrix:

$$\begin{bmatrix} u \\ \vartheta \end{bmatrix} \sim N\left(0, \begin{bmatrix} 1 & \rho\sigma \\ \rho\sigma & \sigma^2 \end{bmatrix}\right) \tag{3}$$

where σ is the standard deviation of ϑ and ρ is the correlation between u and ϑ.

The WTP can be true zero or positive when the respondent is not a protester ($d = 1$) and is treated as unobserved when the respondent is a protester ($d = 0$). The true zero responses are considered as a censoring point in the Tobit model. The two equations have a common set of explanatory variables contained in Z and X. They differ in critical variables that distinguish between protests and economically rational behavior. Z for the self-selectivity equation contains variables related to feelings, ethics, and ideology, such as worries, mental health status, willingness to reveal income, and some sociodemographic variables. X differs from Z in that it includes financial variables, such as the level of income and WTP-specific variables (scenario and starting point bias).

Mental health status is measured with the General Health Questionnaire GHQ-12 (Goldberg, 1978; Goodchild & Duncan-Jones, 1985), calculating the chronic-General Health Questionnaire score (C-GHQ) for the few weeks before the interview. It reflects problems of anxiety, social dysfunction, and loss of confidence that respondents may have suffered in the few weeks before the interview.

3.4. Survey Implementation and Sampling

A survey was conducted in Spring 2015 in the Basque Country, Spain. Data were collected in face-to-face interviews with self-administrated sections. The sample is split into two subsamples: one with individuals who had had prior experience of flooding (referred to below as the *Flooded* group) and another with individuals at risk of being flooded (the *At risk* group). In total, 450 individuals were interviewed, of which 300 had experienced flooding and 150 were at risk of being exposed to flood waters with recurrence intervals varying between the 500- and 10-year storm. Flood maps from the Basque Water Agency were consulted to select areas to survey. For this population living on floodplains, stratified random sampling was used with age and gender as strata.

A natural pre-test of the survey with 40 interviews was performed to ensure the clarity of the questionnaire and the validity of the values used to elicit the WTP. The iterative dichotomous choice questions with an OE follow-up structure were considered appropriate for the survey.

The sample is distributed accordingly between male (48%) and female (52%), the youngest individual being 18 and the oldest 92. The average age is 51. The sample is nearly equally distributed between towns with fewer than 10,000 inhabitants with between 10,000 and 20,000 inhabitants and with over 20,000, located in 16 different municipalities. Few respondents live in detached houses (Table 4). The final sample comprises 441 observations after cleaning up data. Missing values in the WTP question are ruled out, and the maximum WTP value reported (€2,000) is not included as it strongly influenced the results. This is the case of only one respondent.

There were flooding and sea storms in the winter preceding the survey. Floods in the Basque Country, Spain, occur mostly after long, heavy rainfall, possibly combined with high tides, and can also occur after sudden snow melt. A plan of early warning and emergency for flood risk is in place in the Basque Country since 1999. The population targeted is located in the north of the Basque Country. Different flood events have been experienced by interviewees. In the *Flooded* group (292 valid observations), 37.7% experienced their *latest* flood in 2015, 17.2% between 2010 and 2014, 14.4% between 2000 and 2009, and 30.6% before 2000. This survey is part of a wider study on human-related intangible impacts from flooding. Mental health impacts from flooding based on GHQ-12 and self-reported scores are analyzed in Foudi et al. (2017).

4. Results

4.1. Willingness to Pay and Characteristics of Respondents

About 74% of the respondents answer no in the WTP participation question. Given the answers to the debriefing question (Table A1), about 54% of the sample is considered as protest responses and 20.4% as true zero responses. Most of the protest respondents (63.1%) object to pay higher taxes, while most of the true zero respondents cannot afford to pay (Table A1). Distrust in institutions is the second main reason to protest (18.2% of cases). Twenty-six percent of the sample report a positive WTP value (115 of the 441 observations; Table 4). For about two-thirds of them (79 cases over 115), the WTP is obtained from the symptom-free scenario, while the other 36 answered for the PTS scenario (Table 3). Of these 36 cases, 31 have also reported a WTP in the first scenario. The average WTP in the PTS scenario (€180.3) is higher than in the symptom-free scenario (€71.9) and the distributions differ

Table 3
Willingness to Pay and Elicitation Scenario

	WTP>0			WTP>0 and true zeros
WTP	Symptom free scenario	PTS scenario	Final WTP	Final WTP
Cases (n individuals)	79	36	115	205
Cases (percent over total population)	17.91%	8.16%	26.07%	46.48%
Average (Euros)	71.9	180.3	105.9	59.4
Stand. Dev.	102.9	202.1	149.4	123.5
Median	50	100	70	30
IQR	35	125	65	70
Max	875	1,000	1,000	1,000

Table 4
Descriptive Statistics

	WTP>0 d = 1	True zero d = 1	Protest d = 0	Total d = {0,1}	
Quantitative variables[a]	Mean (std)	Mean (std)	Mean (std)	Mean (std)	Cases
Age[A]	45.8 (17.2)	54.7 (19.9)	53.3 (16.6)	51.6 (17.7)	441
C-GHQ[B]	4.7 (2.5)	4.9 (2.2)	4.1 (2.7)	4.4 (2.5)	438
Qualitative variables[b]	Percent	Percent	Percent	Percent	Cases
Selectivity	26.1%	20.4%	53.5%	100%	441
Flooded group	60.9%	64.4%	69.5%	66.2%	292
At risk group	39.1%	35.6%	30.5%	33.8%	149
Weather[A]					
Sunny	30.4%	23.3%	47.9%	38.3%	169
Rainy	39.1%	46.7%	25.4%	33.3%	147
Cloudy-Dry	30.4%	30.0%	26.7%	28.3%	125
Income information reported[A]	60%	80.0%	65.7%	67.1%	296
Income category[A]					
<1,200€	33.3%	63.9%	25.8%	36.8%	109
1,200–2,500€	50.7%	31.9%	61.3%	51.7%	153
>2,500€	15.9%	4.2%	12.9%	11.5%	34
Home owner	56.5%	60.0%	64%	61.2%	270
Live in a detached house	7%	4.4%	3.8%	4.8%	21
With children (under 18 years.o)	39.1%	27.8%	28.8%	31.3%	138
Female	50.4%	61.1%	48.7%	51.7%	228
Worried about future flooding	50.4%	42.2%	39.8%	43.1%	190
With home insurance[C]	42.6%	44.4%	53.8%	49%	216
Flood prevention measures implemented[C]	44.3%	33.3%	48.3%	44.2%	195

Note. The significance of these tests is indicated by the A, B, and C superscripts: A for a significant relation at 99% confidence level, B for a significant relation at 95% confidence level, and C for a significant relation at 90% confidence level. A Dunn test is performed for quantitative variables to compare the types of participants according to the quantitative variables. Results are not reported for readability of the table but the interpretation of the table in the text accounts for the results of the tests. Std stands for standard deviation.

[a]A Kruskal-Wallis test is performed to test the hypothesis of a different population between the quantitative variables and the three types of participants. [b]A Chi square test is performed to test the independence of the qualitative variables and the type of participants.

significantly (Wilcoxon test: Prob >|z| = 0.00): individuals who answer for the PTS scenario are more heterogeneous and widely distributed as regards WTP.

Protesters are more reluctant to report their income than participants (Table 4). Those of them who report their income are more likely to belong to the intermediate income category (1,200–2,500€). They are more likely to have home insurance and to have implemented preventive measures. They are found more frequently when the interview took place on a sunny day. They are slightly older than the positive bidders and are also those with the lowest C-GHQ score.

True zero respondents are slightly older than positive respondents and face more current mental health issues than protesters (Table 4). They are much less reluctant to report their income than the rest and most frequently belong to the lowest income category. They engage much less in prevention measures. Such respondents are found more often on rainy days.

Positive respondents are younger than the rest and face greater mental health issues than protesters (Table 4). They tend to be more reluctant than the rest to provide information on their income and those who do report

it are in the low and intermediate income categories in proportions similar to the average for the sample. Such respondents are found more frequently on rainy days than sunny days compared to the average for the sample.

4.2. Factors Explaining Willingness to Pay

The estimation of the system as per Equations 1 and 2 is reported in Table 5. The statistical significance of ρ confirms the nonindependence of the self-selection and WTP equations. An alternative treatment of the protest responses consisting of excluding them from the analysis would therefore have resulted in a sample selection bias in estimating the effect of covariates. This confirms that a correlated stochastic decision-making process by individuals cannot be rejected: individuals value the good with a given choice model (Equation 2) and decide whether to disclose their reservation price (Equation 1) according to another choice model (Strazzera, Genius, et al., 2003). A unique choice model for true zero and positive WTP values (Equation 2) is assumed as they are at minima driven by economic rationality (more specifically income in this case), while protest attitudes (Equation 1) are related more closely to emotional factors. No significant starting point bias from the values of the iterative dichotomous choice questions is observed (Table 5).

4.2.1. Quality of Information

Some individuals (17.5% of participants, 31% of positive WTP values, as per Table 3) report an additional WTP when they are informed of the PTS scenario. The PTS scenario is observed to have a significant effect in the model estimated (Table 5), regardless of prior experience: more complete information in the description of mental health symptoms increases WTP. The symptom-free description of mental health risk thus seems to bias WTP downward.

The quality of the information reported to describe mental health symptoms must be consistent with what individuals are likely to experience during a flood event if it is to represent symptoms objectively. The most frequent symptoms reported by flooded individuals in this study relate to reexperiencing the flood, hyperarousal, and unhappiness. Being reminded of the flood by triggers that resemble or symbolize an aspect of it is the most frequently experienced symptom. Those triggers lead individuals to feel nervous, have palpitations, or feel tense. Flashbacks, hypervigilance, difficulties in sleeping, and difficulties in concentrating and in coping with problems are other impacts. Flooded individuals feel unhappy and unable to enjoy their day-to-day life activities. These symptoms closely correspond to those of the PTS scenario (Table 2).

4.2.2. Prior Experience of Flooding

Results from the sample selection equation highlight the importance of controlling for prior experience of flooding. Individuals who have not experienced flooding but are at risk are more likely to reveal their reservation price than individuals who have already experienced a flood (Selection equation in Table 5): the lack of experience of flooding generates a demand for protection against mental health impacts of flooding. However, when associated with the quality of information on the scenario, the effect of experience on WTP is not conclusive (WTP scenario variables in Table 5): no statistically significant differences in scenario coefficients between the *At risk* and the *Flooded* group are observed among respondents for the PTS scenario (Wald test: Prob > chi2(1) = 0.6966). This is likely to be due to the sequencing treatment: all respondents were informed of the symptoms, so prior experience did not play such a great role as it would have with a generic description of risk.

The positive effect of lack of experience on demand for flood protection against mental health risks from flooding contrasts with the literature analyzing WTP for flood risk reduction, where a positive effect of experience rather than of lack of experience on WTP for infrastructure or non-infrastructure-based prevention programs is often reported (Navrud et al., 2012; Reynaud & Nguyen, 2016; Roder et al., 2019; Zhai et al., 2006). The positive effect of experience may be due to the fact that flood victims are indeed likely to experience more post-traumatic fear and a reduced feeling of safety (Quan et al., 2020) and that experience is necessary for accurate appraisal of flood threat in order to take preventive measures (Grothmann & Reusswig, 2006; Richert et al., 2016). This result suggests rather that the prior experience effect may not be confirmed for intangible impacts of flooding, such as mental distress, and may indeed be supported by the "inoculation" hypothesis: exposure to stress increases individual mental resilience to subsequent stress (Davydov et al., 2010; Seery et al., 2010). This hypothesis considers that a successful adaptation response to adversity is retained in individual memory and generates behavioral

Table 5
Tobit Model With Sample Selection

	Sample selection equation Equation 1	WTP equation Equation 2
WTP scenario		
Symptom-free scenario *x* Flooded group		*Reference*
Symptom-free scenario *x* At risk group		0.874
		(33.573)
PTS scenario *x* Flooded group		199.461[a]
		(54.809)
PTS scenario *x* At risk group		220.512[a]
		(44.980)
Starting point bias		
High WTP starting point		9.564
		(28.599)
Subjectivity-Experience		
At risk group, with no experience of flooding (=1 if yes)	0.276[b]	
	(0.140)	
Mental health and worries		
C-GHQ score	0.092[a]	
	(0.027)	
Worried about future flooding (=1 if yes)	0.233[c]	
	(0.135)	
Environmental stressor		
Sunny day	*Reference*	*Reference*
Rainy day	0.680[a]	−11.750
	(0.153)	(32.898)
Cloudy day	0.380[b]	−25.788
	(0.158)	(34.505)
Risk aversion related		
Home insurance (=1 if yes)	−0.331[b]	3.544
	(0.134)	(28.388)
Flood prevention measures (=1 if yes)	−0.342[b]	79.570[b]
	(0.134)	(39.385)
Income		
Income <€1,200		*Reference*
Income €1,200–€2,500		63.191[b]
		(27.871)
Income > €2,500		126.111[b]
		(75.612)
Income information reported (=1 if yes)	0.134	
	(0.141)	
Sociodemographics		
With children (under 18 years.o.) (=1 if yes)		−1.349
		(28.045)

Table 5
Continued

	Sample selection equation Equation 1		WTP equation Equation 2
Live in a detached house (=1 if yes)	0.445		
	(0.308)		
Landlord (=1 if yes)	0.138		
	(0.139)		
Age	−0.013[a]		
	(0.004)		
Woman (=1 if yes)	0.133		
	(0.130)		
Constant	−0.348		−60.819
	(0.269)		(43.715)
σ		5.073[a]	
		(0.231)	
ρ		−0.499[a]	
		(0.183)	
Log likelihood		−751.898	
LR (23)		103.57	
Prob < chi2		0.000	
Observations		441	

Note. Robust standard errors in parentheses. The sample selection coefficients (Equation 1) are not marginal effects.
[a]Significant at the 99% confidence level. [b]Significant at the 95% confidence level. [c]Significant at the 90% confidence level.

immunization (Davydov et al., 2010). Hence, Norris and Murrell (1988) find that flood survivors show lower anxiety levels than individuals who have not experienced flooding when exposed to another flood disaster.

4.2.3. Aging

Age is a relevant factor in determining ability to cope with adverse events. Two hypotheses are often advanced to explain the effect of aging: the vulnerability and inoculation hypotheses. The vulnerability hypothesis argues that older adults are at greater risk (Chung et al., 2017; Telles et al., 2009) and are exposed to comorbidity effects (Andrews et al., 2002), which may correspond to a certain willingness to be protected. The inoculation hypothesis, by contrast, may explain why older individuals suffer less distress as reported in other studies (Ginexi et al., 2000; Tunstall et al., 2006), because the life experience of older individuals increases their resilience to negative events (T. Hu, Tan, et al., 2015) and this may reduce their demand for protection. Here, older adults are found to be less likely to be willing to pay to reduce mental health risk from flooding (Selection equation in Table 5). Another reason could be socioeconomic: older individuals are less likely to demand this protection because they are also most financially vulnerable; in the sample, the older individuals belong to the lowest income category, which could also explain why they are more often true zero or protest bidders (cf. Table 4).

4.2.4. Environmental Stressors

PTSD is an anxiety disorder whose symptoms entail reexperiencing, avoidance, and hyperarousal (American Psychiatric Association, 2000). Environmental stressors such as weather can be reminders of past negative events as described in the PTS scenario with the effect of heavy rainfall. A weather-specific distress index tapping feelings of apprehension during mildly threatening weather has, for example, been used to capture the mental health effects of flooding, and the effects of covariates on this index are observed which are similar to those of anxiety indices (Norris & Murrell, 1988). The weather conditions of the day of the interview are used here and it is found that rainy or cloudy days can act as reminders that trigger individual willingness to avoid suffering anxiety.

On non-sunny days, respondents are more likely to demand mental health prevention program as per the results of Equation 1 shown in Table 5.

4.2.5. Worries, Prior Mental Health, and Risk Perception

Fear and worries are feelings induced by risky situations. The expected utility type of risk prevention decisions posits that individuals base their decisions on cognitive elements and assess the severity and likelihood of the possible outcomes of the alternatives. Feelings are not integrated into the decision process but are rather a consequence of it. Alternatively, the risk-as-feelings hypothesis (Loewenstein et al., 2001) postulates that responses to risky situations result also from direct emotional influences and feelings, such as fear, worries, or anxiety. Appraisal of cognitive drivers is then affected by emotional factors. Hence, in the Protection Motivation Theory (Grothmann & Reusswig, 2006), fear and worries influence cognitive factors, precisely in the assessment of the perceived consequences of a potential flood. The role of worries and anxiety in deciding whether to protest or participate in the demand for mental health risk protection (Equation 1) is tested and worries about the possibility of experiencing a flood in the near future are found to increase the likelihood of participating in a flood risk prevention program. Prior mental health status, measured by the C-GHQ score, reflects current psychological morbidity, which relates to anxiety, social dysfunction, and loss of confidence. Results indicate that individuals with higher C-GHQ scores are more likely to demand flood risk protection. Feelings are thus an element of the decision to seek protection against flooding, which seems to confirm the applicability of the risk-as-feelings hypothesis to prevention of mental health risks arising from flooding.

4.2.6. Complementarity With Self-Insurance

Self-insurance is found to reduce the demand for prevention of mental health risks arising from flooding obtained with collective flood defence measures: those individuals who have home insurance or have implemented prevention measures (keep sand and bags on the property, keep ditches and drains around the property clean, build walls around the property, purchase water pumps, keep alert for flood warnings during high-risk months, avoid buying expensive downstairs furnishings, and avoid keeping irreplaceable items or goods of sentimental value on the ground floor of the home) are less likely to participate and reveal their reservation price (Selection equation in Table 5). However, the prior implementation of flood prevention measures increases the WTP of participants (WTP equation in Table 5). This demand for additional protection could be explained by the Protection Motivation Theory. The perceived self-efficacy of individual measures (Reynaud et al., 2013; Richert et al., 2016), that is, the belief that individual flood protection measures will be effective in protecting an individual, and the presence of collective flood prevention measures (Richert et al., 2019) influence the decision whether to implement individual prevention measures. These factors may well make risk-averse individuals who have already implemented self-prevention measures willing to pay for collective flood prevention if they judge the latter more effective in protecting them.

4.2.7. Income

Demand for reducing mental health impacts from flooding is sensitive to individual income: the middle-class income group and the high-class income group are more willing to pay than the lower class income group (WTP equation in Table 5). As expected, respondents from the high-class income group are willing to pay more than the rest of respondents. No effect of refusing to report income-level information on the probability of being a protester is observed (Selection equation in Table 5).

5. Discussion

Making respondents focus only on mental health impacts remains challenging as floods have multiple impacts and mental health status is a consequence of those impacts. Some respondents focus not only on mental health but also report reasons for participating based on the effects of secondary stressors (property and content damage) or more general effects from flooding (Table A2): The reason “To avoid damage from flooding” is the most frequently stated to justify participation. It is more inclusive in terms of damage type than the specific motive of avoiding stress. The presence of a more inclusive reason to participate could help determine whether there is an embedding effect—the tendency to assign equal values to a good and to a subset of that good (Kahneman & Knetsch, 1992). A significant difference in WTP (Mann-Whitney test: Prob > |z| = 0.0039) between these

two types of reason is found: respondents who refer to the specific stress motive value flood risk prevention more highly than respondents who value flood damage in general, which may not indicate the presence of an embedding effect. However, a rigorous conclusion on the embedding effect and size of these WTPs would have required the experiment to be set up for that purpose and an ordering effect to be controlled for (Carson & Mitchell, 1995).

The nature of the good and the payment vehicle may have influenced participation. Low participation should not be viewed as a low demand for prevention of mental health risk from flooding but rather as the preference for other types of prevention and other payment vehicles to prevent such risk. This may be motivated by the fact that mental health has not just a community resilience component (Norris et al., 2008) but also a human resilience component (Bonanno, 2004), which can make people less willing to contribute to the mental health of others through taxes as mental health has a personal component, which makes the effect of wellbeing of other uncertain for taxpayers.

The paper assumes some underlying values in the choice to participate in the program. Not only rational motives such as income and risk preferences but also motives related to feelings (risk-as-feelings hypothesis) are considered. Other values and nonrational behaviors are also likely to influence WTP. Contribution to public goods depends on altruistic behaviors. Jones-Lee (1991, 1992) shows that the optimal contribution is higher in the exclusive presence of safety-focused altruism (caring only for others' health and safety and not for their wealth) and lower when altruism is exclusively wealth-focused (caring only for others' wealth). Flood risk prevention through collective flood defences has a public dimension and may induce an altruistic component in the valuation of the good. The presence of altruistic behavior is checked for with follow-up questions to elicit the main reasons for participating (Table A2). Altruistic motives captured by the statement "I am concerned about others in this area" and the open text motive "To save people" are reported by 19.1% of participants and moral satisfaction motives captured by the statement "It's a good cause" are reported by 9.1% of participants. Participants who refer to these reasons show a WTP, which is not significantly different from that of the others (Mann-Whitney test: Prob > |z| = 0.609), which indicates that altruism is not likely to have significantly influenced the results in this study.

Individual behaviors beyond economic rationality are also relevant elements in understanding individuals' decisions, regarding flood risk management measures (Aerts et al., 2018; Botzen, Kunreuther, Czajkowski, & Moel, 2019; Kuhlicke et al., 2020). Two behavioral biases (Botzen et al., 2021) are particularly relevant to this study: the availability bias and myopia. The availability bias (Tversky & Kahneman, 1973) leads individuals to bias their estimation of the consequences of a flood and their lack of experience or threat appraisal (Protection Motivation Theory) can explain that bias (Botzen et al., 2019, 2021). In this study, it is inexperience rather than experience that motivates the decision to participate in the collective prevention program. It has been argued that the inoculation hypothesis can explain this attitude (Section 4.2.2). The availability bias may be another reason: non-experienced individuals may overestimate both the probability of suffering psychological distress after flooding and the intensity of the symptoms. Providing more detailed information on risk, as with the posttraumatic stress scenario, have reduced this bias in the WTP value. Even so, a heuristic bias persists as it is difficult to fully control for heuristics made by individuals when informed about symptoms. An example of this is the number of individuals who participate for motives not exclusively related to mental health (Table A2). Another relates to the remainder effect of the weather of the day of the interview on the demand. This effect and possibly the occurrence of a flood in the year of the survey can also interact with how individuals manage the information received on flood risk.

Myopia and discounting are other behavioral biases. Botzen et al. (2019) find that individuals with high discount rates for the future are less likely to undertake flood risk prevention measures, particularly those measures that present immediate benefits during a flood, such as dry flood-proofing measures. Psychological effects of flooding may be long lasting (Foudi et al., 2017) and individuals (particularly non-experienced individuals) may fail to perceive them as long-term consequences of a flood. Thus, heavy discounting on the future benefits of preventing mental health problems from flooding may explain the low level of participation. It is found here that when associated with worries (see Section 4.2.5), the long-term dimension of the decision increases participation.

6. Conclusion

This paper analyzes demand for a reduction in mental health risks arising from flooding. A hypothetical infrastructural flood defence instrument is tested as collective prevention measure. A CV method is used to elicit WTP to avoid mental health problems from flooding. Two levels of information are combined in a sequential scenario: one symptom-free and the other with PTS symptoms to deal with human resilience and experience effects. A two-step model fits the data to account on the one hand for the self-selectivity bias resulting from protesting or participating and on the other hand for the censored nature of the data on participants, where true zeros and positive respondents are observed. The model is applied to a sample of individuals who have been flooded and who are at risk of flooding in the Basque Country, northern Spain.

The results confirm that there is a correlated stochastic decision-making process: individuals value the prevention of mental health risks arising from flooding with a given choice model driven by economic rationality, regardless of whether they are true zeros or positive respondents, and decide whether to participate (or to protest) according to another choice model driven by feelings and experience, among other factors.

The description of the risk on mental health is the most important factor that makes the demand sensitive. A precise description of the risk, with explicit PTS symptoms, makes individual willing to pay more for a collective flood defence program than a symptom-free or generic description of the risk, whatever their prior experience with floods. Human resilience can explain the reasons why a nonspecific description of mental health risk results in a lower demand. Demand is also driven by economic rationality: higher income increases demand and previous self-insurance measures reduce it. Moreover, self-insurance increases the WTP for individuals who demand protection, which might indicate that risk-averse individuals want to rely on the collective protection system, which they may assess as more effective or as a complement to self-insurance measures. Participation is also driven by feelings: worries about future floods and general anxiety contribute to participation and highlight the importance of the risk-as-feelings hypothesis in programs against mental health impacts from flooding. Prior experience with flooding is also a driver of participation: it reveals a certain behavioral immunization and enhancement of individual mental resilience after a flood.

Isolating willingness to prevent mental health effects of flooding from other flood damage is challenging. The high rate of refusal to participate because of the payment vehicle denotes a preference for other systems of payment and possibly other types of measure for mental health risk prevention. Such a program should also consider the level of altruism in mental health risk prevention and the interdependencies between collective or individual measures.

Appendix A: Protest, True Zero, and Participation Motives

Table A1 describes the main reasons motivating true zero and protest responses.

Table A1
Debriefing Questions Distinguishing Between True and Protest Zero Responses

	True zero	Protest
I cannot afford to pay	55.6%	
I do not believe I am at risk of being flooded	21.1%	
I have already taken flood protection measures and hence do not need improvements to flood defence	11.1%	
I do not believe I will suffer from stress in the event of a flood	7.8%	
Indifferent	4.4%	
I do not believe flood defence will be improved/Do not trust		18.2%
I do not believe flood defence improvements can help me avoid stress effects		3.8%
I object to paying higher taxes		63.1%
Others should pay		14.8%
Total cases	90	236

Table A2 describes the main reasons for participating in the program.

Table A2
Main Reasons for Participating

Reason	Percent
I would like to avoid the stress effects described	16.4%
I would like to avoid the impacts on my physical health	1.8%
I would like to avoid loss of my irreplaceable items	0.0%
I would like to avoid damage to my property and contents	20.9%
I would like to avoid my property losing its value	0.9%
I would like to avoid stress to my pets	0.0%
I am concerned about others in this area	12.7%
It is a good cause	9.1%
Others (from open text responses)	
To save people and improve their well-being	6.4%
To avoid damage from flooding	24.5%
Other	7.3%
Total cases	110

Conflict of Interest

The authors declare no conflicts of interest relevant to this study.

Data Availability Statement

The data set and the questionnaire upon which the analyses were based are available on the repository https://doi.org/10.5281/zenodo.6320539.

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References

Aerts, J. C. J. H., Botzen, W. J., Clarke, K. C., Cutter, S. L., Hall, J. W., Merz, B., et al. (2018). Integrating human behaviour dynamics into flood disaster risk assessment. *Nature Climate Change*, *8*(3), 193–199. https://doi.org/10.1038/s41558-018-0085-1

Ajzen, I., Brown, T. C., & Rosenthal, L. H. (1996). Information bias in contingent valuation: Effects of personal relevance, quality of information, and motivational orientation. *Journal of Environmental Economics and Management*, *30*(1), 43–57. https://doi.org/10.1006/jeem.1996.0004

Alberini, A., Rosato, P., Longo, A., & Zanatta, V. (2005). Information and willingness to pay in a contingent valuation study: The value of S. Erasmo in the lagoon of venice. *Journal of Environmental Planning and Management*, *48*(2), 155–175. https://doi.org/10.1080/0964056042000338136

Alderman, K., Turner, L. R., & Tong, S. (2012). Floods and human health: A systematic review. *Environment International*, *47*, 37–47. https://doi.org/10.1016/j.envint.2012.06.003

American Psychiatric Association. (2000). *Diagnostic and statistical manual of mental disorders*. (DSM-IV-TR) (4th ed.). American Psychiatric Association. Retrieved from https://www.nlm.nih.gov/research/umls/sourcereleasedocs/current/DSM4/

Andrews, G., Slade, T., & Issakidis, C. (2002). Deconstructing current comorbidity: Data from the Australian national survey of mental health and well-being. *The British Journal of Psychiatry*, *181*(4), 306–314. https://doi.org/10.1192/bjp.181.4.306

Bateman, I. J., Langford, I. H., Turner, R. K., Willis, K. G., & Garrod, G. D. (1995). Elicitation and truncation effects in contingent valuation studies. *Ecological Economics*, *12*(2), 161–179. https://doi.org/10.1016/0921-8009(94)00044-V

Bergstrom, J. C., Stoll, J. R., & Randall, A. (1990). The impact of information on environmental commodity valuation decisions. *American Journal of Agricultural Economics*, *72*(3), 614–621. https://doi.org/10.2307/1243031

Blomquist, G. C., & Whitehead, J. C. (1998). Resource quality information and validity of willingness to pay in contingent valuation. *Resource and Energy Economics*, *20*(2), 179–196. https://doi.org/10.1016/S0928-7655(97)00035-3

Bonanno, G. A. (2004). Loss, trauma, and human resilience: Have we underestimated the human capacity to thrive after extremely aversive events? *American Psychologist*, *59*(1), 20. https://doi.org/10.1037/0003-066X.59.1.20

Bonanno, G. A., Brewin, C. R., Kaniasty, K., & Greca, A. M. L. (2010). Weighing the costs of disaster: Consequences, risks, and resilience in individuals, families, and communities. *Psychological Science in the Public Interest*, *11*(1), 1–49. https://doi.org/10.1177/1529100610387086

Botzen, W. J., Aerts, J. C. J. H., & van den Bergh, J. C. J. M. (2013). Individual preferences for reducing flood risk to near zero through elevation. *Mitigation and Adaptation Strategies for Global Change*, *18*(2), 229–244. https://doi.org/10.1007/s11027-012-9359-5

Botzen, W. J., Duijndam, S., & van Beukering, P. (2021). Lessons for climate policy from behavioral biases towards COVID-19 and climate change risks. *World Development*, *137*, 105214. https://doi.org/10.1016/j.worlddev.2020.105214

Botzen, W. J., Kunreuther, H., Czajkowski, J., & de Moel, H. (2019). Adoption of individual flood damage mitigation measures in New York city: An extension of protection motivation theory. *Risk Analysis*, *39*(10), 2143–2159. https://doi.org/10.1111/risa.13318

Botzen, W. J., & van den Bergh, J. C. J. M. (2012). Monetary valuation of insurance against flood risk under climate change*. *International Economic Review*, *53*(3), 1005–1026. https://doi.org/10.1111/j.1468-2354.2012.00709.x

Boyle, K. J., Welsh, M. P., & Bishop, R. C. (1993). The role of question order and respondent experience in contingent-valuation studies. *Journal of Environmental Economics and Management*, *25*(1), S80–S99. https://doi.org/10.1006/jeem.1993.1034

Brouwer, R., & Akter, S. (2010). Informing micro insurance contract design to mitigate climate change catastrophe risks using choice experiments. *Environmental Hazards*, *9*(1), 74–88. https://doi.org/10.3763/ehaz.2010.SI07

Brouwer, R., Akter, S., Brander, L., & Haque, E. (2009). Economic valuation of flood risk exposure and reduction in a severely flood prone developing country. *Environment and Development Economics*, *14*(3), 397–417. https://doi.org/10.1017/S1355770X08004828

Brouwer, R., Tinh, B. D., Tuan, T. H., Magnussen, K., & Navrud, S. (2014). Modeling demand for catastrophic flood risk insurance in coastal zones in Vietnam using choice experiments. *Environment and Development Economics*, *19*(2), 228–249. https://doi.org/10.1017/S1355770X13000405

Cameron, T. A., & Englin, J. (1997). Respondent experience and contingent valuation of environmental goods. *Journal of Environmental Economics and Management*, *33*(3), 296–313. https://doi.org/10.1006/jeem.1997.0995

Carson, R., & Hanemann, M. (2005). Contingent valuation. In K.-G. Mäler & J. R. vincent (Eds.), *Handbook of environmental economics* (Vol. 2). Elsevier.

Carson, R. T. (1991). Constructed markets. In J. B. Braden, & C. D. Kolstad (Eds.), *Measuring the demand for environmental quality*. North-Holland/Elsevier. Retrieved from https://ci.nii.ac.jp/naid/10006142812/

Carson, R. T., & Mitchell, R. C. (1995). Sequencing and nesting in contingent valuation surveys. *Journal of Environmental Economics and Management*, *28*(2), 155–173. https://doi.org/10.1006/jeem.1995.1011

Champonnois, V., & Erdlenbruch, K. (2021). Willingness of households to reduce flood risk in southern France. *Journal of Flood Risk Management*, *14*, e12696. https://doi.org/10.1111/jfr3.12696

Chanel, O., Cleary, S., & Luchini, S. (2007). Individual responsiveness to information in CV surveys: Commitment matters. *Revue d'Économie Politique*, *117*(5), 761–779. https://doi.org/10.3917/redp.175.0761

Cho, S.-H., Yen, S. T., Bowker, J. M., & Newman, D. H. (2008). Modeling willingness to pay for land conservation easements: Treatment of zero and protest bids and application and policy implications. *Journal of Agricultural & Applied Economics*, *40*(1), 267–285. https://doi.org/10.1017/S1074070800028108

Chung, M. C., Jalal, S., & Khan, N. U. (2017). Posttraumatic stress symptoms, co-morbid psychiatric symptoms and distorted cognitions among flood victims of different ages. *Journal of Mental Health*, *26*(3), 204–211. https://doi.org/10.3109/09638237.2016.1149803

Cummings, R. G., Brookshire, D. S., & Schulze, W. D. (1986). *Valuing environmental goods: A state of the arts assessment of the contingent valuation method*. Retrieved from https://ci.nii.ac.jp/naid/10009848622/

Davydov, D. M., Stewart, R., Ritchie, K., & Chaudieu, I. (2010). Resilience and mental health. *Clinical Psychology Review*, *30*(5), 479–495. https://doi.org/10.1016/j.cpr.2010.03.003

DEFRA. (2005). *The appraisal of human related intangible impacts of flooding*. R&D Technical report FD2005/TR. Department for Environment Food and Rural Affairs.

del Saz-Salazar, S., & Rausell-Köster, P. (2008). A Double-Hurdle model of urban green areas valuation: Dealing with zero responses. *Landscape and Urban Planning*, *84*(3–4), 241–251. https://doi.org/10.1016/j.landurbplan.2007.08.008

Di Baldassarre, G., Viglione, A., Carr, G., Kuil, L., Yan, K., Brandimarte, L., & Blöschl, G. (2015). Debates—perspectives on socio-hydrology: Capturing feedbacks between physical and social processes. *Water Resources Research*, *51*(6), 4770–4781. https://doi.org/10.1002/2014WR016416

Entorf, H., & Jensen, A. (2020). Willingness-to-pay for hazard safety—A case study on the valuation of flood risk reduction in Germany. *Safety Science*, *128*, 104657. https://doi.org/10.1016/j.ssci.2020.104657

Fahad, S., & Jing, W. (2018). Evaluation of Pakistani farmers' willingness to pay for crop insurance using contingent valuation method: The case of Khyber Pakhtunkhwa province. *Land Use Policy*, *72*, 570–577. https://doi.org/10.1016/j.landusepol.2017.12.024

Fan, Q., & Davlasheridze, M. (2016). Flood risk, flood mitigation, and location choice: Evaluating the national flood insurance program's community rating system. *Risk Analysis*, *36*(6), 1125–1147. https://doi.org/10.1111/risa.12505

Fernandez, A., Black, J., Jones, M., Wilson, L., Salvador-Carulla, L., Astell-Burt, T., & Black, D. (2015). Flooding and mental health: A systematic mapping review. *PLoS One*, *10*(4), e0119929. https://doi.org/10.1371/journal.pone.0119929

Foudi, S., Osés-Eraso, N., & Galarraga, I. (2017). The effect of flooding on mental health: Lessons learned for building resilience. *Water Resources Research*, *53*(7), 5831–5844. https://doi.org/10.1002/2017WR020435

Fuchs, S., Karagiorgos, K., Kitikidou, K., Maris, F., Paparrizos, S., & Thaler, T. (2017). Flood risk perception and adaptation capacity: A contribution to the socio-hydrology debate. *Hydrology and Earth System Sciences*, *21*(6), 3183–3198. https://doi.org/10.5194/hess-21-3183-2017

Ghanbarpour, M. R., Saravi, M. M., & Salimi, S. (2014). Floodplain inundation analysis combined with contingent valuation: Implications for sustainable flood risk management. *Water Resources Management*, *28*(9), 2491–2505. https://doi.org/10.1007/s11269-014-0622-2

Ginexi, E. M., Weihs, K., Simmens, S. J., & Hoyt, D. R. (2000). Natural disaster and depression: A prospective investigation of reactions to the 1993 midwest floods. *American Journal of Community Psychology*, *28*(4), 495–518. https://doi.org/10.1023/a:1005188515149

Glenk, K., & Fischer, A. (2010). Insurance, prevention or just wait and see? Public preferences for water management strategies in the context of climate change. *Ecological Economics*, *69*(11), 2279–2291. https://doi.org/10.1016/j.ecolecon.2010.06.022

Goldberg, D. P. (1978). *Manual of the general health questionnaire*. NFER. Retrieved from http://trove.nla.gov.au/version/11878284

Goodchild, M. E., & Duncan-Jones, P. (1985). Chronicity and the general health questionnaire. *The British Journal of Psychiatry*, *146*(1), 55–61. https://doi.org/10.1192/bjp.146.1.55

Grothmann, T., & Reusswig, F. (2006). People at risk of flooding: Why some residents take precautionary action while others do not. *Natural Hazards*, *38*(1–2), 101–120. https://doi.org/10.1007/s11069-005-8604-6

Havet, N., Morelle, M., Remonnay, R., & Carrere, M.-O. (2012). Econometric treatment of few protest responses in willingness-to-pay studies: An application in health care. *Recherches Économiques de Louvain*, *78*(2), 53–74. https://doi.org/10.3917/rel.782.0053

Herriges, J. A., & Shogren, J. F. (1996). Starting point bias in dichotomous choice valuation with follow-up questioning. *Journal of Environmental Economics and Management*, *30*(1), 112–131. https://doi.org/10.1006/jeem.1996.0008

Hoehn, J. P., & Randall, A. (2002). The effect of resource quality information on resource injury perceptions and contingent values. *Resource and Energy Economics*, *24*(1), 13–31. https://doi.org/10.1016/S0928-7655(01)00051-3

Hu, S., Tan, H., Cofie, R., Zhou, J., Yang, T., Tang, X., & Liu, A. (2015). Recovery from post-traumatic stress disorder after a flood in China: A 13-year follow-up and its prediction by degree of collective action. *BMC Public Health*, *15*, 615. https://doi.org/10.1186/s12889-015-2009-6

Hu, T., Zhang, D., & Wang, J. (2015). A meta-analysis of the trait resilience and mental health. *Personality and Individual Differences*, *76*, 18–27. https://doi.org/10.1016/j.paid.2014.11.039

Johnson, B., & Whitehead, J. (2000). Value of public goods from sports stadiums: The CVM approach. *Contemporary Economic Policy*, *18*(1), 48–58. https://doi.org/10.1111/j.1465-7287.2000.tb00005.x

Jones, N., Clark, J. R. A., & Malesios, C. (2015). Social capital and willingness-to-pay for coastal defences in south-east England. *Ecological Economics*, *119*, 74–82. https://doi.org/10.1016/j.ecolecon.2015.07.023

Jones-Lee, M. W. (1991). Altruism and the value of other people's safety. *Journal of Risk and Uncertainty*, *4*(2), 213–219. https://doi.org/10.1007/BF00056126

Jones-Lee, M. W. (1992). Paternalistic altruism and the value of statistical life. *The Economic Journal*, *102*(410), 80–90. https://doi.org/10.2307/2234853

Jorgensen, B. S., & Syme, G. J. (2000). Protest responses and willingness to pay: Attitude toward paying for stormwater pollution abatement. *Ecological Economics*, *33*(2), 251–265. https://doi.org/10.1016/S0921-8009(99)00145-7

Joseph, R., Proverbs, D., & Lamond, J. (2015). Assessing the value of intangible benefits of property level flood risk adaptation (PLFRA) measures. *Natural Hazards*, *79*(2), 1275–1297. https://doi.org/10.1007/s11069-015-1905-5

Kahneman, D., & Knetsch, J. L. (1992). Valuing public goods: The purchase of moral satisfaction. *Journal of Environmental Economics and Management*, *22*(1), 57–70. https://doi.org/10.1016/0095-0696(92)90019-S

Kartman, B., Stålhammar, N.-O., & Johannesson, M. (1996). Valuation of health changes with the contingent valuation method: A test of scope and question order effects. *Health Economics*, *5*(6), 531–541. https://doi.org/10.1002/(sici)1099-1050(199611)5:6<531::aid-hec235>3.0.co;2-j

Kriström, B. (1997). Spike models in contingent valuation. *American Journal of Agricultural Economics*, *79*(3), 1013–1023. https://doi.org/10.2307/1244440

Kuhlicke, C., Seebauer, S., Hudson, P., Begg, C., Bubeck, P., Dittmer, C., et al. (2020). The behavioral turn in flood risk management, its assumptions and potential implications. *WIREs Water*, *7*(3), e1418. https://doi.org/10.1002/wat2.1418

Kuo, Y.-L. (2016). Is there a trade-off between households' precautions, mitigations and public protection for flood risk? *Environmental Hazards*, *15*(4), 311–326. https://doi.org/10.1080/17477891.2016.1208729

Loewenstein, G. F., Weber, E. U., Hsee, C. K., & Welch, N. (2001). Risk as feelings. *Psychological Bulletin*, *127*(2), 267–286. https://doi.org/10.1037/0033-2909.127.2.267

Loomis, J., Gonzalez-Caban, A., & Gregory, R. (1994). Do reminders of substitutes and budget constraints influence contingent valuation estimates? *Land Economics*, *70*(4), 499–506. https://doi.org/10.2307/3146643

Luechinger, S., & Raschky, P. A. (2009). Valuing flood disasters using the life satisfaction approach. *Journal of Public Economics*, *93*(3–4), 620–633. https://doi.org/10.1016/j.jpubeco.2008.10.003

Madani, K., & Shafiee-Jood, M. (2020). Socio-Hydrology: A new understanding to unite or a new science to divide? *Water*, *12*(7),1941. https://doi.org/10.3390/w12071941

Mitchell, R. C., & Carson, R. T. (1989). Using surveys to value public goods: The contingent valuation method. *Resources for the Future*.

Navrud, S., Tuan, T. H., & Tinh, B. D. (2012). Estimating the welfare loss to households from natural disasters in developing countries: A contingent valuation study of flooding in vietnam. *Global Health Action*, *5*(s4), 17609. https://doi.org/10.3402/gha.v5i0.17609

Navrud, S., & Vondolia, G. K. (2020). Farmers′ preferences for reductions in flood risk under monetary and non-monetary payment modes. *Water Resources and Economics*, *30*, 100151. https://doi.org/10.1016/j.wre.2019.100151

Needham, K., Czajkowski, M., Hanley, N., & LaRiviere, J. (2018). What is the causal impact of information and knowledge in stated preference studies? *Resource and Energy Economics*, *54*, 69–89. https://doi.org/10.1016/j.reseneeco.2018.09.001

Needham, K., & Hanley, N. (2019). Valuing a managed realignment scheme: What are the drivers of public willingness to pay? *Ocean & Coastal Management*, *170*, 29–39. https://doi.org/10.1016/j.ocecoaman.2018.12.015

Netusil, N. R., Kousky, C., Neupane, S., Daniel, W., & Kunreuther, H. (2021). The willingness to pay for flood insurance. *Land Economics*, *97*(1), 17–38. https://doi.org/10.3368/wple.97.1.110819-0160R1

Ngamaba, K. H., Panagioti, M., & Armitage, C. J. (2017). How strongly related are health status and subjective well-being? Systematic review and meta-analysis. *The European Journal of Public Health*, *27*(5), 879–885. https://doi.org/10.1093/eurpub/ckx081

Norris, F. H., & Murrell, S. A. (1988). Prior experience as a moderator of disaster impact on anxiety symptoms in older adults. *American Journal of Community Psychology*, *16*(5), 665–683. https://doi.org/10.1007/BF00930020

Norris, F. H., Stevens, S. P., Pfefferbaum, B., Wyche, K. F., & Pfefferbaum, R. L. (2008). Community resilience as a metaphor, theory, set of capacities, and strategy for disaster readiness. *American Journal of Community Psychology*, *41*(1–2), 127–150. https://doi.org/10.1007/s10464-007-9156-6

Owusu, S., Wright, G., & Arthur, S. (2015). Public attitudes towards flooding and property-level flood protection measures. *Natural Hazards*, *77*(3), 1963–1978. https://doi.org/10.1007/s11069-015-1686-x

Paranjothy, S., Gallacher, J., Amlôt, R., Rubin, G. J., Page, L., Baxter, T., et al. (2011). Psychosocial impact of the summer 2007 floods in England. *BMC Public Health*, *11*, 145. https://doi.org/10.1186/1471-2458-11-145

Price, J. I., Lloyd-Smith, P. R., Dupont, D. P., & Adamowicz, W. L. (2019). Floods and water service disruptions: Eliciting willingness-to-pay for public utility pricing and infrastructure decisions. *Water Economics and Policy*, *5*(2), 1850021. https://doi.org/10.1142/S2382624X18500212

Quan, L., Zhen, R., Yao, B., & Zhou, X. (2020). Traumatic exposure and posttraumatic stress disorder among flood victims: Testing a multiple mediating model. *Journal of Health Psychology*, *25*(3), 283–297. https://doi.org/10.1177/1359105317707568

Reynaud, A., Aubert, C., & Nguyen, M.-H. (2013). Living with floods: Protective behaviours and risk perception of Vietnamese households. *The Geneva Papers on Risk and Insurance—Issues and Practice*, *38*(3), 547–579. https://doi.org/10.1057/gpp.2013.16

Reynaud, A., & Nguyen, M.-H. (2016). Valuing flood risk reductions. *Environmental Modeling & Assessment*, *21*(5), 603–617. https://doi.org/10.1007/s10666-016-9500-z

Reynaud, A., Nguyen, M.-H., & Aubert, C. (2018). Is there a demand for flood insurance in Vietnam? Results from a choice experiment. *Environmental Economics and Policy Studies*, *20*(3), 593–617. https://doi.org/10.1007/s10018-017-0207-4

Richert, C., Erdlenbruch, K., & Figuières, C. (2016). The determinants of households' flood mitigation decisions in France—On the possibility of feedback effects from past investments. *Ecological Economics*, *131*, 342–352. https://doi.org/10.1016/j.ecolecon.2016.09.014

Richert, C., Erdlenbruch, K., & Grelot, F. (2019). The impact of flood management policies on individual adaptation actions: Insights from a French case study. *Ecological Economics*, *165*, 106387. https://doi.org/10.1016/j.ecolecon.2019.106387

Robin, C., Beck, C., Armstrong, B., Waite, T. D., Rubin, G. J., & Oliver, I. (2020). Impact of flooding on health-related quality of life in England: Results from the national study of flooding and health. *The European Journal of Public Health*, *30*(5), 942–948. https://doi.org/10.1093/eurpub/ckaa049

Robinson, P. J., & Botzen, W. J. W. (2019). Flood insurance demand and probability weighting: The influences of regret, worry, locus of control and the threshold of concern heuristic. *Water Resources and Economics*, *30*, 100144. https://doi.org/10.1016/j.wre.2019.100144

Roder, G., Hudson, P., & Tarolli, P. (2019). Flood risk perceptions and the willingness to pay for flood insurance in the Veneto region of Italy. *International Journal of Disaster Risk Reduction*, *37*, 101172. https://doi.org/10.1016/j.ijdrr.2019.101172

Seery, M. D., Holman, E. A., & Silver, R. C. (2010). Whatever does not kill us: Cumulative lifetime adversity, vulnerability, and resilience. *Journal of Personality and Social Psychology*, *99*(6), 1025–1041. https://doi.org/10.1037/a0021344

Sekulova, F., & van den Bergh, J. C. J. M. (2016). Floods and happiness: Empirical evidence from Bulgaria. *Ecological Economics*, *126*, 51–57. https://doi.org/10.1016/j.ecolecon.2016.02.014

Söderberg, M., & Barton, D. N. (2014). Marginal WTP and distance decay: The role of 'protest' and 'true zero' responses in the economic valuation of recreational water quality. *Environmental and Resource Economics*, *59*(3), 389–405. https://doi.org/10.1007/s10640-013-9735-y

Strazzera, E., Genius, M., Scarpa, R., & Hutchinson, G. (2003). The effect of protest votes on the estimates of WTP for use values of recreational sites. *Environmental and Resource Economics*, *25*(4), 461–476. https://doi.org/10.1023/A:1025098431440

Strazzera, E., Scarpa, R., Calia, P., Garrod, G. D., & Willis, K. G. (2003). Modelling zero values and protest responses in contingent valuation surveys. *Applied Economics*, *35*(2), 133–138. https://doi.org/10.1080/0003684022000015900

Tapsell, S. M., Penning-Rowsell, E. C., Tunstall, S. M., & Wilson, T. L. (2002). Vulnerability to flooding: Health and social dimensions. *Philosophical Transactions of the Royal Society of London—A: Mathematical, Physical and Engineering Sciences*, *360*(1796), 1511–1525. https://doi.org/10.1098/rsta.2002.1013

Telles, S., Singh, N., & Joshi, M. (2009). Risk of posttraumatic stress disorder and depression in survivors of the floods in Bihar, India. *Indian Journal of Medical Sciences*, *63*(8), 330–334. https://doi.org/10.4103/0019-5359.55883

Tempest, E. L., Carter, B., Beck, C. R., & Rubin, G. J. (2017). Secondary stressors are associated with probable psychological morbidity after flooding: A cross-sectional analysis. *The European Journal of Public Health*, *27*(6), 1042–1047. https://doi.org/10.1093/eurpub/ckx182

Thistlethwaite, J., Henstra, D., Brown, C., & Scott, D. (2020). Barriers to insurance as a flood risk management tool: Evidence from a survey of property owners. *International Journal of Disaster Risk Science*, *11*(3), 263–273. https://doi.org/10.1007/s13753-020-00272-z

Tkac, J. (1998). Award-winning undergraduate paper: The effects of information on willingness-to-pay values of endangered species. *American Journal of Agricultural Economics*, *80*(5), 1214–1220. https://doi.org/10.2307/1244227

Tunstall, S., Tapsell, S., Green, C., Floyd, P., & George, C. (2006). The health effects of flooding: Social research results from England and Wales. *Journal of Water and Health*, *4*(3), 365–380. https://doi.org/10.2166/wh.2006.031

Tversky, A., & Kahneman, D. (1973). Availability: A heuristic for judging frequency and probability. *Cognitive Psychology*, *5*(2), 207–232. https://doi.org/10.1016/0010-0285(73)90033-9

Venkatachalam, L. (2004). The contingent valuation method: A review. *Environmental Impact Assessment Review*, *24*(1), 89–124. https://doi.org/10.1016/S0195-9255(03)00138-0

Veronesi, M., Chawla, F., Maurer, M., & Lienert, J. (2014). Climate change and the willingness to pay to reduce ecological and health risks from wastewater flooding in urban centers and the environment. *Ecological Economics*, *98*, 1–10. https://doi.org/10.1016/j.ecolecon.2013.12.005

Waite, T. D., Chaintarli, K., Beck, C. R., Bone, A., Amlôt, R., Kovats, S., et al. (2017). The English national cohort study of flooding and health: Cross-sectional analysis of mental health outcomes at year one. *BMC Public Health*, *17*(1), 129. https://doi.org/10.1186/s12889-016-4000-2

Whitehead, J. C., & Blomquist, G. C. (1991). Measuring contingent values for wetlands: Effects of information about related environmental goods. *Water Resources Research*, *27*(10), 2523–2531. https://doi.org/10.1029/91WR01769

Whitehead, J. C., Blomquist, G. C., Hoban, T. J., & Clifford, W. B. (1995). Assessing the validity and reliability of contingent values: A comparison of on-site users, off-site users, and non-users. *Journal of Environmental Economics and Management*, *29*(2), 238–251. https://doi.org/10.1006/jeem.1995.1044

Withey, P., Sullivan, D., & Lantz, V. (2019). Willingness to pay for protection from storm surge damages under climate change in Halifax Regional Municipality. *Journal of Environmental Management*, *241*, 44–52. https://doi.org/10.1016/j.jenvman.2019.04.007

Zhai, G., Fukuzono, T., & Ikeda, S. (2007). Multi-attribute evaluation of flood management in Japan: A choice experiment approach. *Water and Environment Journal*, *21*(4), 265–274. https://doi.org/10.1111/j.1747-6593.2007.00072.x

Zhai, G., & Ikeda, S. (2006). Flood risk acceptability and economic value of evacuation. *Risk Analysis*, *26*(3), 683–694. https://doi.org/10.1111/j.1539-6924.2006.00771.x

Zhai, G., Sato, T., Fukuzono, T., Ikeda, S., & Yoshida, K. (2006). Willingness to pay for flood risk reduction and its determinants in Japan1. *JAWRA Journal of the American Water Resources Association*, *42*(4), 927–940. https://doi.org/10.1111/j.1752-1688.2006.tb04505.x

Zhai, G., & Suzuki, T. (2008). Effects of risk representation and scope on willingness to pay for reduced risks: Evidence from Tokyo bay, Japan. *Risk Analysis*, *28*(2), 513–522. https://doi.org/10.1111/j.1539-6924.2008.01031.x