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Regular Article

The influence of expertise on perceived and actual household disaster preparedness

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1. Introduction

In early 2018 Ireland experienced an atypical period of severe weather which resulted in widespread snow and ice impacting the entire country. This severe weather came about because of two weather events, Storm Emma and the so-called "Beast from the East", a mass of cold polar continental air which had become established over Ireland. The National Emergency Coordination Group (NECG) noted that not since 1982 had a weather event of this severity been experienced [1]. As the weather incident approached, most households purchased a significant volume of supplies. This surge in buying, and the inability of supply chains to match demand, led to newspaper headlines such as "Shoppers clear supermarket shelves ahead of Storm Emma" [2] and "Empty shelves point to [the] fragility in our food supply" [3]. To prepare for the impending snowstorm, a country-wide "Status Red" severe weather warning was issued by Met Éireann, the national weather service [4]. The NECG issued a statement: "for reasons of public safety, the National Emergency Coordination Group is advising that people should not be out of doors from 4 pm today [1st of March 2018]. Please use the hours between now and then to make sure you and yours are indoors by the time" [5]. The Taoiseach Leo Varadkar (Prime Minister of Ireland) further emphasized this advice when he warned, "everyone should be at home after 4 pm, nobody should be on the roads after that" [6]. Research presented at the "Major Emergency Management National Conference" suggests that there was a high level of adherence to the NECG lockdown request [7]. While this extraordinary measure was in place, the Irish Defence Forces, the emergency services, and front-line health professionals were expected to continue to work.

National resilience relies on frontline response services (e.g. Fire, Police and Ambulance/Health) remaining operational during a disaster. A report by U.S. Federal Emergency Management Agency (FEMA) [9] stresses that unless the homes of disaster response personnel are resilient and prepared for emergencies, "responders will be hindered in their ability to perform their jobs when a disaster strikes, and will instead be focused on personal and family safety" (p. 1). There is some expectation that members of the frontline services are more prepared than non-experts, and therefore ready to leave their families during national disasters [10]. However, Landahl and Cox [10], in a study investigating the role of emergency-related public agencies' in building employees' disaster preparedness, find that only 29.1% of organizations from the homeland security community had delivered training and education designed to help build employee and family preparedness. More than 70% of the relevant organizations did not appear to be cognizant of the role they could play in ensuring maximum attendance for duty during a disaster.

This tension between professional and personal responsibility also emerges in the literature. Where frontline staff feel concern for the safety of their home and family during a disaster, they may face role conflict and ultimately be less likely to report for duty [11–16]. Quarantelli [14] states that during a disaster, emergency service personnel "consciously feel concern about ensuring the safety of their family and significant others, and yet also feel they have professional responsibilities to carry out their work" (p.890). From a disaster management perspective, it is critical that those working in front line services not only have prepared households but that they also can evaluate their preparedness accurately – i.e. that perceived and actual preparedness is high and aligned. Being prepared and feeling prepared should reduce concern for family and in turn, increase willingness to work during a disaster [15].

Among the public, strong alignment between perceived and actual household disaster preparedness is not evident in practice [17]. Research focused on individuals' ability to judge levels of household preparedness find that while 61% of respondents felt "adequately prepared for a disaster" only 8% have a disaster supply kit with three days of food, water and medications (p.531) [18]. This indicates that people's perception of their preparedness may not align with their actual or checklist preparedness and that preparedness may mean different things to different people. To date, research shows only a weak correlation between perceived and actual preparedness among the public [17,19]. Basolo et al. [17] highlight the divergence between perceived and actual preparedness as an "area for future research" (p.358).

Little is known about experts' household disaster preparedness. Therefore, to add to the body of knowledge on household disaster preparedness, this study will address the following research questions:

1. are experts' homes more prepared than those of non-experts (where experts are defined as disaster management personnel or members of frontline services)?
2. is there a greater alignment between perceived and actual preparedness among experts than non-experts?

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3. controlling for other relevant factors identified through a review of the literature, such as risk rating, prior exposure to disasters and socio-demographics, does expertise influence actual and perceived preparedness?

2. Systematic literature review

The first step towards answering the research questions set out above involves the completion of a Systematic Literature Review (SLR).

2.1. SLR methodology

To facilitate a transparent and replicable process, the SLR follows the PRISMA methodology [20]. The SLR was conducted between November 2019 and January 2020 and identifies all relevant studies from ten databases: Academic Search Complete/Business Source Complete, Google Scholar, Emerald Management Xtra, SAGE journals online, ScienceDirect, Scopus, SpringerLink, Taylor & Francis Online, Web of Science and Wiley Online Library.

A structured stepwise search using four rounds of keywords is applied - see Table A1 (Appendix) for an overview and breakdown of the search outputs. This ultimately gives the following string: ("disaster preparedness" OR "emergency preparedness" OR "crisis preparedness") AND ("perceived preparedness" OR "actual preparedness" OR "checklist preparedness") AND ("household preparedness" OR "individual preparedness") AND ("regression"). These keywords are applied to "all text" to search the title, keywords, abstract, and full paper fields. No date range limit was applied.

An overview of the search process is included in Fig. 1. To ensure an accurate, replicable process the following exclusion and inclusion criteria are applied:

1. Document Limitation: Only articles published in peer-reviewed journals are included. Hence, reports, conference abstracts, theses, and other grey material are excluded.
2. English and Access check: only articles available in English, and with full-text availability are selected for inclusion.
3. Eligibility check: articles are excluded if they did not examine the factors that predicted preparedness or differences between perceived and actual preparedness.

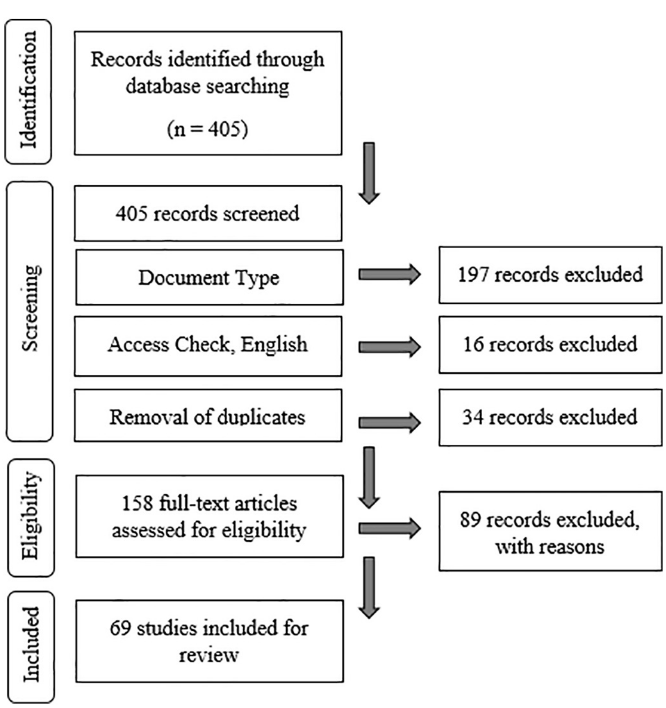

Fig. 1. SLR flow diagram - adapted from PRISMA [20,21].

Following steps 1 and 2 of the screening process, the remaining 192 papers are retrieved from the online databases and duplicates removed, leaving 158 papers. The full-texts are reviewed for eligibility, and given a relevance rating from one, for poor relevance, up to three for highly relevant: examining both perceived and actual preparedness. A rating of two denotes a somewhat relevant paper which examines either perceived or actual preparedness. A total of 69 papers were rated two or three, and are included within the SLR and listed in the Table A2 - Appendix 2.

2.2. SLR overview: geographical and hazard context

The 69 peer-reviewed papers include four relevant literature reviews [22–25] and their findings are also referenced in this review. All 69 papers are published between 2004 and 2020 (Fig. 2). Of the 65 papers which include data analysis, three studies use qualitative methods to examine the preparedness variable(s) [26–28], while the remainder (n = 62) utilize quantitative methods.

A growing body of work focusing on household preparedness (Fig. 1) concerning a wide range of hazards has been completed across many nations. The 65 studies are catalogued by country as geographic and cultural variables may help explain perceived and actual household disaster preparedness. The majority (n = 58) use a sample drawn from one country, with seven studies drawing a sample from two or more countries. The most studied countries are the USA (n = 25) followed by Israel (n = 6), New Zealand (n = 5), China (n = 3) and Germany (n = 3). Two studies are completed in Ethiopia, Iran, Italy, Japan, Philippines, Taiwan, Thailand, Turkey and one study is conducted in Belgium, Canada, Finland, Ireland, Malta, Lebanon, Namibia, Netherlands, Republic of Ghana, Scotland, Slovak Republic, Uganda, and Zambia.

More than half of the 65 studies examine one hazard (n = 35): 12 studies examine Earthquakes [19,26–36] and eight study flooding [37–44], Terrorism is studied in three papers [45–47], as is Hurricanes [8,48,49]. Three hazards are studied twice: War [50,51], Volcanic hazards [52,53] and Pandemic / Public Health Emergencies [54,55]. Finally, there is one study focusing on Wildfires [56], one examined Residential Fires [57], and another landslides [58].

Our review also highlights the practice of grouping several hazards into one group, for example, disasters, or the now discredited term, natural disasters. 20 studies opt to examine preparedness for multiple hazards in one location. These papers examined how factors such as disaster experience, prior exposure to disasters, or the likelihood of being impacted by a "natural disaster" influenced household preparedness (see, [10,59–77]).

Five studies examine two hazards within one study: Typhoons and Earthquakes [78], Earthquakes and Tsunami [79], Earthquakes and Household Fires [80], Fires and Medical Emergencies [81], and Hurricanes and Earthquakes [17]. These studies provide an opportunity to consider how preparedness for different types of disasters may change depending on the hazard [17,81,82] or its risk rating [78–80,82]. For example, Wei

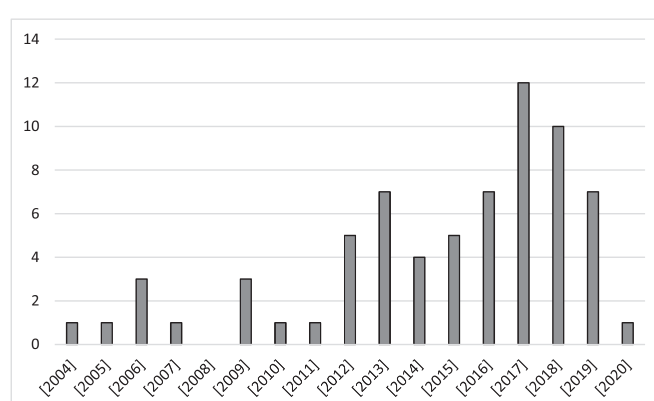

Fig. 2. Distributions of the papers by year.

et al. [78] rather than opting for one measure of disaster experience, select three: the experience of typhoons only; of earthquakes only; and of both emergencies. They find that only experience of a Typhoon is significant in predicting preparedness.

Only two papers study three or more individual hazards or groups of hazards. Paton [83] used several factors (critical awareness, trust, action coping, outcome expectancy) to predict the preparedness intentions of respondents for three hazards, Bushfires, Volcanoes, and Earthquakes. Kirschenbaum [84] regresses actual preparedness on risk perception for six hazard groups: Natural (Earthquakes), Accident (Road and Work), Industry (Industrial Accidents), Technology (Power Outage), National (Future War and Nonconventional), Self-Family (Chemical and Biological Weapons, and Conventional Weapons). In one model, Kirschenbaum [84] shows that perceived risk of future and non-conventional war positively and significantly influences preparedness (supplies) However, for road and work accidents, the opposite is evident - as perceived risk increases, preparedness (supplies) decreases. In another model which regresses preparedness planning, Kirschenbaum [84] finds all categories are non-significant. This research appears to suggest that multiple hazards (or multiple hazards by category) will have different and varying effects on preparedness.

In relation to hazard type, the evidence drawn from the SLR suggests that where hazard-specific preparedness is compared, the factors which predict the level of preparedness are not constant across the models [17,81–83]. Multi-hazard studies provide an important insight that suggests people are motivated to take different levels of preparedness action depending on the hazard type. It is therefore important that we focus not only on hazard-specific preparedness but also examine how overall risk perception in relation to a range of hazards impacts overall household preparedness (e.g. [84]). The evidence from the SLR suggests the latter is under-examined.

2.3. SLR findings: perceived and actual preparedness, and intention to prepare

Measurement of household preparedness should include more than simply storing supplies. It should encompass the possession of disaster skills, household emergency plans, and other physical/structural protection measures [84]. The reviews by Kohn et al. [23], Levac et al. [24], and Wachinger et al. [25] underscore this by highlighting a wide-ranging set of constructs used to measure disaster preparedness. Levac et al. [24] and Kohn et al. [23] suggest disaster household planning and stockpiling are vital components of an accurate preparedness measure. Kohn et al. [23] draw attention to the critical differences between the measures for perceived and actual preparedness. Reporting that only some measures of actual preparedness (e.g. planning) seem to align with perceived preparedness [17]. A sentiment reinforced by Kyne et al. [8] who note “When evaluating disaster preparedness, difference between subjective preparedness and objective preparedness must be taken into consideration” (p. 2). Wachinger et al. [25] in their literature review, introduce a third dimension - willingness or intention to prepare. They suggest that in some studies the intention to prepare is taken, perhaps erroneously, as an indicator of perceived or actual preparedness. As outlined in Table 1, five papers examine only the intention to prepare and do not proceed to identify levels of perceived or actual preparedness.

Table 1
Coding preparedness.

Preparedness measures included	n
Actual measure only	34
Intention measure only	5
Perceived measure only	8
Actual and Intention measures	6
Actual and Perceived measures	7
Perceived and Intention measures	0
All three measures	2
Total	62

This section includes an examination of the 62 papers which analyzed measures of preparedness as dependent variables. As a first step, the preparedness measures are categorized as perceived preparedness, actual preparedness, or intention to prepare (or evacuate). Perceived preparedness is defined as a subjective self-assessment of the level of household preparedness [8]. For example, Bradford et al. [39] ask respondents how prepared they feel on a 5-item scale from not at all prepared to very well prepared. Conversely, actual preparedness usually involves objective reporting as to whether respondents have disaster preparedness items or have completed specific preparedness actions. It is most commonly measured using a checklist (e.g. [35,50]) which can be divided into sub-categories such as provisions/supplies, skills, planning, and protection measures (e.g. [64,65,84]). In summary, actual preparedness can be viewed as an objective measure of preparation for a disaster [8]. As stated above, some studies include a measure of intention to prepare. This measure is distinctly different from perceived and actual preparedness as it examines people's declared future plans rather than current preparedness. While some studies only examine intentions to prepare (e.g. [33]) others include it alongside a checklist. For example, Kerstholt et al. [43] use a 15-item preparedness checklist which allows respondents to indicate whether they have or intend to complete each action.

Of the 62 studies, actual preparedness is the most common with 54.8% (n = 34) of studies measuring only actual preparedness. An additional 24.2% (n = 15) of studies include a measure of actual preparedness and at least one other preparedness measure. The number of studies with each potential combination is presented in Table 1.

Of greatest significance to this paper is the cluster of studies which include measures for perceived and actual preparedness and capture the differences between perceived and actual preparedness within one data sample. Of the nine studies that included at least one measure for both perceived and actual preparedness, two studies included perceived preparedness as an explanatory variable for predicting actual preparedness [34,82]. One study investigated actual (objective) and perceived (subjective) preparedness by examining the four possible combinations a person might exhibit (thinking they are prepared, but not prepared; thinking they are prepared and being prepared; thinking they are not prepared, and not being prepared, thinking they are not prepared but being prepared) [8]. The remaining six studies include an examination of the differences between the factors that predict perceived and actual preparedness [17,19,29,48,54,60].

In terms of the association between perceived and actual preparedness, tests indicate small, positive, significant correlations [17,19,48]. There are inconsistencies between studies in relation to the determinants of perceived and actual preparedness, though it is impossible to draw definitive conclusions, as studies differ in terms of the specific measure of preparedness analyzed and the sets of predictors included in the models. Even for commonly included factors such as experience, risk perception, gender, having a child, age, education, and owning a home, results of the SLR suggest their signs are consistent but the level of significance varies across the six studies. Table 2, an extract from Appendix A2, highlights these differences by showing the relevant studies and findings. For example, Basolo et al. [17] and Ranjbar et al. [29] find that experience does not influence perceived and actual preparedness, while Basolo et al. [48] and Henly-Shepard et al. [60] report that experience predicted one of their two measures of actual preparedness, but was not significant for other or for perceived preparedness. Kirschenbaum et al. [19] similarly demonstrate that experience influenced actual preparedness but not perceived preparedness.

The SLR reveals inconsistency in terms of how risk perception is measured. The 2009 study by Basolo et al. [17] uses dread, the likelihood of occurrence in the next decade, and the likelihood of fatalities as measures of risk perception [48]. They found that these factors were non-significant in all actual preparedness models (hurricanes and earthquakes) and one perceived preparedness (earthquakes) model. For perceived preparedness (hurricanes) the likelihood of fatalities had a significant negative effect. A later study by Basolo et al. [48] combine the measures for dread and likelihood of fatalities to create one measure, perceived risk (hurricanes), and

Table 2
SLR Extract - predictors of perceived and actual preparedness.

Reference	Hazard context	Preparedness variable	Constructs & Variables - Predicting Preparedness	
			Key: **NS** = Non-Significant variable **SIG** = Significant variable +**ev** = Significant positive variable	**-ev** = Significant negative variable **N/A** = Variable not in a model **A, B, C, D**, denote results from multiple models
Basolo et al. [17]	Hurricane / Earthquakes	Perceived & Actual	*DV = Perceived Level of Preparedness for Earthquakes (=A), for Hurricanes (=B)* Confidence in government, +**ev** (A & B) Information sources, +**ev** (A & B) Fatal, −**ev** (B) Non-significant: Experience, Dread, Happen, Gender, Marital status, Annual household income, Age, Race, Child, Education, Tenure. *Preparedness Actions for Earthquakes* *DV = Family Plan* - Information sources +**ev**, remainder **NS** *DV = Supplies* - All **NS** *DV = Mitigation* - All **NS** *DV = Shut off Utilities* - Information sources & Tenure +**ev**, remainder **NS** *Preparedness Actions for Hurricanes* *DV = Family Plan* - Confidence in government & Dread & Marital status +**ev**, remainder **NS** *DV = Supplies* - Child & Tenure +**ev**, remainder **NS** *DV = Shut off Utilities* - Gender & Age, remainder NS	
Basolo et al. [48]	Hurricane	Intention / Perceived & Actual	*Model C, DV's = Level of perceived preparedness (A), household preparedness (family plan) (B), household preparedness (all recommended items on hand) (C)* White, **NS** (All) Gender, **NS** (All) Marital status, **NS** (A & B), +**ev** (C) Child, **NS** (All) Age, +**ev** (A), **NS** (B & C) Immigrant, −**ev** (A), **NS** (B & C)	Education, **NS** (All) Annual HH income, **NS** (All) Tenure, +**ev** (A & C), **NS** (B) Information (some), **NS** (All) Information (a lot), **NS** (A & C), +**ev** (B) Hurricane experience, **NS** (A & C), +**ev** (B) Perceived readiness of local government, +**ev** (A & B), **NS** (C) Perceived risk, +**ev** (A), **NS** (B & C)
DeBastiani et al. [54]	Health Emergency	Perceived & Actual	*(Number of Preparedness Items)* *Sex,* **SIG** *Race,* **SIG** *Age,* **SIG** *Education,* **SIG**	*(Perceived Preparedness)* Sex, **SIG** Race, **SIG** Age, **SIG** Education, **SIG**
Henly-Shepard et al. [60]	Natural Hazard	Perceived & Actual	"The majority of explanatory variables regressed against all three outcomes, self-reported preparedness, coping and adaptive capacity indices, were not found to be statistically significant. The findings from each regression specification are listed in Appendix 5 in ESM." **Non-significant results are not reported.** *Summary for perceived preparedness, multiple model specifications* 5–10 years residence, −**ev** Know of safe places to evacuate to, +**ev** Have experienced or heard stories of disasters, +**ev**	*Summary for Household Coping Capacity, multiple model specifications* Feel the community is prepared, +**ev** 1–5 years residence, −**ev** Participation in a Community Group, +**ev** *Summary for Household Adaptive Capacity* Female, −**ev** I can and will support myself/my family, +**ev** I can and will support myself/my family and anyone in need of assistance, +**ev** I can and will support myself/my family and community at large, +**ev** 1–5 years residence, +**ev** Participation in a Community Group, +**ev**
Kirschenbaum et al. [19]	Earthquake	Perceived & Actual	*Hierarchical linear regression (Model 3 with Moderators) predicting actual preparedness (A) and perceived preparedness (B)* Age, **NS** (A), −**ev** (B) Gender, **NS** (A), +**ev** (B) Education, +**ev** (A & B)	Living in risk zone, **NS** (A), +**ev**(B) Religion, −**ev** (A), **NS** (B) Past experience, +**ev** (A), **NS** (B) Trust in information source, **NS** (A & B) Past experience*trust, **NS** (A & B)
Ranjbar et al. [29]	Earthquake	Intention / Perceived & Actual	*DV: Actual preparedness behavior (A), Intention to prepare (B), Perceived preparedness (C)* Trust, +**ev** (All) Past experience **NS** (A & C), **N/A** (B) Gender, +**ev** (A), **N/A** (B & C) Ownership, **NS** (A), **N/A** (B & C)	Job situation, **N/A** (A & B), **NS** (C) Family members, +**ev** (A), **N/A** (B), −**ev** (C) Age, **NS** (A), +**ev** B, **N/A** (C) Residence region **N/A** (A & C), +**ev** (B) Monthly income, +**ev** (A), **N/A** (B & C)

found that it positively influenced perceived preparedness, but was non-significant for predicting actual preparedness. Considering this evidence, it would seem that variables associated with risk perception may influence perceived preparedness, but at the same time will not impact actual preparedness. However, further testing is required.

2.4. SLR findings: factors used to predict preparedness

This section of the SLR provides an overview of the most prevalent factors that are used to examine household preparedness. These factors are categorized into three groups: risk rating; coping factors; and individual and contextual factors.

2.4.1. Risk rating

The literature review of Bourque [22] notes that "although risk perception may be a necessary predictor of preparedness, it is not a sufficient predictor and is, in fact, largely mediated or moderated by other factors" (p. 363). The SLR suggests there are two common approaches to analyzing risk and that the results across these studies are divided. Firstly, some studies use a combined construct (e.g. risk rating or risk perception) to predict preparedness: some report it as non-significant [44,45,49,53,81] while other studies report significant findings [42,74,75]. In other cases, risk ratings (likelihood and impact) or risk perception (likelihood, impact and fear) are analyzed as multiple separate constructs; for example, Ejeta et al. [41] report on three dimensions: likelihood, consequence and anxiety. Results are again divided, probability/likelihood and consequence/impact are sometimes both reported as significant factors in predicting actual preparedness [43,78], and perceived preparedness [32]. While others find only some of the risk dimensions significant for predicting preparedness: for example, severity [56], vulnerability [47], perceived threat [40,58], and certainty and immediacy [38]. Yet in the same studies other dimensions are non-significant: for example, likelihood [56], severity [40,47], worry [58], and susceptibility [38]. Given the lack of consistency in findings, a wide range of risk perception indicators should be considered for inclusion in any household preparedness model.

2.4.2. Coping appraisal

Coping appraisal relates to individuals' subjective perception of their ability to cope and the efficacy of their preparedness actions. Most of the studies in the SLR contain at least one coping appraisal, and these are usually significant in predicting preparedness. Examples include: outcome expectancy [44,83,85], self-efficacy [38,44,47,74,80], Response-efficacy [38,44,45], and self-reliance [72,76]. There are, however, some instances when coping factors such as collective efficacy and self-efficacy are not significant [40,57,62,63].

Overall, the SLR indicates that an individual's perceived ability to cope with a disaster will generally have a positive, significant, effect on their household preparedness levels. However, these findings are not consistent across all preparedness studies. There is conflicting evidence as to whether the impact of coping factors on preparedness is positive or negative (i.e. the signs of coefficients on some factors are not consistent over all studies), see Appendix A2 for the detailed set of findings on these factors. For example, Joffe et al. [80] and Mabuku et al. [44] find self-efficacy has a negative significant relationship with preparedness. While others show self-efficacy has a positive significant association [38,47,74,80]. Further research is needed to investigate the relationship. Alternative model specifications could test for possible interaction effects that may impact preparedness e.g. expertise (knowledge and training) with self-efficacy (confidence and ability).

2.4.3. Individual and contextual factors

Individual and contextual factors are regularly included within preparedness models. Variables such as age, gender, education, disaster experience, income, homeownership, and having children are most often studied. However, the significance of the relationship between these factors and preparedness can vary greatly (see Appendix A2). Other than demographics, homeownership and disaster experience are frequently found to be significant. For example, several studies report disaster experience as a significant factor in promoting preparedness [35,39,41,42,60,61,76,77], but some report no significant influence [17,29,49,58,66].

The SLR found that expertise was one of the lesser-studied factors in relation to perceived and actual preparedness. In total, six papers studied the effects of expertise (or specialist disaster-related training) on household preparedness. In a study examining perceived preparedness for coastal environmental threats, Cope et al. [73] note that working in the oil industry has a significant negative effect on preparedness while working in the fishing industry is not a significant predictor. Chan et al. [86] and Rebmann et al. [82] find that having participated in recent disaster training (1–2 years) significantly increases actual household preparedness. Rebmann et al. [82] report that where employers encourage staff to undertake household preparedness actions (e.g. establish a household disaster plan), this has a positive and significant effect on general disaster preparedness but not pandemic preparedness. Landahl and Cox [10], in a study of emergency-related personnel, find that 65.9% of Homeland Security organizations provide some general disaster preparedness training to staff but only 29.1% had plans in place to promote family disaster preparedness to staff. Furthermore, Landahl and Cox [10] did not study the effects of expertise (or disaster training) on household preparedness. Tej et al. [67] compared staff of municipal administration offices against the public (residents) and find some significant differences for factors such as following evacuation rules. They conclude that there is an "awareness gap between public administration employees and respondents who are not public administration employees (residents)" (p. 8) [67].

Not all studies suggest expertise has a significant effect. Knuth et al. [81] study the influence of multiple factors, including being from the Civil Defense/Medical Sector, on having or intending to purchase preparedness measures: fire extinguishers, fire blankets, smoke detectors, and first aid kits. Out of the seven tests they perform, being a member of the Civil Defense/Medical Sector only has a positive significant effect on respondents' intention to acquire a fire blanket. Corwin et al. [52] compare response professionals and laypeople's actual preparedness levels and find significant differences between groups for only five out of 20 actual preparedness measures. Response professionals are more likely to have an emergency contact person outside the area, own a smoke detector, seek information on local volcanic hazards, have a trained first-aider in the family, and know who are the vulnerable people in their neighborhood or community. They also find that "Significantly more response professionals agree with each self-efficacy statement than do laypeople" (p. 9), but laypeople and response professionals were similar with regards to their views on who is responsible for their safety and provision of emergency supplies [52].

2.5. SLR summary

The findings of the SLR indicate that while there is an extensive body of research related to household preparedness, very few studies examine both the influence of risk rating and exposure to disasters across a range of hazards. Our study will close this gap by examining the influence of risk rating and of prior exposure to three groups of hazards: natural (drought, flooding, high temperatures, low temperatures, snow, and storms); technological (cyber incidents, disruption to energy supply, fire, nuclear incident abroad, and radiation (domestic); and civil: (foodborne disease, infectious disease (affecting humans), infectious disease affecting livestock, loss of critical infrastructure, terrorism, and waterborne disease).

With regards to expertise, Landahl and Cox [10] stress "The assumption that first responders will report is the foundation of the ability of organizations to maintain continuity and provide essential services to citizens affected by disaster" (p. 1) and Corwin et al. [52] emphasize "the need for more detailed studies of hazard knowledge, risk perception, and preparedness among the response professional community" (p. 16). However, the SLR found that only a small number of studies examine the effect expertise has on preparedness, and none examined differences in its effect on perceived and actual preparedness. The SLR results also highlight that there is insufficient data available to establish definitively the relationship between perceived and actual preparedness; a conclusion in line with Basolo et al. [48] and Kirschenbaum et al. [19].

3. Methods

This study uses a cross-sectional design with households as the unit of analysis. The focus of the research is to examine the alignment between perceived and actual preparedness, as well as the relationship between these factors and expertise, as outlined in the three research questions. To meet the research objectives and capture data from a relatively large sample of

Irish respondents in a narrow time frame, data is collected using a survey methodology outlined by McLennan et al. [87]. The questionnaire was administered in mid-2016, made available in both online and paper format, and collected responses from 2087 households across Ireland. Participants could voluntarily opt-in once they had read the plain language statement explaining the research, and guaranteeing participants anonymity.

The online data collection software Qualtrics is used to gather the majority of data. Twitter and Facebook were used to promote the questionnaire, with a combination of paid ads and participants being encouraged to re-share the link. The questionnaire was also promoted on social media by government and public agencies, such as the Office of Emergency Planning, Met Éireann (the national meteorological service), County Councils, and Dublin Fire Brigade. Each questionnaire took approximately 20 min to complete. To access more specialist communities, the questionnaire was also sent via email to members of the emergency services and via online forums to reach State Registered Nurses and Midwives. Paper copies were also distributed to community and health facilities across Ireland, to encourage responses from less computer literate citizens. Completed survey data was input to Qualtrics.

Regarding the socio-demographic distribution of the non-expert data collected (see Table 3); the gender balance within the sample (52.8% female respondents) is close to that reported by the Central Statistics Office (CSO) Ireland [88], for the nation (51.1% female). Home ownership, (75% for non-experts) and household income (65.7% earn less than €70,000) are also reasonably well aligned with the national data (67.6% home ownership; income: 62.6% had a gross income of less than €60,000) [89,90]. However, there is over-representation of respondents from the 18 to 34 year age range when compared to the national fig. (29.5%, [88]). Regarding the expert group, socio-demographic data is not available, but the gender profile and education range were skewed in comparison with our non-expert data. The skew in education may be explained by the fact that most frontline emergency services personnel hold a university qualification. As for the gender skew towards females, this may be explained by a large percentage of respondents from the health sector which is predominantly female [91].

The analysis is conducted using the statistical software package STATA (StataCorp: Release 14.2/SE). The objectives of the analysis are to (1) examine the differences between expert and non-expert preparedness; (2) inspect the alignment between perceived and actual preparedness among experts and non-experts; (3) explore the effect expertise has on influencing both perceived and actual preparedness while controlling for other relevant factors.

3.1. Analysis

In line with the research objectives, the analysis is divided into three stages. First, we use descriptive statistics to describe the preparedness levels of experts and non-experts within our study. Using Z-tests for the difference in proportions, we explore the difference in individual checklist item preparedness between experts and non-experts. To conclude this first stage of analysis, we use a Mann-Whitney U test to examine whether a statistical difference exists between experts and non-experts perceived and actual preparedness. This nonparametric test is considered most appropriate for our data as it allows us to compare experts' and non-experts' perceived preparedness (a three-point scale) and, separately, actual preparedness (which is treated as a continuous scale, 0–24 items).

Second, we examine how the measures for perceived and actual disaster preparedness compare by using correlation and ordered probit analysis with marginal effect calculations. The analysis is undertaken separately for experts and non-experts. Our focus is on testing if a positive association exists between perceived and actual preparedness, not to identify the direction of causality.

For the final stage of the analysis, where our aim is essentially to identify and compare the impact of expertise on each of perceived and actual preparedness, we estimate multivariate regression models for each, including the same set of measured predictor variables. Drawing from the SLR, several factors likely to influence household preparedness are identified and included as control variables. This results in the following general form for each of the preparedness variables:

$$Preparedness = f[socio\text{–}demographics, risk\ ratings, risk\ exposures, self-efficacy, expertise]$$

Different types of regression are employed to predict actual and perceived preparedness, with the choice determined by how the dependent variable is measured. We use an Ordinary Least Squares (OLS) regression to predict actual preparedness and an ordered probit analysis with marginal

Table 3
Respondents' socio-demographic frequencies.

Characteristic	Experts	Non-experts	Description
Gender (551 experts, 1408 non-exerts)			
Female	75.3% (415n)	52.8% (744)	1 if female, 0 otherwise
Age (551 experts, 1409 non-exerts)			
18–34	30.3% (167n)	41.6% (586n)	1 if aged 18–34, 0 otherwise
35–54	60.8% (335n)	44.9% (633n)	1 if aged 35–54, 0 otherwise
55 or older	8.9% (49n)	13.5% (190n)	1 if aged 55 or older, 0 otherwise
Lives in (551 experts, 1409 non-exerts)			
A city	15.4% (85n)	18% (254n)	1 for city, 0 otherwise
The suburbs or outskirts of a city	15.2% (84n)	8.1% (114n)	1 for Suburbs, 0 otherwise
A town	27% (149n)	16.7% (235n)	1 for town, 0 otherwise
A village	16.2% (89n)	29.9% (421n)	1 for village, 0 otherwise
A rural area	26.1% (144n)	27.3% (385n)	1 for rural area, 0 otherwise
Own vs Rent Home (551 experts, 1406 non-exerts)			
Own Home	75% (413n)	79.2% (1113n)	1 for homeownership, 0 otherwise
Years living at current address (551 experts, 1406 non-exerts)			
Mean (SD)	10.69 (9.14 SD)	13.29 (10.80 SD)	Range $<$ 1–100
Adults (age $>$ 18) living at the address (549 experts, 1406 non-exerts)			
Mode	2	2	Range 1–7
Children (age $<$ 18) living at the address (540 experts, 1406 non-exerts)			
Mode	0	0	Range 0–7
Household Income (466 experts, 1125 non-exerts)			
Below 30,000	9% (42n)	23.7% (267n)	1 for income below 30,000, 0 otherwise
30,000-70,000	60.1% (280n)	42% (472n)	1 for income 30,000-70,000, 0 otherwise
Over 70,000	30.9% (144n)	34.3% (386n)	1 for income over 70,000, 0 otherwise
Education (543 experts, 1408 non-exerts)			
Higher Educated	89.1% (484n)	65.4% (921n)	1 if higher educated, 0 otherwise

effect calculations to examine the ordinal variable, perceived preparedness. Liddell and Kruschke [92] point out that "analyzing ordinal data as if they were metric can systematically lead to errors" (p. 328) and emphasize the need to use an ordered regression model such as ordered probit in cases like ours where the dependent variable is measured on a Likert scale.

To perform the necessary model diagnostic checks, we used the variance inflation factor (VIF) value to check for multicollinearity and White's test for heteroskedasticity. A VIF score of five or over indicates multicollinearity. Our results show VIF scores within acceptable limits [93] having a maximum VIF of 2.21 and a mean VIF of 1.46. The results of White's test suggest no problem of heteroskedasticity ($p = 0.919$).

3.2. Variable definitions

3.2.1. Perceived and actual disaster preparedness

The practice of measuring actual preparedness against a checklist of items designed to identify the level of disaster preparedness within households is well established in disaster research [24,94,95]. However, as well as checking supplies, deliberate actions, such as having a plan, or taking out insurance protection should also be captured. Levac et al. [24] and Paek et al. [96] highlight that a respondent having supplies may not show intentional preparedness. For this study, it is the level of preparedness within the home which we are seeking to establish, however, within the questionnaire we also ask respondents to declare if they have taken action to protect themselves or their home in case of an emergency. This captures deliberate preparedness and controls for additional measures not specified.

Our study uses a checklist of 24 disaster preparedness items and actions which act as broad indicators of household preparedness. These are selected from established preparedness guidelines prepared by FEMA, the American Red Cross and the Irish Office of Emergency Planning (see Table 4, [97–99]). The 24 items are split into three categories: Planning, Action, and Resources, which was comparable with the American Red Cross preparedness campaign "Get a Kit; Make a Plan; Be Informed" [100] and the work of Corwin et al. [52]. To achieve equal weighting, the scores for resources, planning and action are z-transformed separately. These standardized z-scores are then averaged to give the Household Preparedness Score. Further, to check the reliability and validity of these four preparedness indicators, we use both Cronbach's alpha and Spearman correlation coefficients.

Cronbach's alpha is considered critical "in the evaluation of assessments and questionnaires" (p. 54) [101]. But, Kohn et al. [23] report that only 40% of studies about disaster preparedness provide Cronbach's α as a construct reliability metric. Of these, Kohn et al. [23] report a variance between $\alpha = 0.42$ and $\alpha = 0.99$ depending on the items selected. One reason for the lack of reported Cronbach's α could be that studies using a checklist method may obtain low scores. However, a checklist preparedness construct with low internal consistency (i.e. a low Cronbach's alpha score) does not necessarily indicate an untrustworthy scale. For example, a higher error variance with a checklist scale only means a respondent with a certain number of items may score the same as a respondent with a different set of items. This will only have a serious impact if certain preparedness items are weighted differently. That said, we report Cronbach's α to allow for comparison with other studies. Also, to support the reliability testing of our preparedness measures, we use Pearson's correlations. The results of these two tests are: Preparedness Planning (a 5-item construct) $\alpha = 0.47$; Preparedness Action (a 3-item construct) $\alpha = 0.51$; Preparedness Resources (a 16-item construct) $\alpha = 0.74$; Household Preparedness Score (the combined 24-item construct) $\alpha = 0.81$. Pearson's correlations show that all four preparedness indicators are significantly ($p < 0.01$) and positively correlated with one another. Individual correlations range from weak for "action – planning" ($r = 0.355$, $p < 0.01$), too strong for "Household Preparedness Score – resources" ($r = 0.829$, $p < 0.01$). Overall, these results are acceptable.

Perceived preparedness, i.e. a self-reported assessment of preparedness, is measured early within the questionnaire (before we show respondents the list of preparedness items) and asks if respondents consider themselves prepared for a disaster (ordered scale: no, somewhat, yes). A fourth option (unsure) was present within the questionnaire; however, to facilitate ordering of responses, the category and associated responses are removed. Similarly, Basolo et al. [17] measure perceived preparedness on a binary scale (yes/no), while Kirschenbaum et al. [19] use a 3-point scale from not prepared at all up to fully prepared.

Table 4
Household preparedness indicators.

	Expert % (n)	Non-expert % (n)	Z-test
Planning			
Disaster plan - all situations	12.6% (74)	6.2% (87)	4.796**
Disaster plan - specific situations	58.1% (342)	50.1% (706)	3.248**
List of emergency contact numbers	49.4% (291)	44% (620)	2.211*
Important documents kept in the home	86.1% (507)	84.6% (1192)	0.845
Cash kept in the home	41.8% (246)	47.8% (673)	−2.453**
Action			
Acted to protect self or home in case of a disaster	62% (412)	53.5% (753)	3.669**
Household insurance	84.3% (488)	83.4% (1174)	0.462
Household insurance for flooding	52.6% (301)	43.5% (613)	3.689**
Resources			
Smoke detector	99.2% (584)	96.5% (1360)	3.304**
Fire extinguisher	63.2% (372)	57.9% (819)	2.177*
Fire blanket	58.1% (342)	48.8% (688)	3.766**
Carbon monoxide detector	57.4% (338)	45.6% (642)	4.819**
Generator	8% (47)	9.4% (133)	−1.039
Gas Grill (with spare gas)	33.6% (198)	34.1% (480)	−0.194
Tank of fuel (small can, etc.)	31.9% (188)	28.1% (396)	1.709
Tool set	82.5% (486)	83.3% (1173)	−0.401
Axe/Chainsaw	55% (324)	52.7% (742)	0.959
First aid kit	90.8% (535)	84.3% (1188)	3.855**
Batteries	82.9% (488)	78.3% (1103)	2.312*
Torch	90.7% (534)	87.2% (1228)	2.215*
Battery powered radio	30.4% (179)	35.3% (497)	−2.103*
Enough water for 3+ days	40.5% (238)	29.1% (407)	4.983**
Enough food for 3+ days	86.6% (509)	84.1% (1179)	1.401
Enough meds for 8+ days	46% (269)	44.1% (612)	0.785

Notes: Expert (n) = 572–664; Non-expert (n) = 1389–1409; Items coded as 0,1 (No, Yes).
* $p < 0.05$.
** $p < 0.01$.

3.2.2. Expertise

We measure expertise as a dummy variable (1 if the respondent is an expert and 0 otherwise). Experts are individuals who self-identified as a member of the emergency services (voluntary or paid), a member of the defense forces (voluntary or paid), a disaster/crisis/business continuity professional, and/or a member of the health services (a nurse or doctor). We label these respondents as experts because they have professional subject-matter expertise relevant to our study. Their disaster training, education and experience, combined with a deeper understanding of disasters and risk, and greater knowledge of the Irish disaster management system should, in theory, result in differences between experts and non-experts. By definition, experts should be better informed about what preparedness actions are necessary and, therefore, maybe in a better position to judge their household preparedness. For our analysis, a total of 678 respondents (32.5%) are coded as an expert; which leaves 1409 respondents as non-experts.

3.2.3. Risk ratings, exposure, self-efficacy, and socio-demographics

Besides the variables described above, perceived and actual disaster preparedness, and expertise, the final stage of analysis includes the additional variables: risk ratings, prior exposure to disasters, self-efficacy, and socio-demographics.

The questionnaire includes 17 household-related risks drawn from the 26 risks listed on the 2012 Irish National Risk Assessment [102]. These are grouped into three categories:

- natural hazards: drought, flooding, high temperatures, low temperatures, snow, and storms;
- technological hazards: cyber incidents, disruption to energy supply, fire, nuclear incident abroad, and radiation (domestic);
- civil hazards: a foodborne disease outbreak, infectious disease (affecting humans), infectious disease (affecting livestock), loss of critical infrastructure (e.g. water), terrorism, and waterborne disease outbreak.

There are two standard methods for assessing risk: unknown/fear ([103]) and/or likelihood and impact ratings [104,105]. For this study, we use the latter (likelihood and impact ratings). For consistency, we use the five-point Likert scales drawn from the Irish National Risk Assessment ([102]). Likelihood ranges from extremely unlikely (1) to very likely (5), and impact categories range from very low (1) to very high (5). These scales are then multiplied to create a risk rating measure for each (with a value between 1 and 25) and are then averaged for each classification. Natural hazards have a mean value of 8.713 (standard deviation of 3.252), Technological hazards have a mean value of 10.918 (standard deviation of 3.841), and Civil hazards have a mean value of 10.552 (standard deviation of 4.389). The three risk ratings are checked for reliability using Cronbach's α, and all are within acceptable limits (risk ratings to Natural Hazards $\alpha = 0.79$; risk ratings to technological hazards $\alpha = 0.77$; and risk ratings to civil hazards $\alpha = 0.89$).

Respondents' direct exposure to disasters is measured by asking respondents to indicate those, from the list of 17, they have experienced. Responses are summed by classification and averaged. Exposure to natural hazards has a mean of 0.449 (standard deviation of 0.266); exposure to technological hazards has a mean of 0.228 (standard deviation of 0.164), and exposure to civil hazards has a mean of 0.224 (0.222 standard deviations).

Self-efficacy measures respondents' perceived ability to deal with a threat [106]. Self-efficacy is measured by asking if respondents believed they needed assistance from their neighbors, non-profit organizations, emergency services, local government, and/or national government in the event of a disaster. Each of the six sources of assistance was rated from no assistance required (6) to substantial assistance required (1). Categories are summed and averaged to produce a measure of self-efficacy – with 1 representing the lowest self-efficacy score and 6 the highest. Self-efficacy has a mean score of 3.53 (standard deviation of 1.23) with a Cronbach's $\alpha = 0.87$.

Finally, Table 3 presents the summary characteristics listing the socio-demographic variables of the respondents.

4. Results and discussion

In this section, and consistent with our objectives, we present and discuss our research findings across the three stages of analysis. Firstly, we provide an overview of preparedness using summary statistics as well as tests for statistically significant differences between experts and non-experts. Secondly, we examine the measures of perceived and actual preparedness to estimate the extent to which these measures are aligned. Finally, we continue our examination of the impact of expertise, risk ratings and prior disaster exposure on the dependent variables: perceived and actual preparedness.

4.1. Expert and non-expert preparedness

Summary statistics for actual checklist preparedness are presented in Table 4 and separated into experts and non-experts. For 19 of the 24 items, a higher percentage of experts have the preparedness item than non-experts. These differences range from 0.5% to 11.8%, with some of the largest differences presented below.

- 11.8% more experts have a carbon monoxide detector than non-experts;
- 11.4% more experts store enough water for 3+ days than non-experts;
- 9.3% more experts have a fire blanket than non-experts;
- 9.1% more experts knew if they had household insurance for flooding than non-experts;
- 8.5% more experts have acted to protect self or home in case of a disaster than non-experts;
- 8% more experts have a household disaster plan for a specific situation than non-experts.

For each item, a Z-test, for the difference in proportion between expert and non-expert, is conducted and the results are reported in Table 4. A statistically significant difference is most evident concerning the more specialist checklist items. Experts appear to have a greater appreciation of the need for mitigation and planning (pre-disaster plans, carbon monoxide detection, smoke detectors); items needed during a disaster (water, fire blankets, battery torch, contact numbers, fire extinguishers, first aid kits); and during recovery (flood insurance). For more general items such as food, fuel, medicine, household insurance, tool kits, generators, documents and barbecues, there was no significant difference between experts and non-experts. Finally, cash and battery-powered radios were more often found in the homes of non-experts.

For perceived preparedness: 59% of experts consider themselves to be somewhat prepared, 19.1% feel they are prepared, and 14.2% report not being prepared. As for the non-experts, similarly, the majority rate themselves as somewhat prepared (57.7%), but a smaller percentage (12.5%) report being prepared. Perhaps as expected, a higher percentage of non-experts (20%) specified they are not prepared. Overall, these results do not show any vast difference between experts and non-experts.

A Mann-Whitney U test is conducted to examine if a significant statistical difference exists between the experts and non-experts for both preparedness variables. The results show a significant difference in preparedness ratings between experts and non-experts. For actual preparedness, based on the Household Preparedness Score, experts (mean rank = 1048.18) and non-experts (mean rank = 938.50) are shown to be significantly different ($U = 432,807.0$, $z = 3.920$, $p < 0.001$). Similarly, for perceived preparedness experts (mean rank = 1013.99) and non-experts (mean rank = 908.02) scores indicate a significant difference at $U = 433,387.0$, $z = 4.649$, $p < 0.001$. These results show that expertise does affect both perceived and actual preparedness.

Within the risk literature, similar results have been attributed to prior exposure, social status [107] and familiarity [108]. Therefore, to examine further the effect expertise has on perceived and actual preparedness, the regression analysis in Section 3.3 includes these, and other, factors as control variables.

Focusing on the respondents who did not take action to protect themselves or their home in case of a disaster; Table 5 reports the percentages of experts and non-exerts who identify reasons for not taking action to

Table 5
Reasons for no action taken to prepare.

Reason for no action	Experts	Non-experts	Chi-square
Not knowing what to do	22.6% (57n)	39.6% (260n)	$\chi2(1) = 23.053, p < 0.001$
Having no time to prepare	21.8% (55n)	16.6% (109n)	$\chi2(1) = 7.115, p = 0.008$
Not wanting to think about it	9.1% (23n)	16% (105n)	$\chi2(1) = 3.339, p = 0.068$
Expense	16.3% (41n)	21.6% (142n)	$\chi2(1) = 3.270, p = 0.071$
Suggesting the emergency services would assist them	15.1% (38n)	20.7% (136n)	$\chi2(1) = 3.755, p = 0.053$
Believing it would not make a difference	18.7% (47n)	18.4% (121n)	$\chi2(1) = 0.005, p = 0.943$

prepare and the results of a chi-square test of association between expertise and reason for no action. Where a statistically significant association existed, having no time to prepare was the only response where a higher percent of experts indicated it was their reason not to prepare.

4.2. Perceived and actual preparedness for experts and non-experts

To explore the extent to which the measures of perceived and actual preparedness are aligned, we perform two tests. Firstly, correlation analysis is used to examine the four constructs of perceived and actual preparedness. Secondly, we undertake four ordered probit regressions with marginal effect calculations. By including ordered probit analysis this study extends the methodology of Basolo et al. [17] and Kirschenbaum et al. [19], to include an estimated probability change in perceived preparedness following a one standard deviation change in actual preparedness. For the analysis in Section 4.2, experts and non-experts are analyzed separately.

Both sets of correlation tests show similar results suggesting actual preparedness was significant, though weakly, positively correlated with perceived preparedness. For experts, the correlations with perceived preparedness are planning: $r = 0.355$ $p < 0.01$, action: $r = 0.289$ $p < 0.01$, resources: $r = 0.331$ $p < 0.01$, and the Household Preparedness Score: $r = 0.416$ $p < 0.01$. For the non-experts, the correlations for perceived preparedness are planning: $r = 0.338$ $p < 0.01$, action: $r = 0.346$ $p < 0.01$, resources: $r = 0.357$ $p < 0.01$, and the Household Preparedness Score: $r = 0.436$ $p < 0.01$. These results suggest only slight differences exist between how accurately experts and non-experts judge their perceived preparedness.

Four ordered probit regression models are estimated to expand our understanding of the relationship between perceived and actual preparedness. These regressions measure the relationship between the respondents' perceived preparedness (as a dependent variable) and actual preparedness (as the independent variable). In the case of models 2a and 2b, the marginal effect estimates are completed with all other explanatory variables set at their mean values. The subsequent results are displayed in Table 6.

The results in Table 6 show a significant positive relationship between actual preparedness and perceived preparedness. For example, Regression 1a predicts a one standard deviation increase in the Household Preparedness Score increases the probability that a non-expert states they are prepared for a disaster by 0.130 (13 percentage points). For experts, the equivalent figure from Regression 1b is 0.186 (18.6 percentage points). However, the regression coefficients in 1a and 1b are not statistically different ($p = 0.663$), suggesting perceived and actual preparedness align in the same way for both experts and non-experts. This matches the conclusion drawn based on the correlation tests. The estimated ordered probit coefficients suggest no statistically significant difference in the alignment of perceived and actual preparedness for experts versus non-experts. This would indicate that experts appear no more accurate at predicting their preparedness, or lack thereof, than non-experts.

The results in this section contribute to the existing theory by first replicating prior findings which show a relatively weak relationship between perceived and actual preparedness [17,19,60]. Our correlation tests are in line with the results of Basolo et al. [17] who found the correlations for perceived and actual preparedness range between $r = 0.18$ to $r = 0.33$ ($p = 0.05$) depending on the measure for actual preparedness. Kirschenbaum et al. [19] similarly found a slightly stronger significant correlation of

Table 6
Ordered probit analysis with marginal effects.

	Dependent variable: perceived preparedness				
	Ordered probit	Std. Err.	Marginal effects (dy/dx)		
Independent variables	Coef.		No	Somewhat	Yes
Regression 1a: Non-expert Only					
Household Preparedness Score (Z-Score)	0.724***	0.047	−0.197***	0.067***	0.130***
Chi-squared (df = 1)	$\chi2 = 261$***				
N	1240				
Regression 1b: Expert Only					
Household Preparedness Score (Z-Score)	0.693***	0.072	−0.143***	−0.043*	0.186***
Chi-squared (df = 1)	$\chi^2 = 99.10$***				
N	524				
Regression 2a: Non-expert Only					
Planning Preparedness Scale (Z-Score)	0.255***	0.042	−0.069***	0.024***	0.046***
Action Preparedness Scale (Z-Score)	0.256***	0.039	−0.070***	0.024***	0.046***
Resources Preparedness Scale (Z-Score)	0.216***	0.043	−0.059***	0.020***	0.039***
Chi-squared (df = 3)	$\chi^2 = 261.42$***				
N	1240				
Regression 2b: Expert Only					
Planning Preparedness Scale (Z-Score)	0.276***	0.060	−0.057***	−0.017*	0.074***
Action Preparedness Scale (Z-Score)	0.201***	0.060	−0.041***	−0.012*	0.054***
Resources Preparedness Scale (Z-Score)	0.208**	0.067	−0.043**	−0.013ǂ	0.056**
Chi-squared (df = 3)	$\chi^2 = 99.85$***				
N	524				

Note: Coefficient marked ǂ is significant at $p = 0.052$. Planning, Action, and Resources were z-transformed for this analysis.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

r = 0.401 (p < 0.01) between perceived and actual preparedness. Secondly, by estimating the ordered probit models and computing the marginal effects, we explore more fully this significant relationship. We show that the respondents are making some connection between both preparedness constructs as an increase in actual preparedness corresponds with a percentage point increase in the probability a respondent will perceive they are prepared. Further, our study reveals that this marginal impact is relatively large.

4.3. Significance of expertise in influencing preparedness

In the previous sections, we show a statistical difference between the level of preparedness of experts and non-experts, with experts having higher mean rankings for preparedness (Section 4.1). Further, we establish perceived, and actual preparedness are not independent of one another for experts or non-experts (Section 4.2). As outlined earlier, the literature points to the possibility that prior exposure to disasters, risk ratings, and other social factors can influence preparedness. In this section, we address our third research objective by exploring the effect expertise has on perceived and actual preparedness, while controlling for risk rating and prior disaster exposure. Additionally, we control for gender, age, home ownership, rural/urban setting, family size, education, income, and self-efficacy.

The results for the OLS, with Household Preparedness Score as the dependent variable, and the Ordered Probit regression, with perceived preparedness as the dependent variable, are presented in Table 7. In both regressions' expertise is significant (p < 0.001) and positive. This supports the findings in Section 4.1 confirming the positive effect expertise has on actual and perceived preparedness. Furthermore, prior studies about household disaster preparedness (see, [36,109–111]) highlight the significance of factors including prior exposure to specific disasters, self-efficacy, and socio-demographics, and having controlled for these factors the impact of expertise remains significant. A check for interaction effects between expertise and factors such as prior exposure or self-efficacy revealed the coefficients on interaction variables to be individually and jointly insignificant.

In addition to highlighting the significance of the relationship between expertise and preparedness, our results identify other factors that influence perceived and actual preparedness. Alongside expertise, the variables self-efficacy, exposure to natural hazard-related disasters, and having an income of €30,000 or above, are significant and positive in both the perceived and actual preparedness regressions. Being female has a strongly significant negative relationship with perceived preparedness, but only a weakly significant and negative relationship with actual preparedness.

Like Kirschenbaum, et al. [19] our results also show that some variables influence perceived or actual preparedness, not both. Having a higher risk rating towards natural hazard-related disasters, and having a higher number of children in the household, both negatively impact perceived preparedness but are not significant for actual preparedness. Conversely, home ownership increased years of residency in the home, and exposure to technical disasters, have a significant positive impact on actual preparedness but not on perceived preparedness.

Table 7
Influencing perceived and actual preparedness.

	OLS Regression			Ordered Probit Regression		
	Dependent Variable: Household Preparedness Score (Z-Score)			Dependent Variable: Perceived Preparedness		
Independent Variables	Coef.	Std. Err.	P	Coef	Std. Err.	P
Female	−0.069†	0.040	0.082	−0.379***	0.068	<0.001
Age 35–54	0.026	0.045	0.558	0.103	0.077	0.182
Age 55 & Over	0.076	0.070	0.276	−0.020	0.119	0.869
Lives in a village	0.037	0.051	0.475	−0.057	0.088	0.518
Lives in a town	0.121***	0.054	0.026	0.104	0.092	0.258
Lives in a suburb/outskirt of a city	0.080	0.069	0.244	0.118	0.118	0.319
Lives in a city	0.127*	0.057	0.028	0.097	0.098	0.319
Owns home	0.498***	0.050	<0.001	0.035	0.086	0.69
Years at address	0.007***	0.002	0.001	0.004	0.004	0.257
Number of children (at household)	−0.006	0.017	0.745	−0.051†	0.030	0.086
Higher Educated	−0.033	0.045	0.457	−0.001	0.077	0.986
Income 30,000-70,000	0.231***	0.052	<0.001	0.182*	0.090	0.044
Income Over 70,000	0.382***	0.058	<0.001	0.219*	0.099	0.027
Risk Rating of Natural Hazards	−0.001	0.007	0.893	−0.026*	0.012	0.036
Risk Rating of Technological Hazards	−0.006	0.008	0.446	−0.001	0.014	0.958
Risk Rating of Civil Hazards	0.005	0.007	0.508	−0.017	0.012	0.165
Exposure to Natural Hazards	0.310***	0.083	<0.001	0.452***	0.142	0.001
Exposure to Tech. Hazards	0.332*	0.133	0.013	0.290	0.228	0.203
Exposure to Civil Hazards	0.098	0.101	0.333	0.119	0.170	0.486
Self-Efficacy	0.052***	0.016	0.001	0.105***	0.027	<0.001
Expert	0.209***	0.045	<0.001	0.383***	0.076	<0.001
Constant	−1.170	0.113	<0.001			
Cut 1 Constant				−0.459	0.197	
Cut 2 Constant				1.504	0.200	
R^2	0.225					
F	20.45***					
χ2 (Chi-squared) (df = 21)				159.76***		
N	1503			1397		

* p < 0.05.
** p < 0.01.
*** p < 0.001.
† p < 0.001.

5. Conclusions and implications

In this paper, we first examine whether experts' homes are more prepared than those of non-experts'. Secondly, we test for greater alignment between perceived and actual preparedness among experts than non-experts. Finally, we explore whether expertise influences actual and perceived preparedness while controlling for relevant factors drawn from the SLR, and examine if there are differences in the factors that affect perceived and actual preparedness.

One of the most significant findings to emerge from our study is that expertise has a positive, significant effect on both perceived and actual preparedness. Experts' households are better prepared for a disaster than those of non-experts. Having controlled for a wide range of variables (as outlined in Table 7), this research points to a direct relationship between expertise and both perceived and actual preparedness. The SLR illustrates that prior research on this topic has shown mixed results. Our finding, to a degree, contradicts the prior research by Corwin et al. [52] and Knuth et al. [81] who find expertise does not have a consistent significant impact on respondents' preparedness levels. Corwin et al. [52], conclude that “response professionals [experts] largely mirror laypeople in terms of their household preparedness levels” (p. 13). In other research, Cope et al. [73], studying coastal environmental hazards, observe that working in the oil industry had a negative and significant effect on household preparedness.

Landahl and Cox [10] and FEMA [9] emphasize the importance of disaster management personnel and members of frontline services being prepared at home. Our findings are that experts are better prepared than non-experts. However, we also find that experts are no more accurate in judging the level of actual preparedness within their households, which, as outlined by Quarantelli [14], could allow role conflict to emerge among some experts. That is, an expert who feels their household is not prepared (i.e. low perceived preparedness and low or high actual preparedness) for a disaster may be conflicted between fulfilling their personal and professional responsibilities. Hence, an objective for disaster response

Table 8
Marginal effects for perceived preparedness.

Dependent Variable: Perceived Preparedness Marginal effects (dy/dx)			
Independent Variables	No	Somewhat	Yes
Female	0.098***	−0.008	−0.089***
Age 35–54	−0.027	0.004	0.024
Age 55 & Over	0.005†	−0.001	−0.004
Lives in a village	0.015	−0.002	−0.013
Lives in a town	−0.027	0.002	0.024
Lives in a suburb/outskirt of a city	−0.030	0.002	0.028
Lives in a city	−0.025	0.002	0.023
Owns home	−0.009	0.001	0.008
Years at address	−0.001	0.000	0.001
Number of children (at household)	0.014†	−0.002	−0.012†
Higher Educated	0.000	0.000	0.000
Income 30,000-70,000	−0.048*	0.006	0.042*
Income Over 70,000	−0.056*	0.004	0.052*
Risk Rating of Natural Hazards	0.007*	−0.001	−0.006*
Risk Rating of Technological Hazards	0.000	0.000	0.000
Risk Rating of Civil Hazards	0.005	−0.001	−0.004
Exposure to Natural Hazards	−0.120***	0.016 †	0.103**
Exposure to Tech. Hazards	−0.077	0.011	0.066
Exposure to Civil Hazards	−0.031	0.004	0.027
Self-Efficacy	−0.028***	0.004*	0.024***
Expert	−0.094***	0.000	0.095***

Table 8 reports the marginal effects of the probit model for perceived preparedness. The marginal effect values reveal that the probability that a respondent state they are prepared for an emergency is 9.5 percentage points higher if they are an expert, controlling for all other variables at their mean values.
Note: Coefficients marked ǂ are significant at $p < 0.1$.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

and management organizations should be to help ensure perceived and actual preparedness is high and aligned among staff.

A key finding from our research is that there is a positive relationship between experts' and non-experts' perceived and actual preparedness. As a person's actual preparedness increases, so does their perceived preparedness. Studies by Basolo et al. [17] and Kirschenbaum, et al. [19] report significant correlations that range from $r = 0.18$ to $r = 0.40$. Our reported correlations support these findings. We obtain significant positive correlations ranging between $r = 0.289$ and $r = 0.436$. To expand on these correlations, we undertook ordered probit analyses with marginal effects. The results confirm the significant positive relationship between actual and perceived preparedness (see Table 6). However, we find that the level of alignment for perceived and actual preparedness is similar for both experts and non-experts. It might be expected that an experts' perceived and actual preparedness would align more strongly and that their assessment of preparedness would be more objective than subjective given their training and experience. This is not supported by our findings.

Evidence suggests that workplace preparedness can influence household preparedness [82]. A program of training designed to firstly strengthen household preparedness and then align perceived preparedness, perhaps using a checklist approach, could be rolled out in frontline disaster response organizations. However, Landahl and Cox [10] report such training is not readily available even in the Homeland Security organizations they surveyed in the USA. We suggest this is an area which should be built into new recruit training across all response organizations and could be built into national preparedness campaigns. Further research is required to examine the best approach to such training, and the impact of training and preparedness campaigns on actual preparedness and perceived preparedness.

From a methodological perspective, future research could adjust how perceived preparedness is measured. Our study, like those conducted by Basolo et al. [17]; Henly-Shepard et al. [60]; Kirschenbaum, et al. [19], uses a standard categorical measure to gauge perceived preparedness. To facilitate more precise analysis, there is value in using a more nuanced scale, such as the use of a continuous scale, to measure perceived preparedness.

Our paper sheds some light on the factors, other than expertise, which influence perceived and actual preparedness. Firstly, as noted within the SLR, consistent patterns have not been found with regard to which variables influence perceived preparedness, and which actual preparedness. Secondly, the papers reviewed point to different variables predicting perceived and actual preparedness. Our findings contribute additional evidence on the different predictors of perceived and actual preparedness. For example, our results show that living in a town or city, and owning your own home both have a significant and positive relationship with actual preparedness, but the same factors are non-significant in the perceived preparedness model. Similarly, as the number of children in a household increases, the level of perceived preparedness decreases, but the level of actual preparedness is not impacted.

The SLR highlighted that coping factors such as self-efficacy, confidence in one's ability to take preparedness actions, were not consistent in their effects on preparedness. We considered it likely that expertise (knowledge and training) may have had a statistically significant interaction effect with self-efficacy. However, we find these interactions were non-significant.

The results from our data and the SLR also emphasize the importance of using risk rating for, and exposure to, a wide range of disaster types to predict perceived and actual preparedness. Previous work by Kirschenbaum [84] shows that individuals' rating of different hazards can have varying effects on household preparedness. That is, within the same model, some risk ratings are positively related to preparedness, while others are non-significant, or have a negative effect. Similarly, we find that exposure to disasters triggered by natural hazards significantly increases both perceived and actual preparedness, while a higher risk rating for natural hazards negatively impacts on perceived but not actual preparedness. We also show that for technological hazards and civil hazards, both risk rating and prior exposure are non-significant in influencing perceived or actual preparedness.

From a policy perspective and given the national reliance on frontline response organizations, the results of this research can help policy-makers gain a greater understanding of the measures needed to build household and national preparedness. These findings could be used to inform the design and delivery of more effective disaster preparedness education campaigns and training within response organizations. For example, to minimize role conflict among disaster response personnel and members of frontline services, a preparedness campaign offering guidance and support to females and households with children, two socio-demographics found to have a negative, significant effect on perceived preparedness, could be designed. A suite of targeted education campaigns, alongside specialist training initiatives, should promote household preparedness among experts and help ensure perceived and actual preparedness are high and aligned.

From a risk communication perspective, both experts and non-experts should be targeted by preparedness campaigns in light of the considerable proportion who had taken no action to prepare (38% and 46.5% respectively). These campaigns should be focused on knowledge – how to prepare, given that 22.6% of experts and 39.6% of non-experts who did not take action indicated they did not know what to do.

Notwithstanding the issues that exist among those who had taken no action, experts have higher levels of actual preparedness than non-experts, see Table 7. It would be instructive in future research to explore why this may be the case and tailor messaging to remove the preparedness barriers for non-experts, thus bridging the preparedness gap. A further dimension could be to explore the path from risk communication to preparedness actions for experts and non-experts.

Over a fifth of experts who did not take action to prepare stated they had no time to do so. Therefore, in terms of risk communication, a campaign aimed at encouraging those working in frontline response organizations to make the time to prepare their homes could help to remove barriers to response during a disaster.

In times of a national emergency, such as occurred in Ireland during Storm Emma, risk and preparedness messages tailored to frontline response services must be issued separately to those for the general public. Clearly, the instruction that “everyone should be at home after 4 pm, nobody should be on the roads after that” [6] cannot apply to frontline response services (experts) who will be required to leave their homes and work during an emergency. This will only be successful if their households and families are prepared, and they have confidence in the preparedness actions taken, that is, their perceived and actual preparedness are high and aligned.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.pdisas.2021.100150.

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