A Face-to-face Intervention Increases Multi-hazard Household Preparedness Cross-culturally

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Vulnerability to natural disasters is increasing globally [1-3]. In parallel, responsibility for natural hazard preparedness has shifted onto communities and individuals [4].Thus, it is crucial that households increase their preparedness. Yet adoption of household preparedness measures continues to be low, even in high-risk regions [5-8]. In addition, there have been few interventions to change hazard preparedness that are evaluated longitudinally using observational measures. Therefore, we conducted a controlled intervention, with a 12-month follow-up, on adults in communities in the USA and Turkey, focused on improving household earthquake and fire preparedness. We show that this *fix-it* intervention, involving evidence-based, face-to-face workshops, increased multi-hazard preparedness in both cultures longitudinally. Compared to baseline, the primary outcome, overall preparedness, increased significantly in the intervention groups, with Turkish participants improving earthquake preparedness significantly more and US participants fire preparedness significantly more. High baseline outcome expectancy and home ownership predicted overall preparedness change in both intervention groups longitudinally, implying that a sense of agency influences preparedness. An unintended consequence of observation is that it may increase preparedness, as even the control groups changed their behaviour. Therefore, observation of home preparatory behaviours by an external source may be a way to extend multi-hazard preparedness across a population.

Ill-prepared households experience larger losses post-disaster, both economically and socially, with increased loss of life and injury and more displaced people [9]. Hence, investment in evidence-based, effective interventions that draw on psychological understandings of natural hazard preparedness are essential to minimize the detrimental effects of disasters on people. This paper reports the results of a cross-cultural intervention in the US and Turkey that draws on such knowledge.

To date, empirical evidence has demonstrated that people do very little to prepare before a hazard strikes [6,10], and when they do engage in hazard-related behaviour, it tends to be post-event, in the phases of response and recovery [11,12]. Surveys assessing levels of seismic adjustment have shown that people tend to adopt post-impact survival measures (e.g., storing food and water, having an emergency kit) but current pre-disaster preparedness and mitigation levels (e.g. fixing heavy items to wall studs) are not significantly higher than they were in the 1970s [13,14]. Pre-disaster measures are crucial for injury and loss of life prevention [15].

A number of risk reduction efforts have promoted individual and household preparedness for different hazards, and many websites and apps are dedicated to this[16]. Efforts have typically focused on addressing single, specific hazards. Yet, societies prepared for multiple, rather than single, hazards are more resilient [17,18] and hazards can occur simultaneously or in rapid sequence (e.g. earthquakes followed by tsunami or fire). Consequently, multi-hazard preparedness approaches are increasingly promoted in the field of disaster preparedness [17,19].

Despite this trend, the literature contains few intervention studies for promoting actual multi-hazard preparedness behaviours, as opposed to intended and self-reported preparedness. Of those that exist, few have proven effective in increasing preparedness behaviours. In the US, there is a range of interventions in the form of campaigns that focus on earthquake or home fire preparedness, such as “The Great ShakeOut” (earthquakes), “The American Red Cross Home Fire Preparedness Campaign” (home fires), and “Make it Through” (earthquakes, home fires and other hazards), but few of them have been systematically evaluated [20]. This lack of evaluation has impaired the field from its inception [21], with notable exceptions [22,23]. Furthermore, most of the intervention studies lack control groups against which to measure the intervention’s effectiveness [24,25].

The US literature on home fire preparedness interventions is more extensive than that on earthquakes [26-28], with most of the studies focusing on smoke alarm canvassing and smoke alarm installation, methods proven most effective for improving fire preparedness and reducing fire-related deaths and injuries. Face-to-face contact with fire personnel [29] and hands-on training [30] have proven to be the most effective techniques for facilitating adoption of fire preparedness behaviours. However, a key limitation is that evaluations of the impact of most of these interventions, like those in the preparedness field more generally, are based exclusively on self-report measures, making validity difficult to gauge and increasing the risk of social desirability bias [31].

In a different cultural context, in Turkey, there have been significant efforts to develop and implement community training programs focusing on disaster preparedness and mitigation through the Istanbul Seismic Risk Mitigation and Emergency Preparedness Project "ISMEP" [32], the Neighbourhood Disaster Support Project (MAG), and the Turkish Red Crescent, among others. There are no published home fire preparedness intervention studies in Turkey and only one multi-hazard intervention study that focused on earthquakes, floods and landslides [33]. Compared to non-participants, participants in this intervention had higher levels of threat perception, of worry about future disasters and higher reported levels of preparedness behaviours after the intervention. However, this study lacked description of what the intervention entailed and, like most in the field, relied on self-report measures.

The few natural hazard preparedness intervention studies that have been conducted are mostly North American [24,25], Australian [34] or New Zealand based [35]. Comparing results of a multi-hazard preparedness intervention in the US with those of a significantly different culture, such as Turkey, provides essential information regarding whether behaviour can be changed by a similar intervention across different contexts. The US and Turkey embody different cultural characteristics [36,37]. Though culture is a changing and complex entity, the constructs

individualism and collectivism capture aspects of the US and Turkey, respectively. Thus in Seattle people are likely to see themselves as loosely linked to other individuals and motivated by their own preferences, needs and rights while in Izmir they are likely to see themselves as closely linked to others. In the latter they are likely to see themselves as more tied to a collective – such as family or nation – and to feel duty-bound and motivated by its norms [38]. Stemming from such differences, each culture may have a differing sense of agency [38], though agency might also be affected by religious beliefs concerning fate versus individual control over destiny [39]. Regarding culture, there is likely to be more conformity to those in power in Turkey [36,37], which potentially translates into being more likely to carry out what disaster managers recommend.

The importance of exploring cross-cultural applicability in the field of natural hazard preparedness has been highlighted by the United Nations International Strategy for Disaster Reduction via the Integrated Research for Disaster Risk program [40]. Cultural comparisons can identify which of the active ingredients that affect behaviour change are culture-specific and which pertain across cultures; they can thereby inform disaster reduction strategies [40].

This study builds on previous work conducted on the widespread beliefs or social representations of earthquakes in people living in three highly seismic areas: Seattle (US), Izmir (Turkey), and Osaka (Japan) [5]. In that study, Turkish participants reported preparing significantly less for earthquakes than North American participants, with Japanese participants preparing at a level between the two. However, even the US participants performed, on average, under half of the recommended earthquake preparedness behaviours. These findings supported earlier cross-cultural work showing that when North Americans were compared with Japanese participants, they were more likely to have adopted earthquake mitigation measures, had higher self-efficacy, were more optimistic about the outcome of the

hazard, believed they were better prepared than others and had lower perceived vulnerability to earthquakes [41].

Results of these studies, together with Paton et al.'s natural hazards risk reduction preparedness model [42,43], which proposes perceived self-efficacy and outcome expectancy as predictors of preparedness, among other variables, informed the design of the *fix-it* intervention study reported in this paper. When applied to non-individualist cultures, Paton et al. (2010) posit the importance of community variables like collective efficacy as well as trust in agencies and empowerment, and so these were also explored.

This study included both earthquakes and home fires because one of the identified barriers to preparedness is the long return period (perceived infrequency) of damaging earthquakes [5]. Therefore, pairing earthquakes with the more frequent home fire hazard potentially facilitates adoption of preparedness measures. The full description of the intervention and method appears in a protocol paper [44]; a summary of the intervention appears below and please see Methods section. The study protocol describes in detail the hypotheses, rationale and methodology of the study. Published protocols are needed in the hazards intervention literature as they improve the standard of research by enabling replicability.

Most preparedness interventions focus on survival measures, such as having stores of water and a medical aid kit, and not on mitigative behaviours that increase the chances of surviving, such as securing items in the household [45,46]. In order to address this lack, the *fix-it* intervention reported in this paper focused on household adjustments. The earthquake-related adjustments were securing the TV, computer, bookcases and large cabinets to the walls and having no objects placed above sofas or beds. The fire-related adjustments were keeping exits

clear of obstruction, having in-date fire extinguishers and functioning smoke alarms, and knowing how to test the alarms.

The *fix-it* earthquake and fire preparedness intervention included the main elements of previous effective preparedness interventions, chiefly hands-on training and face-to-face interaction. The intervention design was also informed by the behavior change literature [47], the widespread beliefs concerning earthquakes literature (e.g. [5]) and the hazard risk reduction model [42]. Thus, it aimed to facilitate empowerment and community cohesion building, to build trust, to keep anxiety levels low, and to facilitate high self/collective efficacy and outcome expectancy. It aimed to place responsibility and a sense of control over hazard safety onto individuals.

The following psychosocial variables were evaluated before the intervention and one-week, three-weeks and one-year after it: self-efficacy, outcome expectancy, trust, fatalism, critical awareness, earthquake anxiety, empowerment, collective efficacy and corruption (see Supplementary Table 1). They were chosen in keeping with the cross-cultural nature of the endeavour. Paton, Okada and Sagala (2013)[48] argue that when intervening across cultures, not only the more individualist, but also the more collectivist constructs relevant to motivation to prepare must be measured. Indeed the majority of disasters occur in largely collectivist cultures and so the existing theories, often devised within more individualist cultures, require testing. Thus while risk perception has been seen as a key correlate of self-reported preparedness [49] many have not found this link (e.g. [50]). This partly depends on how risk perception is defined and measured and since the field has shifted from 'risk as perception' to 'risk as feeling' [51] asking about anxiety levels goes some way to gauging whether people dread the risk. The current study explored anxiety as well as sense of safety felt in one's home and sense that one's house would be damaged.

Fix-it consisted of two, three-hour workshops over two evenings, one week apart. It focused on fixing and securing eight items in the house: securing bookcases and large cabinets to the wall; securing TVs and computer screens; having functioning smoke alarms and knowing how to test them; ensuring that no pictures/frames were hanging above sofas and/or beds; having all exits clear of obstruction; having in-date fire extinguishers.

Key elements built into the intervention were: a focus on enhancing awareness of the importance of being prepared; telling participants about the principle cognitive and emotive responses to earthquakes found in the same cities prior to this study [5]; presenting videos concerning earthquake and fire safety; having participants play an online videogame on securing the *fix-it* items in a living room; being asked to take photographs of certain items in their homes related to the eight *fix-it* interventions (e.g. of their TV); focussing on "how to" with hands-on training from trusted experts (e.g. Red Cross) where participants were able to touch, explore and discuss different preparedness tools such as smoke alarms, fire extinguishers and tools to secure furniture to wall studs. At the end of the workshop, participants were given a fridge magnet with an acronym for the *fix-it* measures and a mug with the name of the intervention, which aimed to serve as reminders, in the long term, to ensure that the *fix-it* measures were adopted.

The *fix-it* intervention aimed to provide insight into whether an intervention can work to change multi-hazard preparatory behaviours across a range of demographic groups and if so, what ingredients make a multi-hazard intervention effective in the long-term. Study objectives were to increase and sustain overall, earthquake and home fire preparedness; to evaluate predictors of preparedness at baseline; to examine whether changes in psychosocial

variables predict changed preparedness 12 months after the intervention; and to compare results of the same intervention across two cultures.

Baseline differences were assessed regarding sociodemographic, psychosocial and preparedness characteristics of participants. Cross-cultural analyses demonstrated that Seattle and Izmir samples differed on several sociodemographic and psychosocial variables, as well as on levels of preparedness, at baseline. In terms of sociodemographic and housing characteristics (see Supplementary Table 2), Seattle's sample was significantly older ($t(346) = 5.5$; $p<0.001$; Cohen's $d = 0.59$, 95% CI: 0.38-0.81), with higher levels of employment ($\chi^2(1) = 16.5$; $p<0.001$; Cramér's V = 0.22, 95% CI: 0.12-0.33) and education ($\chi^2(6) = 88.74$; $p<0.001$; Cramér's V = 0.52, 95% CI: 0.42-0.63), and higher average household income ($\chi^2(3) = 99.9$; $p<0.001$; Cramér's V = 0.54, 95% CI: 0.43-0.64). In addition, among Seattle participants there were significantly more homeowners (versus renters) ($\chi^2(1) = 45.5$; $p<0.001$; Cramér's V = 0.36, 95% CI: 0.26-0.47) and a higher number of people living in single-family houses (versus apartment buildings) compared to Izmir residents ($\chi^2(2) = 188.6$; $p<0.001$; Cramér's V = 0.74, 95% CI: 0.63-0.84). On the other hand, Izmir participants were significantly more religious ($t(345) = -6.6$; $p<0.001$; Cohen's $d = 0.71$, 95% CI: 0.49-0.93).

Regarding the psychosocial variables at baseline (see Supplementary Table 3), Seattle participants had significantly higher levels of earthquake critical awareness ($t(343) = 3.7$; $p<0.001$; Cohen's $d = 0.41$, 95% CI: 0.19-0.62), outcome expectancy ($t(346) = 3.1$; $p=0.002$; Cohen's $d = 0.34$, 95% CI: 0.12-0.55), empowerment ($t(345) = 2.1$; $p=0.032$; Cohen's $d = 0.23$, 95% CI: 0.02-0.44) and trust in authorities ($t(345) = 6.1$; $p<0.001$; Cohen's $d = 0.67$, 95% CI: 0.45-0.88) than their Izmir counterparts. Izmir participants showed higher levels of fatalism ($t(345) = -2.7$; $p=0.007$; Cohen's $d = 0.29$, 95% CI: 0.08-0.51) and earthquake anxiety ($t(345) = -9.7$; $p<0.001$; Cohen's $d = 1.05$, 95% CI: 0.83-1.28) and reported their

local authorities and government as being more corrupt (t(346) = -4.5; p<0.001; Cohen's d = 0.49, 95% CI: 0.27-0.70) compared to Seattle residents.

Observed preparedness levels at baseline show that Seattle had significantly higher levels of fire preparedness than Izmir (t(346) = 16.5; p<0.001; Cohen's d = 1.79, 95% CI: 1.54-2.04), while Izmir had significantly higher levels of earthquake preparedness (t(346) = -5.7; p<0.001; Cohen's d = 0.65, 95% CI: 0.43-0.86) (see Supplementary Table 4).

Analyses of preparedness-related variables at baseline showed that people in Seattle reported significantly more past experiences with both earthquakes ($\chi^2(1) = 36.4$; $p < 0.001$; Cramér's V = 0.33, 95% CI: 0.23-0.44) and home fires ($\chi^2(2) = 21.3$; $p < 0.001$; Cramér's V = 0.25, 95% CI: 0.16-0.36), were more likely to have looked for information on earthquakes ($\chi^2(2) = 45.3$; $p < 0.001$; Cramér's V = 0.36, 95% CI: 0.26-0.47) and fire safety ($\chi^2(1) = 37.6$; $p < 0.001$; Cramér's V = 0.33, 95% CI: 0.23-0.44), and had more smoke alarms ($\chi^2(1) = 283.4$; $p < 0.001$; Cramér's V = 0.91, 95% CI: 0.80-1.00) than their counterparts in Izmir. Seattle residents were also significantly more confident than Izmir residents that their homes would not be seriously damaged in a major earthquake ($\chi^2(1) = 6.2$; $p = 0.013$; Cramér's V = 0.13, 95% CI: 0.06-0.25) and a major fire ($\chi^2(1) = 24.3$; $p < 0.001$; Cramér's V = 0.26, 95% CI: 0.17-0.37). They reported feeling significantly safer inside their homes if an earthquake occurred ($\chi^2(4) = 67.5$; $p < 0.001$; Cramér's V = 0.44, 95% CI: 0.34-0.55), compared to Izmir residents.

Regarding consistency between self-report (survey) and observational measures of preparedness (observational checklist) in Seattle, all items correlated significantly at the 0.05 level, except the following: "Computer is secured" ($p = 0.900$), "Exits are clear of obstruction" ($p = 0.670$) and "No objects are hanging above sofas/beds" ($p = 0.131$). In Izmir,

all items in the observational checklist correlated significantly with the same self-report items in the survey, with all correlations significant ($p<0.01$).

Variables predicting preparedness at baseline were explored in order to examine what factors lead to people being prepared in the absence of any intervention. Preparedness was assessed by observation: *overall preparedness* included the eight earthquake and fire-related items and analyses were repeated on *earthquake* and *fire preparedness* separately.

Multivariable regression analyses on *overall*, *earthquake* and *fire preparedness* were conducted at baseline for the total data set. The following independent variables were included in the equation: earthquake and fire critical awareness, self-efficacy, outcome expectancy, fatalism, collective efficacy, earthquake anxiety, empowerment, trust, perceived level of corruption, age, religiosity, marital status (married/living with partner versus single/other), employment, education, household income, housing status (owner versus renter), and location. In addition, interaction terms of these variables by location were included. The overall model fit is reported, as are the significant predictors of preparedness (see Table 1).

The model predicting *overall preparedness* was statistically significant: $F(35, 207) = 2.4$, $p < 0.001$, $R^2 = 29\%$ (95% confidence interval: 21-37%), adjusted $R^2 = 17\%$. However, no individual terms reached a 5% significance level. The model predicting *earthquake preparedness* was statistically significant: $F(35, 207) = 3.5$, $p < 0.001$, $R^2 = 37\%$ (95% confidence interval: 29-45%), adjusted $R^2 = 27\%$. The significant interaction terms were fatalism by location ($p = 0.034$) and age by location ($p = 0.004$): in Izmir, *earthquake preparedness* was higher and increased with age but decreased with fatalism. The model predicting *fire preparedness* was also statistically significant: $F(35, 285) = 9.3$, $p < 0.001$, $R^2 = 53\%$ (95% confidence interval: 46-60%), adjusted $R^2 = 47\%$. The interaction terms for corruption by location ($p = 0.041$) and age by location ($p = 0.037$) were significant: in Seattle

fire preparedness was significantly higher and increased with age. In Izmir, *fire preparedness* significantly increased the higher the corruption ratings.

Table 1. Significant Predictors of Earthquake and Fire Preparedness at Baseline

For all subsequent analyses, eleven participants from the intervention group in Seattle were excluded because they were from a vulnerable group living in supported housing and were therefore not permitted to adopt the required preparedness measures at home. Thus, they were excluded from comparisons between the intervention and control groups.

As described in the Supplementary Methods, quota sampling was used to approximately match intervention and control groups by age, gender, homeownership and income. As a check on this process, within the two locations, the researchers compared the intervention and control groups at baseline on these sociodemographic characteristics. There were no significant differences in either location between the two groups on these variables (see Supplementary Table 5).

The researchers further compared preparedness, the other sociodemographic characteristics and the psychosocial variables at baseline between the intervention and control groups. Levels of preparedness between intervention and control groups in either location were not significantly different at baseline.

There were no differences in either location by marital status, employment status or type of residence. Seattle's intervention group reported having significantly more past experiences with earthquakes (Fisher exact $p = 0.026$; Cramér's V = 0.19, 95% CI: 0.08-0.36) and were significantly more likely to have children (Fisher exact $p = 0.020$; Cramér's V = 0.20, 95% CI: 0.09-0.37) than the control group. In Izmir, the control group were significantly less educated ($\chi^2(5) = 15.8$; $p = 0.008$; Cramér's V = 0.29, 95% CI: 0.18-0.43) and more religious (two-sided independent sample t-test, t(189) = -3.5; $p < 0.001$; Cohen's d = 0.39, 95% CI: 0.10-0.68) than the intervention group. In addition, the intervention group in Izmir demonstrated significantly higher earthquake (t(186) = 2.2; $p = 0.024$; Cohen's d = 0.33, 95% CI: 0.04-0.62) and fire critical awareness (t(187) = 2.9; $p = 0.004$; Cohen's d = 0.43, 95% CI: 0.14-0.74), higher outcome expectancy (t(189) = 4.2; $p < 0.001$; Cohen's d = 0.62, 95% CI: 0.33-0.91), higher collective efficacy (t(189) = 2.2; $p = 0.028$; Cohen's d = 0.32, 95% CI: 0.04-0.61) and higher empowerment (t(189) = 2.8; $p = 0.005$; Cohen's d = 0.41, 95% CI: 0.13-0.70) than the Izmir control group. Other comparisons were not significant.

There was some loss to follow-up (or attrition) in both locations: 30/157 (19%) in Seattle and 57/191 (30%) in Izmir. Loss to follow-up was not significantly different by group allocation (intervention or control) in either location (Fisher exact $ps > 0.26$). Further analyses of loss to follow-up are given in Supplementary Table 6.

Regarding changes to preparedness over time, A 2 (experimental group) × 2 (location) ANOVA on change in preparedness, with the intercept term denoting an overall change from

baseline to 12 months, was conducted. *Post hoc* t-tests were then conducted (see Table 2). For *overall preparedness*, the ANOVA was statistically significant ($F(3,257) = 7.775$, $p < 0.001$, $R^2 = 8\%$ (95% confidence interval: 2-14%), adjusted $R^2 = 7\%$), showing the reasonable fit to the model, with a significant main effect of group ($p < 0.001$), but not of location ($p = 0.276$) or the interaction term ($p = 0.520$). That is, twelve months after the intervention, the intervention groups showed significantly greater increases in *overall preparedness* compared to control groups across both sites (see Figure 1a). This yields a medium effect size (partial $\eta^2 = 0.078$) using Cohen [52].

For *earthquake preparedness*, the ANOVA was statistically significant ($F(3,257) = 6.954$, $p < 0.001$, $R^2 = 8\%$ (95% confidence interval: 2-14%), adjusted $R^2 = 6\%$), with significant main effects of group ($p = 0.001$) and location ($p = 0.002$), but not the interaction term ($p = 0.289$). That is, the intervention groups showed significantly greater increases (partial $\eta^2 = 0.039$, a small effect size), but also participants in Izmir showed greater increases than those in Seattle (partial $\eta^2 = 0.035$, a small effect size; see Figure 1b). For *fire preparedness*, the ANOVA was also statistically significant ($F(3,257) = 7.926$, $p < 0.001$, $R^2 = 9\%$ (95% confidence interval: 2-16%), adjusted $R^2 = 7\%$) with significant effects again for group ($p< 0.001$) and location ($p = 0.004$), but not the interaction term ($p= 0.707$). That is, the intervention groups showed significantly greater increases (partial $\eta^2 = 0.054$, a small effect size), but for fire preparedness, participants in Seattle showed greater increases than those in Izmir (partial $\eta^2 = 0.032$, a small effect size; see Figure 1c).

Figure 1 to be placed here

Regarding the specific checklist items that changed 12 months after the intervention, for each item individuals were coded as having improved or not. Fisher's exact tests were then conducted comparing intervention and control groups, aggregated over both locations.
In the intervention groups, irrespective of location, the fixing of large cabinets, TVs and computers had improved significantly, as had keeping exits clear of any obstructions. Comparing the two locations, Seattle participants had significantly increased their ownership of in-date fire extinguishers and functioning smoke alarms (see Supplementary Table 7).

Predictors of change in preparedness were explored 12 months after the intervention in the intervention groups. Multivariate regression analyses with the same predictor variables used in the baseline regression analysis were conducted on change in *overall, earthquake,* and *fire preparedness* 12 months after the workshops. For *overall preparedness*, the overall model was significant ($F(33,90) = 1.765$, $p = 0.002$, $R^2 = 39\%$, 95% confidence interval: 29-49%). Higher outcome expectancy at baseline ($p = 0.002$) as well as being a homeowner ($p = 0.041$) were significant predictors in both cultures. Furthermore, the effect for outcome expectancy was significantly stronger in Seattle (interaction term, $p= 0.017$). None of the other predictor variables showed a significant relationship.

The researchers also tested for change in the same predictor variables over time. There were no significant changes at 12 month follow-up in either Seattle or Izmir.

What works in changing disaster preparedness? Results showed that *fix-it* was effective in improving and sustaining multi-hazard preparedness in Seattle and in Izmir. A theory-based, face-to-face intervention that applies methods familiar in the health behaviour change literature and the psychology of natural hazard preparedness can be highly effective in changing behaviour in different cultures.

After 12 months, the intervention was effective in both cultures. Compared to baseline, the primary outcome, overall preparedness, increased significantly in the intervention groups,

with Izmir participants improving earthquake preparedness significantly more and Seattle participants fire preparedness significantly more. These results are in line with baseline differences in the two types of preparedness in the two cities, which may have been affected by the differing fire and earthquake safety policies in each country. In the US, states have regulations requiring the proper installation of smoke alarms in households [53]. By contrast, in Izmir, there are no regulations on fire safety. It has been shown that the impact of public health interventions (e.g., smoke-free environments, seatbelt use) is enhanced when supported by robust legislation [54] and the research presented in this paper may support this. Robust legislation sets out the social norm for a particular set of behaviours and where responsibility lies for carrying them out[55]. It may be a crucial adjunct to behaviour change interventions.

In addition, Seattle participants reported more experiences with home fires than Izmir participants did and it is mandatory to have working fire alarms according to Washington State Law[56]. Furthermore, the majority of houses in Seattle are made of wood, in contrast to the concrete high-rise buildings in Izmir. Thus, home fires are likely to be more salient for Seattle residents and despite already having higher levels of fire preparedness at baseline, these increased significantly over time post-intervention and significantly more than in Izmir.

Contrary to what the literature shows [5], residents of Izmir compared to those of Seattle scored higher on *earthquake preparedness* at baseline, on the observational checklist measure. However, in many of the homes in Izmir, it was noted by researchers conducting the home visits that large cabinets or bookcases were built into the wall, lending participants an advantage in terms of scoring higher on preparedness over Seattle participants whose cabinets were mostly freestanding. This is relevant to those endeavouring to increase preparedness: those measures that are normative within households and not easily reversible overcome the problem of preparedness behaviour reverting over time. Four of the *fix-it* measures were of

this nature. Three of the four *fix-it* measures that changed most in the sample longitudinally were of this nature.

When reporting *earthquake preparedness* on the survey, participants in Seattle scored significantly higher than their counterparts in Izmir. The list of *earthquake preparedness* items on the survey went beyond the *fix-it* items to include having food and water stored, an emergency kit and an emergency plan, for which Seattle residents scored significantly higher. These results emphasize the multidimensional nature of hazard preparedness. Findings of this and similar studies must be interpreted with caution by considering what forms of preparedness are being assessed.

Individuals in the control groups also showed improved *overall, earthquake,* and *fire preparedness* compared to baseline, with improvements being statistically significant in Izmir. This suggests that the home visits carried out to conduct the assessments, with the observation and scoring of home earthquake and fire preparedness by people within participants' homes, played a role in increasing preparedness behaviour in the control group. This demonstrates the Hawthorne Effect [57], which is the change in behaviour by participants due to their awareness of being (repeatedly, in this case) observed.

Predictors of preparedness were explored for all participants in each city before the intervention. This provided an inroad into predictors independent of an intervention. For *earthquake preparedness*, fatalism played an important role in Izmir, where those with high levels of fatalism prepared less. This is consistent with literature showing that fatalism is pervasive in earthquake-related thinking in many cultures [5,58] and can act as a barrier to preparedness. Furthermore, age was a significant predictor of higher *earthquake preparedness* levels in Izmir at baseline, where older people prepared more. Age also predicted higher *fire preparedness* in Seattle, where the older participants prepared more. This may be because older people have more experience of various disasters. This is

consistent with previous studies conducted with US samples [59]. Being older and non-fatalistic is likely to increase multi-hazard preparedness behaviours.

Perceived corruption played an important role in predicting preparedness in Izmir at baseline. Results showed that those residents in Izmir who viewed their government and construction industry as more corrupt showed higher levels of *fire preparedness* than those who reported lower levels. This is inconsistent with previous earthquake research that found higher ratings of corruption to be a barrier to earthquake preparedness in Izmir residents [5]. The link between perception of corruption and preparedness requires further exploration.

In terms of the intervention's effect, which psychosocial and demographic variables predicted changed preparedness after 12 months? High outcome expectancy at baseline, as well as being a homeowner, predicted overall preparedness change in the intervention groups at 12 months, with a stronger effect in Seattle. Outcome expectancy – the sense that one's preparedness behaviours will work to reduce one's risk – is a proven predictor of intentions to prepare, according to Paton et al.'s natural hazards risk reduction model [42] and the behaviour change model [60-62]. Findings of this study are consistent with the behaviour change literature and take Paton et al.'s model one step further by showing outcome expectancy to be a predictor of actual preparedness behaviour whereas Paton et al. (2003) analysed only intended behaviours via self-reports.

Fix-it targeted people's beliefs in their ability to mitigate hazard consequences via trusted experts in the workshops. In addition, the home visits made at multiple time-points to check whether a set of behaviours had been adopted, indicated to participants that there was something that could be done to prevent or reduce the ill consequences of hazards. The concept of self-efficacy has received more attention in the literature than outcome expectancy has. The latter is an independent concept [63]. Evaluating outcome expectancy has now become common practice in health interventions due to the weight of evidence supporting its value[64].

Promoting the belief that a behaviour will effectively lead to the desired outcome is the very opposite of promoting fatalism, which this and other studies have found to be a barrier to preparedness. Thus giving people a sense of agency regarding natural hazard preparedness plays a key role in changing their behaviour.

Regarding home ownership, it has long been found to be a predictor of preparedness [5,33], though the findings on this are equivocal. Results of this study confirmed and took this finding a step further, in that being a homeowner significantly predicted observed preparedness change even one year after the intervention. This may relate to having a greater sense of control over one's home when owning it and, indeed, being in control of whether one can make permanent fixes. It needs to be noted, however, that home ownership is not a precondition for the fixes studied in this intervention as renters changed their behaviour significantly too. Removing items from exits and having in-date fire extinguishers, for example, are not predicated on home ownership.

The researches excluded a small group because they were in sheltered housing and so had no permission to adopt fixes in their abodes. This highlights the plight of the disempowered, who should attract far more attention in the literature as we know that the disempowered tend to suffer disproportionately from disasters[65].

Despite cultural differences and the expectation that the active ingredients of behaviour change would be culture-specific, the two variables, outcome expectancy and home ownership, were the only significant predictors of behaviour change, and were so in both cultures. This supports the idea that certain determinants of disaster preparedness may be universal [66]. The stronger effect of outcome expectancy in Seattle may be related to its residents being significantly more confident in the safety of their homes and holding higher levels of trust.

Limitations of this study include variability in the way the study was conducted, due to the demands in each culture. For example, Turkish participants had the survey read aloud to them (due to literacy concerns), which may have increased their social desirability bias. There were also situations outside the control of the researchers, such as an attempted coup and multiple terrorist attacks in Turkey during the study period, which may have shifted participants' focus away from the behaviours prescribed by the intervention. In addition, two months before the Seattle intervention, *The New Yorker* published the article "The Really Big One", reporting that a mega-quake on the West Coast would cause the worst natural disaster in North American history. Certain participants in Seattle's intervention group talked of increased fear, which may have influenced how they responded to the intervention. Nevertheless, these external events affected both intervention and control groups.

Furthermore, it was not practical to carry out a random allocation between intervention and control group within this real world setting. Instead, quota sampling was used and successfully matched intervention and control groups on age, gender, home ownership and income and there were no differences in baseline preparedness between the intervention and control group in each city. However, there were some significant differences in other variables at baseline, notably in terms of education level and some psychosocial variables in Izmir. Such differences may have contributed to the greater impact of the intervention on the intervention groups.

Regarding power, the power analysis performed pertained to the primary outcome measure only. The study was not necessarily sufficiently powered to pick up important predictors of preparedness change 12 months after the intervention.

Finally, regarding limitations, the study purposefully focused on a narrow band of behaviours that could be conducted in the home by individuals for three reasons. Firstly, the behaviour change literature indicates that interventions need to be limited to few, simple

behaviours in order to glean what might be driving the change[67]. Secondly, and regarding the choice of the particular narrow band of behaviours, most preparedness interventions directed at individuals focus on survival measures (e.g. having a medical aid kit), planning (e.g., having an emergency plan), knowledge and skills (e.g., first aid), and not on mitigative behaviours that increase the chances of surviving, such as securing items in the household. Some argue that it is these mitigative behaviours that often save people from injury/death, especially in developing countries where homes may not be built with a rigorous seismic code[68]. Furthermore, none of the chosen mitigative measures had previously been examined in systematically evaluated interventions and all can be done relatively easily by the householder, as opposed to certain structural preparedness behaviours that often lie beyond the control of the householder, like retrofitting.

However, despite these limitations, the *fix-it* intervention had a significant impact on preparedness behaviour across cultures and it significantly improved *earthquake* and *fire preparedness* even in Izmir, where participants reported high levels of fatalism, distrust and perceived corruption and tended to be renters rather than homeowners.

In conclusion, *fix-it* has proven to be an effective community intervention to improve multi-hazard preparedness in two different cultures and to sustain the effect one year after the intervention, demonstrating the value of a face-to-face, rather than digital, intervention and a theory-based design. As the first cross-cultural, multi-hazard intervention study for hazard preparedness to be formally evaluated longitudinally and observationally, this study aims to enhance the evidence-base on natural hazard preparedness interventions. It points to the importance of including observational measures in a study, not least because the very act of being observed may have played a role in behaviour change, as seen by the control group improving their preparedness without the intervention workshops. In fact, observation of home preparatory behaviours by an external person may be a way to roll out change in

preparatory behaviour to a wider segment of the population. The successful efforts to conduct smoke alarm canvassing in the fire domain in the US could be extended to the host of home preparedness behaviours relevant to other natural hazards. Furthermore, the study confirms the same two drivers of change in two diverse cultures: outcome expectancy and home ownership. These appear to be universally important determinants of natural hazard behaviour change. Thus, the *fix-it,* multi-hazard intervention and principles underpinning it can be rolled out to further communities in order to decrease the major loss of life and injury wrought by natural hazards globally.

Methods

The *fix-it* intervention was conducted in Seattle in September 2015, with a 12-month follow-up assessment conducted in September 2016. In Izmir, the intervention was conducted in May/June 2016, with the 12-month follow-up assessment conducted in May/June 2017. One week and three-month follow-up assessments were also conducted, with results available in the Supplementary Information section (see Supplementary Figure 1). In this paper, only the longitudinal (12-month) results are reported.

Study design

This paper describes a cross-cultural, quasi-experimental, controlled intervention study, with a longitudinal, pretest-posttest design. The intervention group in the targeted communities in Seattle and Izmir received a face-to-face intervention on earthquake and home fire preparedness. Control groups did not receive the intervention but completed all assessments. Data collection was performed blind to the conditions of the experiments.

Area Selection and Group Allocation

Seattle and Izmir were chosen as both cities are located in highly seismic areas, are coastal with the concomitant risk of tsunami and have not endured a highly damaging earthquake in recent

decades [5]. They are also very different cultures, encompassing both the developing and developed world. The intervention targeted particular, existing communities as sense of community (feelings of belonging/attachment to people and places, Paton, 2000) and community participation have been found to be variables that affect preparedness and adoption of mitigation measures [69,70]. Consequently, in each city, one geographical area representative of the census population of each city was allocated to be the intervention group and the *fix-it* intervention was conducted there. A geographically separate, equally large area, matched by sociodemographic characteristics, served as the field for those in the control condition. This is a quasi-randomized design in that the areas from which the control and intervention groups were taken in each culture were not only matched but also randomly assigned to being either the control or the intervention area. Areas were selected and mapped with the help of GIS (geographic information systems) specialists in the team.

Recruitment and Sample

Sample size was determined by a power analysis. In order to perform a two-group comparison of the primary outcome, an observational measure of earthquake and fire preparedness, with a standard alpha of 0.05, 64 individuals per group (128 individuals per city) provides 80% power to detect a significant difference of 5% between the intervention group and the control group, in a two-tailed analysis.

Recruitment agencies from each city were hired to recruit quota samples, one adult representative per household based on demographics that could influence preparedness (see Supplementary Methods); they were requested to obtain a total of 100 participants for the intervention and 100 for the control group in each city. Participants and recruitment agency members were blind to group allocation. After completion of the baseline assessments, participants in the intervention group attended two *fix-it* intervention workshops. Those in the

control group did not receive the workshops. When each of the assessments were completed (baseline, one-week, three months and one-year after intervention) participants (control and intervention groups) received their respective incentives for participation.

The sample in Seattle one week after the intervention consisted of 157 people (85 intervention and 72 control group), which decreased after 12 months to 127 (66 in the intervention and 61 in the control group). In Izmir, 191 adults completed the post-assessment (90 in the intervention and 101 in the control group), dropping to 134 (67 in each group) 12 months after the intervention. The sample recruited in both cities consisted of resident adults aged 18-80. Seattle's participants had a mean age of 50 (SD=13). The majority of the Seattle participants were female (61%), Caucasian (76%), Christian (48%), married or living with their partner (54%), and homeowners (69%). More than half of the sample reported being employed (69%). In Izmir, the mean age was 42 (SD= 14) with a majority of female residents (55%), of Turkish ethnicity (77%), Muslim (92%), married or living with their partner (55%), and home renters (68%).

Measures

Each assessment (at baseline, one week, three months and 12 months after the intervention) consisted of a 25-minute self-report survey and observational checklist administered to participants in both intervention and control groups in the two cities in their homes. To access all study materials and measures please see the protocol paper[44]. The checklist, which includes both earthquake and fire preparedness items, was filled out by a member of the recruitment agency as they visually checked to see if each measure had been implemented or not. Thus, the checklist constitutes the observational measure of the study: the main outcome measure to assess *overall*, *earthquake*, and *fire preparedness*. An *overall*

preparedness score, comprising earthquake and fire items, was calculated to provide a measure for multi-hazard preparedness.

Cultural sensitivity did not allow assessments to be conducted in identical ways in both cities. While in Seattle the self-report surveys were conducted online at baseline and subsequently on paper (due to agency problems with their server), Turkish participants, due to instances of illiteracy, had the survey read aloud to them by a member of the recruitment agency. All materials - the survey, the observational checklist and informed consent forms - were translated from English to Turkish and then back translated by Turkish researchers who were bilingual and trained by the first author.

Statistical Analysis

SPSS statistical software package version 20 was used for conducting the statistical analyses. Stata SE version 15 was used to calculate effect size confidence intervals. Where applicable, all tests were two-tailed. Outcome variables in linear models approximately followed Normal distributions, based on visual inspection. Behaviour change was assessed by comparing the observational checklists from before and one year following the intervention.

To explore between group and between location differences at baseline, χ^2- and t-tests were used. The primary outcome measure was *overall preparedness*, with secondary analyses of *earthquake* and *fire preparedness*. Behaviour change was analysed using a 2 (experimental group) × 2 (location) ANOVA, including a group×location interaction term. Correlations were carried out to evaluate relationships between self-report and observational preparedness measures to determine the extent of agreement between them. Regression analyses were conducted to model baseline preparedness and change in preparedness. These analyses included the predictor variables *earthquake and fire critical awareness, self-efficacy, outcome expectancy, fatalism, collective efficacy, earthquake anxiety, empowerment, trust and corruption,* all measured at the four time points, location and interaction terms (created by

multiplying a location dummy variable by the predictor variables). Interrater reliability on the first 5% of the observational checklists in each of the cities, using two independent raters, produced satisfactory results (Seattle $\kappa = 0.65$; Izmir $\kappa = 0.64$). Following this, recruitment agency staff were trained further to observe the items with more consistency and accuracy.

Consent and Ethical Approval

Informed written consent was obtained from each participant, before the baseline assessments, by a member of the recruitment agencies. Ethical approval was obtained from the UCL Ethics Committee, Ethics Project ID Number: 1392/001. In addition, supplementary approval was needed from the Middle East Technical University (METU) Human Subjects Ethics Committee (Protocol number: 2016-SOS-051), as well as from the Izmir government (ID number: 61736526 - 051.08-207/146).

Data Availability

The data that support the findings of this study are available from the corresponding author upon request. These anonymised data will be held indefinitely. They will be held in SPSS Portal format. They will be accompanied by metadata on the study and a data dictionary describing the variables.

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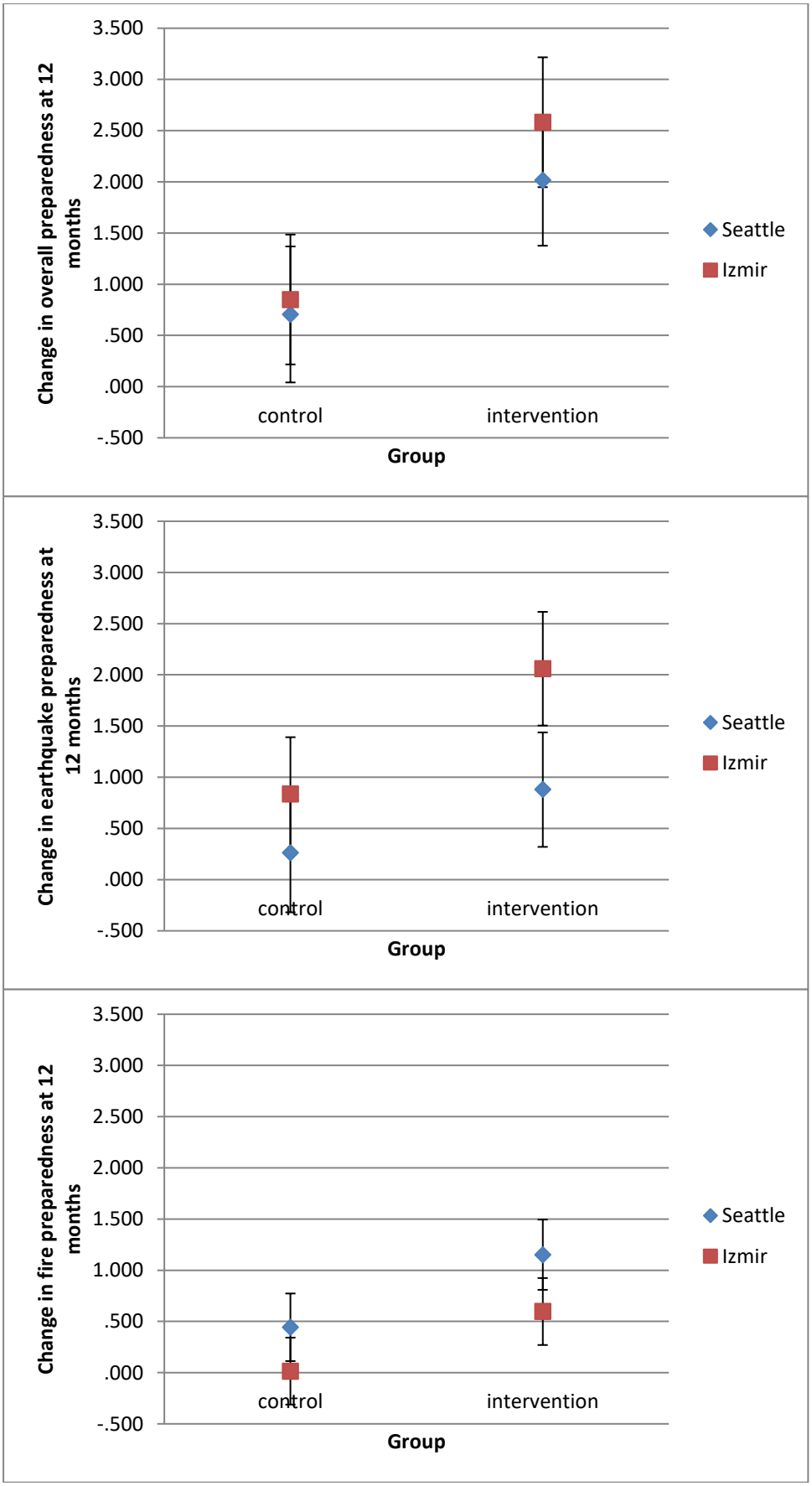
Competing Interests

The authors declare no competing interests.

Contributions

HJ had overall responsibility for devising the study, project planning, training of researchers and data write up. HP directed the data analysis and played a major role in the project write up. TR played an overarching role in project planning. CD and EG played a major role in the data collection and running the intervention in Izmir. GP was the key post-doctoral researcher for the duration of the project and played a key role in project planning, running of the intervention in Seattle, data analysis and write up.


Change in overall preparedness at 12 months
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Change in earthquake preparedness at 12 months
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Figure 1. Changes in preparedness over time, by experimental group and location. (a) is for overall preparedness, followed by its component parts, (b) earthquake preparedness and (c) fire preparedness. Data are from 66 individuals in the intervention group and 61 in the control group in Seattle, and from 67 individuals in the intervention group and 67 in the control group in Izmir. Changes are from baseline to 12 months and 0 represents no change. Error bars are 95% confidence intervals.

Table 1. Significant Predictors of Earthquake and Fire Preparedness at Baseline

	Earthquake Preparedness			
Predictors	*B*	95% CI	*β*	*p*-level
Fatalism	1.36	-0.48, 3.20	0.34	0.153
Age	-0.09	-0.17, -0.01	-0.53	0.040*
Location[1]	0.84	-11.98, 13.66	0.15	0.897
Interaction variables[2]				
Fatalism	-1.18	-2.26, -0.10	-0.75	0.034*
Age	0.08	0.04, 0.12	0.92	0.004*
	Fire preparedness			
Predictors	*B*	95% CI	*β*	*p*-level
Corruption	-0.99	-2.03, 0.05	-.04	0.062
Age	0.04	0.00,0.08	0.40	0.025*
Location[1]	-4.90	-10.80, 1.00	-1.44	0.105
Interaction variables[2]				
Corruption	0.62	0.03, 1.21	0.73	0.041*
Age	-0.02	0.00, -0.04	-0.47	0.037*

[1] Location coded as 1 = Seattle, 2 = Izmir
[2] Interaction variables by location
* $p < .05$

Table 2. Changes in Preparedness Levels 12 Months after the Intervention[1]

Seattle	Intervention (*n* = 66)					Control (*n* = 61)					Between groups			
	M	SD	95% CI	*t*(65)	*p*-level	M	SD	95% CI	*t*(60)	*p*-level	*t*(125)	*p*-level	95% CI of difference	*d*
Overall preparedness change	2.01	2.93	1.29, 2.74	5.573	<0.001**	0.70	3.23	-0.12, 1.53	1.701	0.094	2.391	0.018*	0.23, 2.39	0.42
Earthquake preparedness change	0.87	2.85	0.18, 1.58	2.498	0.015*	0.26	2.71	-0.43, 0.96	0.755	0.453	1.244	0.216	-0.36, 1.60	0.22
Fire preparedness change	1.15	1.35	0.82, 1.48	6.929	<0.001**	0.44	1.75	-0.01, 0.89	1.968	0.054	2.561	0.012*	0.16, 1.26	0.45
Izmir	Intervention (*n* = 67)					Control (*n* = 67)					Between groups			
	M	SD	95% CI	*t*(66)	*p*-level	M	SD	95% CI	*t*(66)	*p*-level	*t*(132)	*p*-level	95% CI of difference	*d*
Overall preparedness change	2.58	2.64	1.94, 3.23	8.003	<0.001**	0.85	1.42	0.50, 1.20	4.878	<0.001**	4.721	<0.001**	1.01, 2.46	0.82
Earthquake preparedness change	2.05	2.07	1.55, 2.57	8.131	<0.001**	0.84	1.29	0.52, 1.15	5.271	<0.001**	4.095	<0.001**	0.63, 1.82	0.70
Fire preparedness change	0.59	1.30	0.28, 0.91	3.749	<0.001**	0.01	0.94	-0.22, 0.25	0.129	0.898	2.959	0.004*	0.19, 0.97	0.51

Between groups between location									
	t(131)	*p*-level	95% CI of difference	*d*		*t*(126)	*p*-level	95% CI of difference	*d*
Overall preparedness change	-1.171	0.244	-1.52, 0.39	0.20		-0.335	0.738	-1.01, 0.72	0.06
Earthquake preparedness change	-2.730	0.007*	-2.04, -0.33	0.47		-1.547	0.124	-1.31, 0.16	0.27
Fire preparedness change	2.410	0.017*	0.10, 1.01	0.42		1.737	0.085	-0.06, 0.92	0.31

* p<0.05, ** p<0.001

[1] Within each sub-group, one-sample *t*-tests comparing to a mean of 0 (no change) are shown. The right-hand and bottom sections show independent samples *t*-tests between groups.

Supplementary Tables

Supplementary Table 1. Definition of Psychosocial Variables Evaluated Longitudinally

Variable	Definition	Author	Psychometric Properties
Self-efficacy	Beliefs regarding personal capacity to act effectively	Modified version of Riggs and Knight's scale (Riggs & Knight 1994)[71]	α= 0.80
Outcome expectancy	The perception of whether one's actions will reduce the problem or threat	Paton et al. 2003[42]	Not provided
Trust	One's trust in several institutions including education, armed forces, government, scientists and the church	Joffe et al. 2013[5]	α = 0.88
Fatalism	Cultural belief of the power of the natural, religious or human forces seen as responsible for the hazards' consequences	Joffe et al. 2013[5]	α = 0.78
Critical awareness	How often one thinks and talks about earthquakes/home fires	Paton et al. 2003[42] Modified version of Dalton's measure [72]	Not provided
Earthquake anxiety	A set of seven items (e.g., "I avoid thinking about earthquakes", "I avoid things that remind me of earthquakes")	Malcom Johnston (Paton et al. 2003)[42]	Not provided
Empowerment	The perception of one's capacity to gain mastery over one's affairs and confront environmental issues while being supported in this regard by external sources (Paton & Bishop 1996)	Modified version of Speer & Peterson's scale (Speer & Peterson 2000)[73]	Subscales: * Empowerment through relationships: α= 0.72 * Shaping ideology: α= 0.77 *Behavioural empowerment: α= 0.78
Collective efficacy	The perception of one's community/neighbourhood's ability to prepare for a hazard	Modified version of Riggs and Knight's scale (Riggs & Knight 1994)[71]	α= 0.84
Corruption	Perceived level of corruption of the government and the construction industry	Joffe et al. 2013[5]	α = 0.83

Supplementary Table 2. Sociodemographic Characteristics in Seattle and Izmir at Baseline

	Seattle (n = 157)		Izmir (n = 191)				
	Mean	SD	Mean	SD	t	d.f.	p-level
Age	50.03	13.06	41.74	14.41	5.5	346	<0.001**
Religiosity[1]	1.93	1.79	2.93	0.97	-6.6	345	<0.001**
	%		%		χ^2		p-level
Gender							
Male	39.5		44.5				
Female	60.5		55.5		0.9		0.346
Marital status							
Single/other	45.09		45.0				
Married/Living with partner	54.1		55.0		0.0		0.876
Employment status							
Employed	68.8		52.9				
Other	31.2		47.1		16.4		<0.001**
Education							
Elementary school	0.6		15.2				
Middle school	--		11.0				
High school	8.3		29.8				
Vocational training	6.4		2.1				
University-undergraduate	51.0		38.7				
University-postgraduate	19.7		3.1				
None of the above	0.6		__		88.74		<0.001**
Household income							
$25K or less / 1,499TL or less	17.2		13.6				
$26K-$44K / 1,500-3,899TL	13.4		38.2				
$45K-$65K / 4,000-5,999TL	20.4		42.9				
$66K and over/ 6,000TL and over	49.0		5.2		99.9		<0.001**
Housing status							
Owner	68.8		32.5				
Renter	31.2		67.5		45.5		<0.001**
Type of residence							
Single family (e.g., a house)	69.4		4.7				
Multifamily (e.g., apartment building)	22.9		94.2				
Other (e.g., sheltered housing)	7.6		0.5		188.6		<0.001**

** p <0.001

[1]Religiosity was measured on a scale from 1 to 5 (1= not religious and 5= very religious)

Seattle	Izmir	Between groups

	(*n* = 157)		(*n* = 191)		*t*-test				
Psychosocial variables	Mean	SD	Mean	SD	t-test	d.f.	*p*-level	CI for difference	*d*
EQ critical awareness	2.88	0.82	2.50	1.01	3.7	343	<0.001**	0.19, 0.58	0.41
Fire critical awareness	2.46	0.83	2.32	1.06	1.3	344	0.167	-0.06, 0.35	0.15
Self-efficacy	3.26	7.69	2.64	0.46	1.1	346	0.264	-0.47, 1.72	0.11
Outcome expectancy	5.20	7.54	3.49	0.42	3.1	346	0.002*	0.63, 2.78	0.32
Fatalism	2.09	0.63	2.27	0.64	-2.7	345	0.007*	-0.32, -0.05	0.28
Collective efficacy	2.25	0.34	2.21	0.49	0.8	345	0.406	-0.05, 0.13	0.09
Earthquake Anxiety	1.88	0.40	2.37	0.49	-9.7	345	<0.001**	-0.58, -0.39	1.10
Empowerment	2.45	0.42	2.36	0.36	2.1	345	0.032*	0.01, 0.17	0.23
Trust	2.90	0.50	2.51	0.65	6.1	345	<0.001**	0.27, 0.52	0.67
Corruption	2.78	0.53	3.07	0.64	-4.5	346	<0.001**	-0.42, -0.16	0.49

Supplementary Table 3. Psychosocial Variables at Baseline

* $p < 0.05$, ** $p < 0.001$

Supplementary Table 4. Overall, Earthquake and Fire Preparedness Levels at Baseline Observed in Participant Homes

	Seattle (*n* = 157)		Izmir (*n* = 191)		Between groups *t*-test	
Preparedness variables	Mean	SD	Mean	SD	*t*(346)[1]	*p*-level
Overall preparedness	14.61	2.39	14.11	3.10	1.3	0.167
Earthquake preparedness	7.15	1.88	8.90	2.67	-5.7	<0.001**
Fire preparedness	7.40	1.50	5.14	1.03	16.5	<0.001**

** $p < 0.001$

[1]Two-tailed independent sample t-tests

Supplementary Methods

Selection criteria instructions for quota sampling given to the agencies

1. Which of the following categories includes your age?

18-35	CONTINUE	**RECRUIT AROUND 30 PEOPLE FROM EACH AGE GROUP (with half in each age group being women)**
36–54	CONTINUE	
55 -80	CONTINUE	

2. Record Gender (ASK IF NECESSARY)

Female	CONTINUE	**RECRUIT 50%-50%**
Male	CONTINUE	

3. Are you a homeowner or a renter?

Homeowner	CONTINUE	**RECRUIT 90 HOMEOWNERS AND 30 RENTERS**
Renter	CONTINUE	

4. Which of the following categories describes your annual household income?

$25,000 or less	CONTINUE	**RECRUIT A MIX (50% BELOW $45,000 AND 50% ABOVE $45,000) equivalent scaled for Izmir**
$26,000-44,000	CONTINUE	
$45,000-65,000	CONTINUE	
$66,000 and over	CONTINUE	

Supplementary Table 5. Comparisons at Baseline between Intervention and Control Groups
SEATTLE

	Intervention	Control	*p*
Housing status (owner)	81% (59/73)	68% (49/72)	Fisher exact $p = 0.089$
Gender (female)	62% (45/73)	63% (45/72)	Fisher exact $p = 1.0$
Household income	median = $66,000+	median = $45,000-65,000	Mann-Whitney $z = 1.7$, $p = 0.087$
Age	mean = 50	mean = 50	$t(143) = 0.11$, $p = 0.92$

IZMIR

	Intervention	Control	*p*
Housing status (owner)	29% (26/90)	36% (36/101)	Fisher exact $p = 0.36$
Gender (female)	62% (56/90)	50% (50/101)	Fisher exact $p = 0.082$
Household income	median = 1500-3999TL	median = 1500-3999TL	Mann-Whitney $z = 0.2$, $p = 0.84$
Age	mean = 41	mean = 43	$t(189) = 1.17$, $p = 0.24$

Supplementary Table 6. Attrition Rates according to Sociodemographic Characteristics in Seattle and Izmir
SEATTLE

	Retained at follow-up	Lost to follow-up	*p*

Housing status (owner)	76% (96/127)	67% (12/18)	Fisher exact $p = 0.40$
Gender (female)	62% (79/127)	61% (11/18)	Fisher exact $p = 1.0$
Household income	median = $66,000+	median = $66,000+	Mann-Whitney $z = 1.0$, $p = 0.34$
Age	mean = 50	mean = 46	$t(143) = 1.33$, $p = 0.19$

IZMIR

	Retained at follow-up	Lost to follow-up	*p*
Housing status (owner)	27% (36/134)	46% (26/57)	Fisher exact $p = 0.018$*
Gender (female)	58% (77/134)	51% (29/57)	Fisher exact $p = 0.43$
Household income	median = 1500-3999TL	median = 1500-3999TL	Mann-Whitney $z = 0.4$, $p = 0.70$
Age	mean = 44	mean = 36	$t(189) = 3.81$, $p < 0.001$**

Supplementary Table 7. Changes in Individual Checklist Items 12 Months after the Intervention (Fisher exact *p*-level)[1]

Checklist items	Main effect Intervention			Main effect Location		
	Fisher exact *p*	Cramér's V	Bootstrapped 95% CI	Fisher exact *p*	Cramér's V	Bootstrapped 95% CI
TV is secured	0.012*	0.16	0.03-0.26	0.344	0.06	0.00-0.18
Computer is secured	0.005*	0.18	0.06-0.27	0.111	0.11	0.01-0.21
Bookcase is secured	0.541	0.05	0.00-0.15	1.000	0.01	0.00-0.01
Large cabinet is secured	<0.001**	0.20	0.10-0.30	0.761	0.02	0.00-0.06
No objects above sofas/beds	0.172	0.09	0.01-0.21	0.108	0.10	0.01-0.22
Exits are clear of obstruction	0.017*	0.15	0.03-0.26	0.737	0.02	0.00-0.08
Functioning smoke alarms	0.070	0.12	0.01-0.23	0.002*	0.20	0.08-0.31
In date fire extinguisher	0.081	0.11	0.01-0.25	<0.001**	0.29	0.18-0.39

* $p<0.05$, ** $p<0.001$

[1]Coded as improvement versus no improvement by intervention and by location

Supplementary notes

In Seattle, 33% of those who were contacted and reached enrolled in the study. In Izmir, 60% of those contacted enrolled in the study. Characteristics of those who refused are not known.

Seattle enrolment:

All recruiting was completed over the phone. There was no in-person contact used to find participants. The intervention group are called the 'Meadowbrook quota' and the control group are the 'Crown Hill quota'. Cold calling from the phone directory was used on all people in these areas in the phone directory. The areas had to be enlarged to fill the quotas but the main highway running vertically between the neighbourhoods (and north of the ship canal) acted as the dividing line whereby those west of it fell into the 'Crown Hill quota' and those east of it into the 'Meadowbrook quota'. People were screened over the phone using the recruiting screener (see selection criteria instructions for quota sampling given to the agencies above) and qualified participants were recruited to participate in the study.

All of those who qualified were told that an interviewer would be calling them to schedule a specific date and time for the first home visit (where the baseline data was collected). All participants were called prior to their first home visit by the recruitment agency researcher and scheduled for a specific home visit to complete the baseline assessments. After this phase, the intervention group ('Meadowbrook Quota') were all called and reminded of the day, date, time and location for their workshops. They were given two reminder calls for their workshops, one the night prior to their first workshop and the second the night prior to their second workshop. After the workshops were completed, all participants were called by the interviewer conducting their one-week follow-up home assessments to schedule the visit. They received their specific incentive for participation at this point. The same procedure and measures were administered at three-months after the workshops and one-year after.

Izmir enrolment:

Participants in Izmir were recruited in person through home visits. Face-to-face contact and proof of identification is routine in Izmir when providing professional services. Cold calling is regarded as unacceptable and is not used. Both the research agency and the Turkish research collaborators advised that participants be recruited by knocking on doors. Therefore, the recruitment phase and the baseline assessments were completed simultaneously at the first home visit of those who agreed to participate. In Izmir, the streets in the two designated neighbourhoods (Bornova for the intervention group, Buca for the control group) were chosen randomly by the agency. If a baseline assessment was completed in one household in one building, the member of the agency skipped the adjacent building. On each street, up to four participants were recruited. The agency was asked to recruit according to the quota (see selection criteria instructions for quota sampling given to the agencies above).

Supplementary References

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