Does place visualisation increase household preparedness for natural hazard events? A longitudinal intervention

Amanda Wallis^a, Ronald Fischer,^a Wokje Abrahamse^b

^aSchool of Psychology, Victoria University of Wellington

P.O. Box 600, Wellington 6140, New Zealand

*Corresponding Author: ronald.fischer@vuw.ac.nz

^bSchool of Geography, Environment, and Earth Sciences, Victoria University of Wellington

P.O. Box 600, Wellington 6140, New Zealand

Declaration of Interest: None

Funding:

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Victoria University of Wellington provided scholarship funding for the first author's doctoral candidature, during which this manuscript was produced.

Acknowledgements:

Thank you to all our willing participants.

This is a pre-print of an accepted manuscript published in the Journal of Environmental Psychology: <https://doi.org/10.1016/j.jenvp.2021.101556>

A link to the pre-registration can be found here: <https://osf.io/cps8q/>

A link to supplementary analyses can be found here: <https://osf.io/3wsph/>

© 2021. This manuscript version is made available under the CC-BY-NC-ND 4.0 license <http://creativecommons.org/licenses/by-nc-nd/4.0/>

PLACE VISUALISATION AND DISASTER PREPAREDNESS

Abstract

Novel approaches are needed to increase preparedness behaviours in populations with high disaster risk. Crucially, such approaches need to take into account the relationships that people have with place. We report a randomised controlled trial to test the effectiveness of an online place attachment mental visualisation task to increase preparedness behaviours. Findings from a pilot (Study 1) using pre and post-test measures showed mixed evidence for the influence of mental visualisation on place attachment. Using a pre-registered randomised controlled trial with a two-week follow-up in a community sample (Study 2), we expected that visualising one's house or neighbourhood would result in stronger intentions to prepare, and greater implementation of preparedness behaviours at a follow-up, when compared to visualising a neutral place. Findings showed no main effect of visualisation on survival, mitigation, or community preparedness behaviours. These studies broadly indicate that our online mental place visualisation task was not sufficient to influence preparedness behaviours. We discuss implications of these findings for the advancement of place attachment theory and behaviour-change techniques.

Keywords: Place attachment; natural hazards; disaster preparedness; intervention; behaviour change; place visualisation

PLACE VISUALISATION AND DISASTER PREPAREDNESS

Does place visualisation increase household preparedness for natural hazard events? A longitudinal intervention

1. Introduction

Individuals with greater place attachment often report greater disaster preparedness (Anton & Lawrence, 2016; Mishra, Mazumdar, & Suar, 2010; van Valkengoed & Steg, 2019), with many studies theorising that place attachment leads to disaster preparedness (Mishra et al., 2010; Paton, Bürgelt, & Prior, 2008). Using a field experiment, we explicitly test the utility of a simple task in which individuals visualise specific places to increase preparedness intentions and behaviours. We initially test this experimental design in a pilot study with undergraduate students to examine whether place visualisation (i.e. mental visualisation of a specific type of place) increases place attachment (Study 1), before fully testing the effectiveness in a longitudinal field experiment in a community sample (Study 2).

Why is our research important? Rates of disaster preparedness are generally low globally, even among those populations with high risk of damage from natural hazard events (hereafter referred to as ‘at-risk populations’) (Joffe, Rossetto, Solberg, & O’Connor, 2013). It is crucial to study the effectiveness of possible interventions that can be applied easily to larger populations in order to minimise damage and loss of life when natural hazard events occur (Verrucci et al., 2016). Community-based education programmes can be a successful avenue for increasing preparedness, however these are both resource and time-intensive (Johnston et al., 2013; Said, Ahmadun, Mahmud, & Abas, 2011). We need more evidence-based behaviour-change techniques that are cost-effective, simple, and scalable. Based on previous work on place attachment, that is the diverse ways in which individuals feel attached to a place, we propose and test the effectiveness of one intervention to increase both intentions and actual preparedness behaviour.

PLACE VISUALISATION AND DISASTER PREPAREDNESS

The most prominent theory of place attachment (currently) defines it as “the bonding that occurs between individuals and their meaningful environments” (Scannell & Gifford, 2010, p.1) and proposes three major dimensions. This tripartite model of place attachment encompasses a person (group vs. individual), process (affect, cognition, and behaviour), and place (e.g. spatial scale) dimension. In our study, we focus on an individual’s attachment to specific places at two different scales (their home and their neighbourhood) and we include tasks that guide the individual to focus on both affective and perceptual-cognitive aspects of these places, in order to change behaviour that is aimed at protecting these places in the case of a natural hazard event. Therefore, our task and intervention are grounded in contemporary theories and conceptualisations of place attachment.

A number of studies have demonstrated that attachment to local areas (i.e. house and neighbourhood) is correlated positively with disaster preparedness (Anton & Lawrence, 2016; Mishra et al., 2010; Paton et al., 2008; Xu, Peng, Liu & Wang, 2018) and that place attachment is associated with better behavioural coping in the face of high natural hazard risk (Stancu et al., 2020). This link might be stronger if the perceived or objective risk was low (Bonaiuto, De Dominicis, Fornara, Ganucci Cancellieri & Mosco, 2011; De Dominicis, Fornara, Ganucci Cancellieri, Twigger-Ross & Bonaiuto, 2015), but it is also found in high risk populations (Wallis, Fischer, & Abrahamse, 2021).

Considering the spatial scale, both cross-sectional and experimental studies have concluded that attachment to one’s house or community were more strongly associated with disaster preparation and pro-environmental behaviour than attachment to regional or national level place attachment (Forsyth, van Vugt, Schlein, & Story, 2015; Wallis et al., 2021). Climate change (a global threat) is responsible for rising rates of natural hazard events (Bouwer, 2011). Attitudes and behaviours related to climate change are associated with greater global place attachment (Devine-Wright & Batel, 2017; Walker, Leviston, Price &

PLACE VISUALISATION AND DISASTER PREPAREDNESS

Devine-Wright, 2015; Wullenkord, Heidbreder & Reese, 2020), meaning that attachment at the global level may also be relevant for predicting disaster preparedness behaviour.

However, both a larger literature on attitude-behaviour links (Fishbein & Ajzen, 2010; Weigel, Vernon, & Tognacci, 1974) as well as previous research on preparedness behaviour point towards stronger relationships between attitudes and behaviours when they are matched at spatial specificity. That is, local attachment that matches the level of preparedness behaviour itself (e.g. house attachment for strengthening house foundations, or neighbourhood attachment for checking on vulnerable neighbours) appears most relevant for disaster preparedness behaviours (Wallis et al., 2021). To understand these broad patterns, researchers have theorised that local place attachment causes greater embeddedness in a place, and awareness of threats to that place, therefore motivating behaviour to protect the place and ensure safety (Florek, 2010; Mishra et al., 2010; Paton et al., 2008). This theoretical linkage between place attachment and preparedness behaviour is commonly featured in preparedness theories (for a summary, see Paton, 2019), proposing place attachment as a constituent variable for understanding disaster preparedness behaviours. In this current research, we test this assumed causal link between local place attachment and preparedness to provide evidence for these theoretical assumptions.

In the field of geography, ‘geovisualisations’ (realistic three-dimensional simulations of real-world places) have been explored as tools to encourage certain pro-environmental behaviours (e.g. collaborative coastal management efforts: Newell & Canessa, 2015; Newell & Canessa, 2017; Newell & Canessa, 2018). However, until recently, geovisualisation research rarely considered the role of place-based theories for these visualisations. A study by Newell and Canessa (2018) found that mental place visualisations (e.g. picturing a coastal place) were associated with greater place attachment levels, as well as greater concern for place protection. Importantly, experimental research has found that mental place visualisation

PLACE VISUALISATION AND DISASTER PREPAREDNESS

can directly influence place attachment intensity (Reese, Oettler & Katz, 2019), while viewing static satellite images of a place did not (Wullenkord et al., 2020). In a seminal study, Scannell and Gifford (2017) instructed participants to visualise a place to which they deemed themselves emotionally attached and guided them through a series of sensory observations of the chosen place. They found that place attachment visualisation was associated with increased feelings of self-esteem, meaning, and belonging. The authors also concluded that mental place visualisation was a successful manipulation of place attachment. People who visualised a place they were attached to reported greater attachment to that place of visualisation, compared with place attachment ratings of those who visualised a ‘neutral’ place. In a conceptual replication, Reese and colleagues (2019) found that mentally visualising a place without their meaningful features (e.g. social connections or physical components) can reduce subsequent place attachment ratings. It is therefore important that visualisations are focused on meaningful features of the visualised places. Studies have also demonstrated that mental visualisation techniques (e.g. mentally picturing people that they are close to) has the potential to influence behavioural and psychological responses (e.g. information-seeking behaviour, compassion, and altruistic behaviour) (Kumashiro & Sedikides, 2005; Mikulincer, Shaver, Gillath, & Nitzberg, 2005). These findings also suggest that mentally visualising a certain place may increase people’s attachments with that place (and thereby provoke attitudes, cognitions or behaviours that are congruent with these attachments). Taken together, this body of research suggests that the use of place visualisations can be a cost-effective and simple behaviour change intervention. This evidence forms the rationale for the current studies in which we trial a place visualisation tool to increase disaster preparedness intentions and behaviours.

Finally, we argue that it is important for natural hazard research to incorporate behavioural measures (e.g. a person’s self-reported completion of an action) in addition to

PLACE VISUALISATION AND DISASTER PREPAREDNESS

intention measures (e.g. a person's self-reported intention to undertake an action). Even though intentions are related to behaviours and thought to be antecedents to successful behaviour change (e.g., Ajzen, 1991; Najafi, Ardalan, Akbarisari, Noorbala, & Elmi, 2017; Paton, Bajek, Okada, & McIvor, 2010; Sheeran & Webb, 2016), people who form intentions do not always proceed to change their behaviour. This disconnect between intention and behaviour may be due to self-regulatory failures or external barriers (Sheeran & Webb, 2016). To draw conclusions about the effectiveness of a behavioural intervention in general, we need to evaluate changes in behaviour and intentions (McKenzie-Mohr, 2000).

In this paper, we provide a novel contribution to the field of place attachment research by testing the applicability of a mental place visualisation intervention to increase disaster preparedness outcomes (both intentions and behaviours) through increased place attachment (see Figure 1). In doing so, we aim to provide evidence for the usefulness of place attachment interventions and further our theoretical understanding of the mechanism by which mental place visualisations might encourage behaviour change (Anton & Lawrence, 2016; Mishra et al., 2010; Newell & Canessa, 2018; Paton et al., 2008; Reese et al., 2019; Scannell & Gifford, 2017; Wallis et al., 2021). Our study also offers new experimental insights into the causal relationship between place attachment and behaviour. To expand on previous findings in line with Scannell and Gifford's (2010) tripartite model, our main research question will investigate whether a place attachment visualisation task can increase disaster preparedness intentions and self-reported behaviour. In two studies, we test the potential of a novel, scalable, and evidence-based preparedness intervention for increasing preparedness in at-risk populations.

Figure 1. Flow diagram depicting conceptual relationships between mental place visualisation (intervention task), place attachment, and disaster preparedness outcomes

2. Study 1

This study is a pilot test of the experimental design and represents a conceptual replication of an experimental manipulation of place attachment (Scannell & Gifford, 2017). We attempt to overcome some of the limitations of the original study. For example, the authors did not measure changes in attachment scores using a pre- and post-test design. In our study, we therefore measure house and neighbourhood attachment at two time-points (before and after the experimental manipulation) as an added manipulation check, because research findings suggest that houses and neighbourhoods elicit, on average, positive ratings of place attachment (Devine-Wright & Batel, 2017; Lewicka, 2010; Wallis et al., 2021). We also added a true control condition of people who did not engage in any visualisation task. Furthermore, local place attachment (house and neighbourhood) is positively correlated with disaster preparedness (Anton & Lawrence, 2016; Bonaiuto et al., 2011; Mishra et al., 2010; Paton et al., 2008), whereas correlations with larger spatial scales are often weaker. This suggests that local attachment may be particularly relevant for people’s decision to prepare for natural hazard events (Wallis et al., 2021). On these grounds, we focus our study on house and neighbourhood attachment as a predictor of disaster preparedness behaviours (manipulated through a mental place visualisation task). We predict that mentally visualising one’s house or neighbourhood will result in higher self-reported house and neighbourhood

PLACE VISUALISATION AND DISASTER PREPAREDNESS

attachment after the visualisation task compared to before the visualisation task, and when compared with people who visualise a neutral place or those in the control condition.

Second, we test our overarching main hypothesis that when people visualise a place that they are attached to, they will report greater preparedness intentions (Paton et al., 2010; Najafi et al., 2017). Preparedness is measured in our study with three functional categories. Survival preparedness refers to actions taken to increase individual chances of survival in the direct aftermath of a disaster, whereas mitigation preparedness refers to actions that minimise risk of damage during a disaster. Community preparedness are preparedness actions that involve community engagement (Verrucci et al., 2016). We anticipate that when people visualise one's house or neighbourhood, they will report greater preparedness intentions compared with people who visualise a neutral place or people who are not instructed to visualise any place.

Hypothesis 1. We hypothesise that participants who visualise their house or neighbourhood will report greater subsequent attachment to both their houses and their neighbourhoods compared with participants who are instructed to visualise a neutral place, or no place at all.

Hypothesis 2. We hypothesise that participants who visualise their house or neighbourhood will report stronger survival preparedness intentions, mitigation preparedness intentions and community preparedness intentions, compared with those participants who are instructed to visualise a neutral place, or no place at all.

2.1. Materials and methods

2.1.1. Participants. A power analysis using G*Power (Faul, Erdfelder, Lang, & Buchner, 2007) computed a required sample size of approximately 138 participants to detect an effect size of $f=.27$ with a power of .80 for our second hypothesis. This effect size was informed by correlational findings from previous studies (Wallis et al., 2021). A total of 131

PLACE VISUALISATION AND DISASTER PREPAREDNESS

first-year psychology undergraduate students at Victoria University of Wellington, New Zealand participated in exchange for course credit. This sample was 85% female, with an average age of 19 years (ranging from 18 years to 31 years; see Table 1 for all demographic information). The study was conducted online using Qualtrics (2020). Participants were not given any time limit within which they had to complete the survey (although the visualisation tasks within the survey were timed to encourage engagement). Further, participants were able to complete the survey at any time, and any location of their choosing on an internet-enabled device of their choosing. This study was granted ethical approval by the Victoria University of Wellington Human Ethics Committee.

2.1.2. Experiment. Building on Scannell and Gifford (2017), our study compared two experimental conditions: one group were asked to visualise a place to which they are attached, and a second group was asked to visualise a neutral place as a control. In addition, we introduced a third control group who were not instructed to visualise any place at all (note that Scannell and Gifford's study did not have a true control group). This control group was included to help determine whether any changes in behaviour are due to the visualisation of a specific place to which people are attached (as expected), from visualising places more broadly or from simply engaging in the study. Participants were randomly assigned to one of these three conditions (place attachment visualisation, $n=39$; neutral visualisation, $n=37$; control, $n=40$). We found no significant between-group differences on key variables (preparedness levels, pre-test place attachment, disaster experience, or socio-demographic factors), indicating that randomisation was successful.

Attachment place visualisation. Participants were asked to indicate whether they felt a greater connection with their house or their neighbourhood. Participants were then asked to visualise their chosen place (house or neighbourhood) in three distinct exercises. The first exercise asked participants to visualise what they could see in their place, the second exercise

	Study 1	Study 2	
Variable		Time 1	Time 2
N	116	401	177
Age (average)	19 years	35-44 years	35 – 44 years
Female	85%	87%	87%
NZ European/Pakeha	71%	74%	73%
Māori	4%	6%	6%
Pasifika	1%	2%	2%
European	6%	8%	12%
Asian	10%	3%	2%
Other	8%	7%	5%
University qualification	-	68%	73%
Income (average)	-	\$40 – 59,000	\$40 – 59,000
House residence (average)	< 1 year	3-5 years	3 – 5 years
Home ownership	0%	54%	57%
Mean disaster experience (1-5)	1.80	2.03	-

Table 1. Socio-demographic descriptive information

involved visualising what participants could smell, hear, and touch in their place, and the third exercise involved visualising the feelings and emotions participants associated with being in the place. Each of these three visualisation tasks (timed at one minute each), were interspersed with a writing task (also timed at one minute each) requiring participants to briefly note down what was visualised in the previous task. While conceptually similar to the visualisation task used by Scannell and Gifford (2017), our visualisation task was completed online without a research assistant present. Therefore, we imposed other methods of ensuring that participants stayed on task (i.e. countdown timer) as well as interspersing separate writing sections throughout the visualisation tasks. Most participants in the attachment visualisation condition chose to visualise their house rather than their neighbourhood (79%).

Neutral place visualisation. This visualisation task was identical to the attached place visualisation task except for the place visualised by participants. Participants were instructed to pick a neutral or ordinary place that they visited frequently but felt no connection with (e.g. supermarkets or bus-stops).

Control. Participants in the control condition were instructed to provide written answers to six different prompts (filler tasks). These tasks were included so as to roughly match the amount of time spent on these tasks with the amount of time other participants spent on the visualisation. Each of the writing tasks were therefore also timed for one minute using a countdown timer. The writing prompts elicited information such as “Please spend the next minute describing your favourite meal in as much detail as you can. What is in it? What does it look like? What does it smell like?” While some elements of these writing tasks likely elicited visualisation strategies, and may have increased positive affect, the tasks themselves did not prompt specific visualisation of places. This control group was included to confirm that any experimental effects from the place attachment visualisation were due to place-specific visualisation and not due to the effect of the visualisation itself or a result of positive

PLACE VISUALISATION AND DISASTER PREPAREDNESS

affect more broadly. As such, this control task was designed so that mental visualisation and the generation of positive emotion were possible.

2.1.3. Measures. *Place attachment.* Place attachment was measured with an 11-item scale on a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). This scale was used by Anton and Lawrence (2016; adapted from Brown & Raymond, 2007; Williams & Roggenbuck, 1989; Williams & Vaske, 2003). Six items specifically measured place identity (e.g., “I identify strongly with this place”) and five items measured place dependence (e.g., “This place is the best place for what I like to do”). Refer to Table 2 for a full list of items. All participants answered these questions in relation to both their houses ($\alpha=.93$) and their neighbourhoods ($\alpha=.96$). House and neighbourhood attachment were moderately and positively associated with one another (pre-test: $r=.49$, $p<.001$, 95% CI [.34, .62]; post-test: $r=.61$, $p<.001$, 95% CI [.48, .71]). For those assigned to the neutral visualisation condition only, questions were also asked in relation to participants’ neutral places of their choosing. All scales were administered twice in a pre-test/post-test design (before and after the experimental task).

Preparedness. Twenty-three preparedness actions were presented and split into three sub-categories: seven survival actions (i.e., “Make an emergency kit”; $\alpha=.94$); eight mitigation actions (i.e., “Fasten tall furniture to the wall”; $\alpha=.94$); and eight community actions (i.e., “Talk to people I know about getting prepared”; $\alpha=.92$), adapted from the Earthquake Readiness Scale (Paton & Johnston, 2008; Spittal, Walkey, McClure, Siegert, & Ballantyne, 2006) and extended preparedness items developed by Wallis and colleagues (2021). Participants indicated their intentions to prepare for each of the 23 actions that they had not already completed (i.e. indicated that they had ‘done this already’). These responses were recorded on a 5-point response scale (1 = definitely not to 5 = definitely yes). Overall intention (1-5) was averaged across each action of each preparedness type to calculate a

	Study 1					Study 2		
	Pre-test			Post-test		Time 1		
	N	Mean (SD)	Alpha	Mean (SD)	Alpha	N	Mean (SD)	Alpha
House attachment	116	3.01 (.93)	.93	2.91 (1.00)	.96	393	3.42 (.96)	.94
I feel that my house is a part of me	116	3.27 (1.16)		3.03 (1.23)		393	3.66 (1.19)	
My house is very special to me	116	3.50 (1.22)		3.31 (1.23)		391	3.83 (1.24)	
I identify strongly with my house	116	3.11 (1.27)		2.96 (1.29)		392	3.54 (1.24)	
I am very attached to my house	116	3.16 (1.25)		3.12 (1.31)		391	3.68 (1.22)	
Living in my house says a lot about who I am	116	2.86 (1.10)		2.97 (1.20)		391	3.47 (1.20)	
My house means a lot to me	116	3.30 (1.19)		3.22 (1.23)		390	3.83 (1.10)	
My house is the best place for what I like to do	116	3.40 (1.12)		3.06 (1.14)		391	3.76 (1.05)	
No other place can compare to my house	116	2.56 (1.23)		2.48 (1.15)		389	2.83 (1.34)	
I get more satisfaction out of living in my house than I would anywhere else	116	2.78 (1.24)		2.55 (1.18)		390	2.97 (1.28)	
Doing what I do in my house is more important to me than doing it anywhere else	116	2.69 (1.19)		2.68 (1.13)		390	3.04 (1.22)	
I would not substitute any other place for doing the types of things that I do in my house	116	2.50 (1.17)		2.58 (1.13)		391	2.91 (1.25)	
Neighbourhood attachment	116	2.49 (.94)	.96	2.43 (1.00)	.96	393	2.98 (.99)	.96
I feel my neighbourhood is a part of me	116	2.64 (1.16)		2.53 (1.25)		392	3.20 (1.19)	
My neighbourhood is very special to me	116	2.61 (1.12)		2.59 (1.25)		391	3.31 (1.17)	
I identify strongly with my neighbourhood	116	2.54 (1.10)		2.34 (1.19)		391	3.10 (1.19)	
I am very attached to my neighbourhood	116	2.59 (1.14)		2.55 (1.20)		392	3.25 (1.23)	
Living in my neighbourhood says a lot about who I am	116	2.55 (1.14)		2.39 (1.15)		391	3.05 (1.16)	
My neighbourhood means a lot to me	116	2.53 (1.18)		2.62 (1.23)		391	3.29 (1.16)	
My neighbourhood is the best place for what I like to do	116	2.79 (1.21)		2.58 (1.17)		391	3.10 (1.16)	

PLACE VISUALISATION AND DISASTER PREPAREDNESS

No other place can compare to my neighbourhood	116	2.16 (1.07)	2.26 (1.10)	392	2.58 (1.18)
I get more satisfaction out of living in my neighbourhood than I would anywhere else	116	2.42 (1.09)	2.30 (1.07)	390	2.72 (1.20)
Doing what I do in my neighbourhood is more important to me than doing it anywhere else	116	2.28 (1.05)	2.23 (1.03)	390	2.58 (1.12)
I would not substitute any other area for doing the types of things that I do in my neighbourhood	116	2.23 (1.08)	2.29 (1.07)	392	2.56 (1.15)

Table 2. Study 1 and 2: Attachment item descriptive statistics, 1 (Strongly disagree) – 5 (Strongly agree)

single variable of intention for each participant for each preparedness type. This resulted in three continuous variables: survival preparedness intentions, mitigation preparedness intentions, and community preparedness intentions. Table 3 provides an overview of the full list of items.

Attention check. Attention during the experimental task was measured with a single-item measure. After the experimental phase of the survey, we asked all participants “Answering honestly, how seriously do you think you took the writing tasks that you just completed?” Three response options were presented: “I took the tasks very seriously”, “I gave them some thought”, or “I did not take the tasks seriously”.

Additional variables. Using single-item measures, we collected information on age, gender, length of residence, home ownership, and ethnicity to determine representativeness of our sample. Positive and negative affect was measured twice (before and after the experimental tasks) using the 10-item international Positive and Negative Affect Schedule Short Form (I-PANAS-SF; Thompson, 2007).

2.2. Results

2.2.1. Data treatment. Following data cleaning, our final sample consisted of 116 participants. From our original sample (N=131), one participant dropped out during the survey and a further ten participants spent less than two minutes total on their experimental task (a pre-determined cut-off) and were deemed to have not thoroughly engaged with the tasks. Most remaining participants (97%) indicated that they had given the experiment tasks at least some thought, and over one quarter indicated that they took the tasks very seriously (27%). Only a small minority indicated that they did not take the tasks seriously at all (3%) and these participants (n=4) were excluded from subsequent analyses. This means that all remaining participants made some effort in complying with the experiment instructions.

Preparedness items	Study 1			Study 2		
	N	Mean (SD)	Alpha	N	Mean (SD)	Alpha
Survival	114	3.34 (.84)	.94	347	2.72 (1.02)	.93
1. Store water	62	3.39 (1.08)		138	2.88 (1.17)	
2. Store non-perishable food	71	3.61 (1.01)		171	2.98 (1.13)	
3. Make an emergency kit	58	3.66 (1.04)		187	2.83 (1.13)	
4. Make an emergency plan (e.g., knowing where to meet family)	88	3.81 (1.03)		221	3.05 (1.20)	
5. Store supplies (such as plastic bags and toilet paper) to use as an emergency toilet	97	3.31 (1.03)		229	2.97 (1.19)	
6. Purchase items to use if power is lost such as a torch, radio, or gas cooker	64	3.45 (1.10)		147	2.89 (1.20)	
7. Purchase a water tank	105	2.32 (1.04)		276	1.78 (.97)	
Mitigation	115	3.00 (.88)	.94	382	2.32 (.91)	.95
8. Cloud-store important documents and/or photos on an internet server	66	3.26 (1.03)		251	2.78 (1.14)	
9. Ensure my home and contents are insured for the right amount in the event of a disaster	64	3.31 (1.10)		125	2.46 (1.19)	
10. Seek out information about the different natural hazard risks posed to my home	86	3.06 (1.09)		196	2.57 (1.09)	
11. Have the strength of my building checked (or ask landlord to do the same)	79	2.71 (1.11)		285	1.84 (1.04)	
12. Fasten tall furniture to the wall	87	2.62 (1.17)		267	2.34 (1.17)	
13. Secure movable objects in my home (such as computers and TVs)	102	2.94 (1.18)		313	2.40 (1.18)	
14. Strengthen my house/its foundations (or ask landlord to do the same)	90	2.53 (1.05)		313	1.67 (.92)	
15. Ensure that heavy objects are stored on the floor and at the bottom of cupboards	76	2.97 (1.01)		182	2.69 (1.17)	
Community	116	2.73 (.76)	.92	380	2.32 (.90)	.93
16. Identify people in my neighbourhood who need checking up on in the event of a disaster	104	2.86 (1.00)		285	2.23 (1.04)	
17. Store enough emergency supplies to help others not in my household	109	2.94 (1.16)		328	2.36 (1.11)	
18. Volunteer my time to help prepare my community	114	2.61 (.94)		340	2.04 (.97)	
19. Participate in a lifesaving skills/emergency response course and feel confident in my ability to help others	89	2.98 (1.02)		253	2.07 (1.02)	
20. Talk to people I know about getting prepared	102	2.96 (.96)		231	2.62 (1.13)	
21. Attend a community meeting where preparation is discussed	116	2.27 (.93)		327	2.06 (1.04)	
22. Have contact details of my neighbours in case of emergency	84	2.81 (1.02)		244	2.24 (1.05)	

PLACE VISUALISATION AND DISASTER PREPAREDNESS

23. Identify my local Community Emergency Hub and understand how to use it to coordinate community response	111	2.56 (1.04)	226	2.61 (1.19)
---	-----	-------------	-----	-------------

Table 3. Study 1 and 2: Descriptive information on preparedness intentions (1-5)

2.2.2. Manipulation check. We found that participants in the place attachment visualisation condition were more attached to the place that they visualised using a post-test measure of place attachment (house or neighbourhood: $M=3.37$, $SD=.77$) compared with those in the neutral place visualisation condition ($M=2.16$, $SD=.96$, $t(74)=-6.08$, $p<.001$, $d=-1.40$, 95% CI [-1.60, -.81]). This suggests we successfully manipulated the target of the visualisation and is in line with the manipulation check findings of Scannell and Gifford (2017)

Additionally, we found no significant interaction between time-points (pre-test and post-test) and experimental condition on positive affect ($F(2,113)=1.83$, $p=.166$, $\eta_p^2=.03$) or negative affect ($F(2,113)=.88$, $p=.419$, $\eta_p^2=.02$), indicating that, of the three experimental conditions (place attachment visualisation, neutral place visualisation or control), no condition influenced positive or negative emotion any more or less than another. Both positive and negative affect significantly decreased from Time 1 to Time 2 irrespective of experimental condition (positive: $F(1,113)=6.89$, $p=.010$, $\eta_p^2=.06$; negative: $F(1,113)=17.294$, $p<.001$, $\eta_p^2=.133$), which may be because pre-existing emotions (that participants were experiencing prior to starting the study) reduced in intensity as a result of focusing on the survey. We do not foresee this as having any interference on the study findings reported below given that, on average, all participants experienced the same shift in emotion.

2.2.3. Hypothesis 1. Place Attachment. We conducted a repeated measures ANOVA to determine whether there was an interaction between point of measurement (pre- and post-test) and experimental condition on house and neighbourhood attachment. Contrary to our hypothesis, we did not find a significant interaction between point of measurement and experimental condition ($F(2,113)=2.52$, $p=.085$, $\eta_p^2=.04$) despite a small but noticeable effect size, see Figure 2. No significant interaction ($F(2,113)=1.75$, $p=.179$, $\eta_p^2=.03$) was found

when examining neighbourhood attachment at pre-test ($M=2.49$, $SD=.94$) or post-test ($M=2.43$, $SD=1.00$), see Figure 3.

Figure 2. Study 1: Mean and standard deviation for house attachment by condition

Figure 3. Study 1: Mean and standard deviation for neighbourhood attachment by condition

Given that the eta-squared values for these interactions were sizeable, we conducted exploratory tests to explore these findings in more depth. We performed separate ANOVAs

(for attachment at pre-test and post-test separately). We did not find between-group differences for house attachment at pre-test ($F(2, 113)=1.76, p=.176, \eta_p^2=.03$) between attachment visualisation ($M=3.22, SD=.85$), neutral visualisation ($M=2.98, SD=.98$), or control ($M=2.84, SD=.93$). At post-test, while controlling for pre-test house attachment, we found no significant main effect of experimental condition on house attachment ($F(2, 112)=2.81, p=.065, \eta_p^2=.05$) however planned contrasts indicated that there was a significant difference in post-test house attachment (controlling for pre-test house attachment) between the groups ($t(112)=2.32, p=.022$). House attachment was higher for those in the place attachment condition (adjusted $M=3.04, SE=.07$) compared with the neutral condition ($M=2.81, SE=.07$) and control group ($M=2.86, SE=.07$);). Using post-hoc tests with Bonferroni correction, we found no significant between-group differences (see supplementary materials for statistical reporting: <https://osf.io/3wsph/>)

No between-condition differences were found for neighbourhood attachment at pre-test, $F(2, 113)=.42, p=.656, \eta_p^2=.01$ (attachment visualisation: $M=2.60, SD=.99$; neutral visualisation: $M=2.44, SD=.83$; control: $M=2.42, SD=1.00$) or post-test neighbourhood attachment (controlling for pre-test), $F(2, 112)=1.91, p=.152, \eta_p^2=.03$ (attachment visualisation: $M=2.53, SE=.07$; neutral visualisation: $M=2.36, SE=.07$; control: $M=2.39, SE=.07$).

2.2.4. Hypothesis 2. Contrary to predictions, we found no main effect of visualisation condition on preparedness intentions: survival intentions ($F(2, 111)=.27, p=.763, \eta_p^2=.00$), mitigation intentions ($F(2, 112)=.59, p=.558, \eta_p^2=.01$), or community intentions ($F(2, 113)=.00, p=1.00, \eta_p^2=.00$). See supplementary materials for additional exploratory analyses: <https://osf.io/3wsph/>.

2.3. Discussion

This study presents findings from a pilot trial using an experimental manipulation of place attachment to influence disaster preparedness intentions. We tested a place visualisation task using visualisation of a place followed by a series of writing tasks. Using the same criteria as Scannell and Gifford's original study (2017), our intervention was successful at manipulating place attachment. We found some indication that the place visualisation was associated with higher levels of post-test house attachment, but this main effect was not statistically significant. We did not find an effect of place attachment visualisation on any of the preparedness intentions in our sample. In our next study we tested the effectiveness of a place visualisation intervention in a pre-registered study with a community sample.

3. Study 2

Small-scale place attachment (i.e. attachment to one's house and neighbourhood) is associated with preparedness intentions (survival, mitigation, and community) (Wallis et al., 2021). However, it is only correlated with mitigation and community preparedness behaviour (but not survival actions) according to previous research that also controls for other relevant socio-demographic predictors such as age, income and length of residence (Wallis et al., 2021). Place attachment appears most important when matched to the scale of the behaviour (e.g. community actions at the neighbourhood attachment level, or home-mitigation actions at the house attachment level). Thus, survival actions that are not so tightly tied to a certain place may be less strongly associated with place attachment. Importantly, among the various preparedness actions in general, survival-based preparedness is the most frequently performed type of behaviour, although still well below desirable levels to reduce immediate risks (McClure, Spittal, Fischer, & Charleson, 2015; Verrucci et al., 2016). The overall low level of preparedness behaviours is concerning given the low levels of preparedness overall and the relative inefficacy of commonly used information campaigns (Johnston et al., 2013). Novel interventions are needed to increase preparedness in community samples. We therefore

applied the visualisation intervention tested in Study 1 in a community sample to test whether it can increase preparedness behaviour, in particular less frequently-performed mitigation and community-based preparedness behaviours. In addition to intentions, we also evaluate intervention effectiveness using behavioural outcomes. Our study employs a time delay of two weeks from administering the intervention (Time 1) to the follow-up survey (Time 2) to examine self-reported behaviour change in a community sample. This gives us greater confidence to extrapolate findings and possible effectiveness to the wider population.

In our Study 1, we found mixed evidence for the effectiveness of place attachment visualisation for influencing place attachment. In Study 2, we take the next step and test the effectiveness of this place attachment visualisation intervention at changing preparedness intentions and behaviours in a general community sample. We used a randomised control trial which was pre-registered on the Open Science Framework to test the effectiveness of place attachment visualisation against neutral place visualisation (and a control group). We tested the effectiveness of the place attachment manipulation on two dependent variables: preparedness intentions (survival; mitigation; community) and preparedness behaviour change. Based on previous research finding that place attachment is associated with all types of preparedness intentions, but only with mitigation and community preparedness behaviour (Wallis et al., 2021), we anticipate that our place attachment visualisation will produce changes in behaviour that are matched in scale to the place being visualised (i.e. using house and neighbourhood visualisation to increase mitigation and community preparedness behaviours). Therefore, in this study we seek to test whether place attachment (in the form of a mental place visualisation task) could increase mitigation and community preparedness behaviours from Time 1 to Time 2 (i.e. comparing across time-points). We make the following predictions:

Hypothesis 1. We hypothesise that participants who visualise a place to which they are attached will report stronger overall survival, mitigation, and community preparedness intentions to prepare at Time 1 (immediately after the visualisation task), compared with those participants who visualise a neutral place, or those in the control group.

Hypothesis 2. We hypothesise that participants who visualise a place to which they are attached will report greater mitigation, and community-based preparedness behaviour, but not survival-based preparedness behaviour at Time 2, when compared to Time 1, and when compared with those participants who visualise a neutral place, or those in the control group.

3.1. Materials and methods

3.1.1. Participants. Assuming a conservative attrition rate of 60% between Time 1 and Time 2 (Hochheimer et al., 2016), and the likelihood of incomplete responses, we aimed to recruit liberally for a sample of at least 900 participants at Time 1 to achieve a sample of 300 participants at Time 2. Due to the temporal sensitivity of the intervention in an active earthquake hazard zone, our initial study was set to run for four weeks. We pre-registered that we would cease data collection after one month even if the target sample sizes were not achieved. We recruited a total sample of 557 eligible participants from Wellington, New Zealand at Time 1 who consented to take part in the survey. Only those who volunteered to participate in future surveys were invited to complete the follow-up survey. Of these volunteers, 182 participants took part in the follow-up survey at Time 2 (32.68% retention rate). We found no significant differences between those who dropped-out and those who remained on key variables (place attachment, preparedness intentions and behaviour, number of goals set, disaster experience, and socio-demographic factors), indicating that drop-out was not selective. Sensitivity analysis using G*Power determined that this sample was sufficient to detect a small-medium effect size ($\eta^2 = .05$) with a power of .80, in testing our Hypothesis 2 (Faul et al., 2007). This effect size is comparable to that found in other

successful preparedness behaviour change interventions (e.g. Welton-Mitchell, James, Khanal, & James, 2018). On these grounds, the sample was deemed appropriate to proceed with analysis.

All participants resided in the Wellington, New Zealand region at the time they completed the survey and were vulnerable to risk from multiple natural hazards due to their geographic location (e.g. earthquake, windstorm, tsunami, flood, landslide; Khan, Crozier & Kennedy, 2012). This survey took an inclusive approach to defining preparedness so as to include multiple natural hazards and most preparedness actions surveyed pertain to two or more natural hazard events (e.g. “Strengthen my house/its foundations” may relate to both earthquake and landslide). During the period of our data collection, no strong or severe earthquakes occurred in New Zealand (Geonet, 2020) and no other noteworthy events occurred in New Zealand that may have affected the study findings.

3.1.2. Procedure. The link to the survey was posted on different online channels (local community groups on Facebook) with up to two booster posts on each channel as a means of recruitment during this time. Participants were provided a Qualtrics (2020) link and could complete the survey on their own internet-enabled device, in their own time, at a location of their choosing. At the end of the survey, email addresses were obtained from those who volunteered to be contacted for a follow-up survey two weeks later. This time-frame of two weeks was chosen based on the amount of time it takes to successfully undertake the majority of preparedness actions (i.e., storing food and water) and other studies in the field who have also used similar follow-ups (e.g. Pardini & Katzev, 1983; Skurka, Quick, Reynolds-Tylus, Short, & Bryan, 2018).

An invitation was sent via email two weeks after each participant completed the Time 1 survey and two subsequent reminders were sent once a week after the initial invitation if the participant had not already responded. Our Time 2 survey closed to all participants five

weeks after the last recorded participant completed their responding for our Time 1 survey. This allowed for all Time 1 participants who wished to be involved in the Time 2 survey to receive all three email invites reminding them to participate. This study was granted ethical approval by the Victoria University of Wellington Human Ethics Committee.

3.1.3. Experiment. The experimental design used in this study is nearly identical to that used in Study 1 (T1: place attachment visualisation: $n=113$; neutral place visualisation: $n=126$; control group: $n=162$; T2: place attachment visualisation: $n=53$; neutral place visualisation: $n=64$; control group: $n=60$). However, in this study, we did not include a filler task for the control (no place visualisation) condition. Participants in the control group completed all other measures in this study but were not instructed to take part in any visualisation or writing tasks. The neutral filler tasks were not included because no notable between-group differences were found between the neutral place visualisation condition and control condition in Study 1. This suggests that the experimental design was not sensitive to the differences between the control tasks and the neutral place visualisation task.

Due to survey length constraints in a population sample, we did not include a pre and post-test measure of place attachment or positive and negative affect in this study. We found no significant between-group differences on key variables (preparedness behaviour prior to participation, disaster experience, and socio-demographic factors), indicating that randomisation was mostly successful. Despite this, there were significant between-group differences for house attachment at Time 1 (completed shortly after the intervention, $F(2, 390)=6.46, p=.002, \eta_p^2=.03$): participants in the neutral place visualisation condition reported greater house attachment ($M=3.66, SD=.92$) than both participants in the place attachment condition ($M=3.32, SD=.93, p=.016, t(390)=2.77, d=.37, 95\% \text{ CI } [.05, .63]$) and in the control condition ($M=3.28, SD=.98, t(390)=-3.38, p=.002, d=.40, 95\% \text{ CI } [-.65, -.12]$). Because pre-

test house attachment was not measured, we could not determine if these differences were an intervention effect, or due to failed randomisation.

3.1.4. Measures. The measures used for preparedness behaviour, preparedness intentions, place attachment and disaster experience were identical to Study 1. We also gathered demographic information on the following variables using a series of multi-choice questions: age, gender, length of residence, education (e.g. having a university qualification), income and home ownership status.

3.2. Results

3.2.1. Data treatment. Of the 557 participants who consented and were eligible to partake in the survey, 28 were excluded because they spent less than two minutes on the visualisation task in total. An additional 128 respondents completed fewer than 75% of the total survey indicating insufficient engagement. These exclusion criteria were set in our pre-registered data plan and were intended to filter out participants who failed to adequately engage with the survey therefore undermining the strength of the intervention being tested. A final sample of 401 participants was retained for analysis (Time 1). For Time 2, the final sample consisted of 177 participants (see Table 1 for full demographic information).

3.2.2. Manipulation check. Of those in the place attachment condition, 84% visualised their own houses, while the remainder visualised their neighbourhoods. In the neutral place visualisation condition, over half of participants chose to visualise their supermarket (62%). Other common choices were a library, mall, petrol station, gym, university, or café/restaurant. Participants in the place attachment condition reported stronger attachment to the place they visualised (i.e. house or neighbourhood), after the visualisation task ($M=3.47$, $SD=.87$) compared with participants in the neutral place visualisation condition who rated their attachment to the neutral place they had visualised (e.g. supermarket, library,

mall) ($M=2.24$, $SD=.91$, $t(236)=-10.61$, $p<.001$, $d=-1.38$, 95% CI [-1.46, -1.00]). This suggests we successfully manipulated the target of the visualisation.

3.2.3. Time spent on task. There was no statistically significant difference between the average time spent by those in the place attachment visualisation condition ($M=382.61$ seconds, $SD=234.16$) compared with those in the neutral place visualisation condition ($M=350.23$ seconds, $SD=175.31$; $t(237)=-1.22$, $p=.225$, $d=-.16$, 95% CI [-84.76, 20.01]).

To explore the interaction between timing and intervention condition on preparedness intentions, we ran three linear multiple regression models. We found no significant association between timing and any type of preparedness intentions, either when presented as a single variable in Step 2, or in interaction with intervention condition in Step 3 (see Table 4). For preparedness behaviour at Time 2 (while controlling for pre-existing Time 1 preparedness) we found that timing was a significant predictor of Time 2 survival preparedness only ($\beta=.34$, $p=.036$, 95% CI [.02, .65]), but only when controlling for the interaction term (indicating a possible suppression effect). The greater time spent on the intervention, the greater people's survival preparedness at Time 2, irrespective of intervention condition (see Table 5). Time spent on the mental place visualisation task did not appear to influence the strength of the intervention at changing preparedness intentions or behaviour.

	Survival intentions (β)			Mitigation intentions (β)			Community intentions (β)		
Variable	1	2	3	1	2	3	1	2	3
Dummy (place attachment condition vs. neutral)	-.02	-.04	-.25	.08	.08	-.33	-.06	-.06	-.01
Timing	-	.06	-.14	-	-.07	-.44	-	-.06	-.02
Dummy*Timing	-	-	.24	-	-	.45	-	-	-.05
Model Fit: R^2	.00	.00	.01	.00	.01	.02	.00	.01	.01

Table 4. Standardised regression coefficients for predictors of preparedness intentions (time spent on intervention)

Note. R^2 significance levels indicating p -value for ΔR^2

* = significant at the level of $p < .05$. ** = significant at the level of $p < .01$. *** = significant at the level of $p < .001$.

	Survival behaviours (β)				Mitigation behaviours (β)				Community behaviours (β)			
Variable	1	2	3	4	1	2	3	4	1	2	3	4
Preparedness behaviours Time 1	.88***	.86***	.87***	.86***	.80***	.78***	.78***	.79***	.83***	.82***	.82***	.81***
Dummy (place attachment condition vs. neutral)	-	.20*	.19	.48*	-	.14	.14	-.19	-	.16	.18	.45
Timing	-	-	.09	.34*	-	-	-.01	-.28	-	-	-.08	.16
Dummy*Timing	-	-	-	-.30	-	-	-	.34	-	-	-	-.29
Model Fit: R^2	.77	.78*	.79	.80	.63	.64	.64	.64	.69	.70	.70	.71

Table 5. Standardised regression coefficients for predictors of Time 2 preparedness behaviour (time spent on intervention)

Note. R^2 significance levels indicating p -value for ΔR^2

* = significant at the level of $p < .05$. ** = significant at the level of $p < .01$. *** = significant at the level of $p < .001$

3.2.4. Hypothesis 1: Intentions. We ran a series of non-parametric one-way ANOVAs because the data for survival, mitigation and community preparedness intentions did not meet the assumption of normality using the Shapiro-Wilk test. Contrary to our prediction, we found no significant between-group differences for survival preparedness intentions ($X^2(2)=.81, p=.667, \epsilon^2=.00$), mitigation preparedness intentions ($X^2(2)=2.88, p=.237, \epsilon^2=.01$), or community preparedness intentions ($X^2(2)=.45, p=.798, \epsilon^2=.00$). This indicates that there was no significant effect of place visualisation on intentions. See Table 3 for descriptive statistics on preparedness intentions.

3.2.5. Hypothesis 2: Behaviour. We ran a repeated measures ANOVA with two within-participants factors (time: Time 1 and Time 2; and preparedness type: survival, mitigation, and community) and one between-participants factor (condition: place attachment visualisation; neutral place visualisation; and control). We used ANOVA because results were largely identical when using non-parametric methods. Contrary to predictions, we did not find a significant interaction between preparedness type, time, and condition ($F(4, 288)=.33, p=.860, \eta_p^2=.00$). See Table 6 for descriptive statistics on preparedness behaviours.

We used exploratory ANOVA tests to examine if there were any between-group differences when each type of preparedness was analysed separately at Time 2 while controlling for Time 1 behaviours. We did not find any significant between-group differences at Time 2 for mitigation preparedness behaviour ($F(2, 154)=1.67, p=.191, \eta_p^2=.02$; place attachment visualisation: adjusted $M=3.14, SE=.17$; neutral place visualisation: $M=2.79, SE=.15$; control condition: $M=3.16, SE=.17$) or community preparedness behaviour ($F(2, 149)=1.26, p=.286, \eta_p^2=.02$; place attachment visualisation: adjusted $M=2.37, SE=.17$; neutral place visualisation: $M=2.02, SE=.14$; control condition: $M=2.16, SE=.15$).

		Study 1			Study 2					
		Pre-test			Time 1 Behaviours (y/n)			Time 2 Behaviours (y/n)		
Preparedness items	N	% complete	Alpha	N	% complete	Alpha	N	% complete	Alpha	
Survival			.83			.81			.80	
1. Store water	116	46.55		397	65.24		165	66.06		
2. Store non-perishable food	116	38.79		396	57.07		166	63.25		
3. Make an emergency kit	115	50.43		397	52.39		166	54.22		
4. Make an emergency plan (e.g., knowing where to meet family)	116	24.14		398	43.72		166	39.76		
5. Store supplies (such as plastic bags and toilet paper) to use as an emergency toilet	116	16.38		398	40.95		166	43.37		
6. Purchase items to use if power is lost such as a torch, radio, or gas cooker	116	44.83		398	62.56		166	62.05		
7. Purchase a water tank	116	9.48		396	30.05		165	32.73		
Mitigation			.85			.66			.61	
8. Cloud-store important documents and/or photos on an internet server	116	43.10		397	35.77		166	33.13		
9. Ensure my home and contents are insured for the right amount in the event of a disaster	116	44.83		396	68.69		166	68.67		
10. Seek out information about the different natural hazard risks posed to my home	116	25.86		397	49.37		165	55.76		
11. Have the strength of my building checked (or ask landlord to do the same)	115	32.17		398	26.88		166	24.10		
12. Fasten tall furniture to the wall	116	25.00		393	32.57		165	23.03		
13. Secure movable objects in my home (such as computers and TVs)	115	12.17		397	20.40		166	21.69		
14. Strengthen my house/its foundations (or ask landlord to do the same)	116	22.41		392	20.15		166	18.67		
15. Ensure that heavy objects are stored on the floor and at the bottom of cupboards	116	34.48		397	52.90		165	53.94		
Community			.73			.74			.71	

16. Identify people in my neighbourhood who need checking up on in the event of a disaster	116	10.34	395	26.58	166	27.11
17. Store enough emergency supplies to help others not in my household	116	6.03	396	15.91	166	15.06
18. Volunteer my time to help prepare my community	116	1.72	394	12.69	163	10.43
19. Participate in a lifesaving skills/emergency response course and feel confident in my ability to help others	116	23.27	398	34.42	165	35.15
20. Talk to people I know about getting prepared	115	12.17	391	41.43	166	31.33
21. Attend a community meeting where preparation is discussed	115	0	396	15.91	164	11.59
22. Have contact details of my neighbours in case of emergency	116	27.59	392	38.27	166	37.95
23. Identify my local Community Emergency Hub and understand how to use it to coordinate community response	116	4.31	399	41.60	166	48.80

Table 6. Study 1 and 2: Descriptive information on preparedness behaviours (Time 1 and Time 2)

We did however find a significant between-group difference at Time 2 for survival preparedness behaviour ($F(2, 158)=3.9, p=.021, \eta_p^2=.05$). To examine the nature of these overall differences, we ran post-hoc tests using Bonferroni correction on survival preparedness behaviour at Time 2 and found a significant difference between those in the place attachment visualisation condition (adjusted $M=3.84, SE=.16$) compared to those in the neutral place visualisation condition ($M=3.33, SE=.14, t(158)=-2.47, p=.044, d=.23, 95\% \text{ CI } [-1.01, -.02]$), but not between those in the neutral place visualisation condition compared to the control condition ($M=3.80, SE=.14, t(158)=2.35, p=.060, d=.21, 95\% \text{ CI } [-.00, .94]$). There were no significant differences between those in the place attachment visualisation group and those in the control group ($t(158)=-.22, p=1.00, d=.02, 95\% \text{ CI } [-.55, .21]$). Therefore, both the place attachment and no visualisation condition showed higher survival preparedness behaviour at Time 2 (controlling for Time 1) compared to the neutral visualisation task. See supplementary materials for additional exploratory analyses:

<https://osf.io/3wsph/>.

3.3. Discussion

Previous research has reported significant relationships between place attachment and disaster preparedness. Using a novel place visualisation task, we reported a randomised controlled trial with a two-week follow-up and found no overall between-condition differences for preparedness intentions or preparedness behaviour. Additional exploratory analyses suggested some between-group differences for survival preparedness such that those who completed the place attachment visualisation reported greater survival preparedness at Time 2 (controlling for Time 1), compared to those who completed the neutral place visualisation (but not compared to those in the control group). Despite this, effect sizes across this study were overall very small, indicating limited practical utility. Findings relating to

each of these hypotheses will be discussed in turn below, followed by a discussion of strengths and limitations of the study.

4. General discussion

We ran two studies to test whether place attachment could be used as a tool to increase disaster preparedness in an at-risk population. Across these studies, we found no effect of place attachment visualisation on preparedness intentions and mixed evidence that attachment was influenced by the visualisation. Importantly, when we examined behaviour change over a two-week delay in Study 2, we found no effect of place attachment visualisation on participants' preparedness behaviour for any type of preparedness (when compared with those who visualised a neutral place). We discuss these findings in relation to two possible explanations: controllability of an online experiment and non-causal associations.

Firstly, our intervention may have failed to influence disaster preparedness because we did not have complete control over how participants engaged with the place attachment visualisation through its online delivery. This may have affected the strength of the place attachment manipulation, compared with the study by Scannell and Gifford (2017), who ran their experiment in-person with a research assistant present. An online intervention has the advantage that it can be easily scalable and cost-effective but it provides limited opportunity to oversee the visualisation process. In designing the place visualisation intervention, we carefully considered issues such as the clarity and the placement of the instructions. We also considered how long participants could reasonably be asked to engage in the visualisation and how to enforce this through rigorous pre-testing with volunteers. Supporting our efforts, additional analyses presented in Study 2 found that time spent on the intervention task did not appear to influence the effectiveness of the intervention at changing behaviour. However,

participants may still not have engaged as thoroughly with the task as would be needed to produce a meaningful effect on behaviour.

Secondly, it is possible that place attachment and disaster preparedness are not causally related, despite suggestions of a causal link (Florek, 2011; Mishra et al., 2010; Paton et al., 2008). In van Valkengoed and Steg's (2019) meta-analysis of factors motivating behaviour change, they noted that experimental and longitudinal studies are needed to explore the causality of cross-sectional relationships. Indeed, the extent to which a variable predicts behaviour in correlational studies does not equate to how much change in behaviour will result from manipulating that variable (Sheeran, Klein, & Rothman, 2017). Instead, it may be that the two variables covary together, but are linked through a larger network of variables. In certain theories (e.g. Paton, 2019), preparedness for natural hazards occurs through a multitude of contributing factors that exist on several levels (i.e. personal, family, community, and society). Therefore, while the association between place attachment and preparedness is apparent in previous research, it might be reductive to presume that the manipulation of place attachment alone is sufficient to increase preparedness behaviour without also considering other contributing variables that cause a person to prepare. Alternatively, and while this is contrary to theoretical reasoning, it is also possible that preparedness causes place attachment and not vice versa. Without experimental or longitudinal methods that establish an effect, we cannot be certain of the causality or indeed the directionality of the association.

4.1. Strengths and limitations

These studies have several strengths. Namely, to the best of our knowledge, this is the first study that has used place attachment as an independent variable in the field of disaster preparedness behaviour change. We adapted Scannell and Gifford's (2017) protocol to an online format which could be applied on a wider scale. This allowed us to use a pre-

existing experimental paradigm to inform a community-based intervention using place attachment as a tool to increase actual preparedness behaviour. In addition to this, we used a segmented approach to measuring preparedness (i.e. examining survival, mitigation, and community preparedness as separate outcome variables) This approach provides useful insights about the specific level of preparedness in our sample population and, therefore, the possible long-term resilience of at-risk populations. Furthermore, the design of this study used experimental and longitudinal methods with a community sample, all of which allowed us to test important questions related to the behavioural outcomes of an intervention design. Most importantly, our design allowed us to explore the causal relationship between place attachment and disaster preparedness. This is a research question that has, to the best of our knowledge, not been explored in research before and, therefore, represents new frontiers in place attachment and behaviour change research.

One limitation is a possible lack of power to detect a smaller effect size of the intervention. We based the rationale for this study largely on correlational data between place attachment and preparedness, however correlational studies may over-estimate the size of the effect compared to experimental studies (Sheeran et al., 2017) and we indeed found effect sizes close to zero for preparedness behaviour ($\eta_p^2 = .00 - .01$). In Study 1, we studied a specific population (first year students) that may not have been representative of the wider population and may not have yet developed strong emotional links with their new environment. None of our participants were homeowners and, importantly, most participants had lived in their houses for less than one year. Previous research asserts that these factors do not preclude participants from having formed bonds with their houses or neighbourhoods (e.g. Windsong, 2010) or from having engaged in preparedness behaviours (e.g. storing food and water, having an emergency plan, or securing moveable objects). We admit that a more representative sample would have been better suited for this pilot test. However, this

population represents the future leaders of society as they start a new chapter in their lives and careers. Hence, establishing appropriate behaviour for dealing with risk as these students move to new environments is important, justifying the use of students for trialling this intervention.

Our study was focused on attachment to small-scale places (house and neighbourhood) as a key predictor of preparedness behaviours. While this decision was made based on previous research in this area, it is important to note that the mental visualisation exercise may benefit from testing other visualisation targets (e.g. larger-scale places, global attachment, or other specific disaster scenarios that threaten one's place). It may also be necessary to explore whether interacting attachments (e.g. those at the global *and* the local level; Running, 2013) exert a greater influence on disaster preparedness behaviours. This may be because they are able to evoke the global risk of rising natural hazard events in addition to attitudes specific to their house or neighbourhood. Through exploring these avenues, researchers can then confidently assert the influence of mental place visualisation on preparedness behaviours.

Finally, the comparison groups used in these studies were designed so as to build on work conducted by the authors of the original experimental design (Scannell & Gifford, 2017). In Scannell and Gifford's study, participants who visualised a place they were attached to were compared with participants who visualised a neutral place. In our studies, we added an additional control group who were not explicitly instructed to visualise any group. We did not, however, include a control group in which participants viewed a negative place (e.g. a place to which they are not attached to) as the opposite of the place attachment visualisation condition. Future research would benefit from examining the effects of such a visualisation on disaster preparedness behaviours, if any.

4.2. Implications for practice

We cannot recommend that policymakers or practitioners enact the intervention design described in these studies given that we could not find support for its hypothesised effect. Our place attachment intervention was not more effective at changing preparedness behaviour than no intervention at all. However, on the basis of these findings, we wish to emphasise the importance of evidence-based behaviour-change tools to practitioners and policymakers when it comes to increasing preparedness. Evidently from this research, correlational evidence is not sufficient to justify the implementation of intervention strategies without first testing these in representative community samples with behavioural measures. Research conducted in the implementation science literature supports this, finding that interventions, even those that are successful at changing behaviour using randomised controlled trials, frequently fail to produce behaviour change when implemented in large groups (Al-Ubaydli, List & Suskind, 2017; Kristal & Whillans, 2020). Practitioners and policymakers should heed these warnings when delivering programmes to increase preparedness and, where possible, choose evidence-based interventions that reliably produce the desired effects in diverse populations.

Further, similar to other studies, baseline rates of disaster preparedness were low in our sample and fewer than half of participants had completed preparedness actions. Our research found that mitigation and community-based preparedness behaviours are generally underperformed compared with survival preparedness behaviours. While this imbalance has been reported previously (e.g. McClure et al., 2015), community preparedness has not always been included in these comparisons. Our findings should serve as a signpost to practitioners and policymakers who are responsible for increasing preparedness in their communities. Mounting evidence reports that mitigation measures and community-minded behaviours are crucial to reducing risk and improving outcomes when disasters strike (Paton, 2019) and practitioners and policymakers should incorporate them into their planning.

4.3. Conclusions

To summarise, across two studies (a pilot study and a pre-registered randomised control trial with a community sample and two-week follow-up) we did not find an effect of place attachment visualisation on subsequent disaster preparedness. This is conceptually important given the previously reported cross-sectional patterns. We offer multiple explanations for these findings including the online implementation of our intervention, and the causality of the relationship. To the best of our knowledge, we provide the first experimental study of place attachment on disaster preparedness. Given the low levels of disaster preparedness in at-risk populations and the low efficacy of standard intervention tasks, novel ways of increasing preparedness are needed. We hope these findings will contribute to place attachment theory as it pertains to behaviour change, as well as inform future intervention design using people-place relationships.

References

- Ajzen, I. (1991). The Theory of Planned Behavior. *Organizational Behavior and Human Decision Processes*, 50(2), 179–211. [https://doi.org/10.1016/0749-5978\(91\)90020-T](https://doi.org/10.1016/0749-5978(91)90020-T)
- Al-Ubaydli, O., List, J. A., & Suskind, D. L. (2017). What can we learn from experiments? Understanding the threats to the scalability of experimental results. *American Economic Review*, 107(5), 282–286. <https://doi.org/10.1257/aer.p20171115>
- Anton, C. E., & Lawrence, C. (2016). Does place attachment predict wildfire mitigation and preparedness? A comparison of wildland–urban interface and rural communities. *Environmental Management*, 57(1), 148–162. <https://doi.org/10.1007/s00267-015-0597-7>
- Bonaiuto, M., De Dominicis, S., Fornara, F., Ganucci Cancellieri, U., & Mosco, B. (2011). Flood risk: the role of neighbourhood attachment. In G. Zenz, & R. Hornich (Eds.), *Proceedings of the International Symposium on Urban Flood Risk Management* (pp. 547-558). Graz, Austria: Verlag der Technischen Universitat Graz.
- Bouwer, L. M. (2011). Have disaster losses increased due to anthropogenic climate change? *Bulletin of the American Meteorological Society*, 92(1), 39-46. <https://doi.org/10.1175/2010BAMS3092.1>
- Brown, G., & Raymond, C. (2007). The relationship between place attachment and landscape values: Toward mapping place attachment. *Applied Geography*, 27(2), 89–111. <https://doi.org/10.1016/j.apgeog.2006.11.002>
- Devine-Wright, P., & Batel, S. (2017). My neighbourhood, my country or my planet? The influence of multiple place attachments and climate change concern on social acceptance of energy infrastructure. *Global Environmental Change*, 47, 110–120. <https://doi.org/10.1016/j.gloenvcha.2017.08.003>
- De Dominicis, S., Fornara, F., Ganucci Cancellieri, U., Twigger-Ross, C., & Bonaiuto, M. (2015). We are at risk, and so what? Place attachment, environmental risk perceptions and preventive

coping behaviours. *Journal of Environmental Psychology*, 43, 66-78.

<http://dx.doi.org/10.1016/j.jenvp.2015.05.010>

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, 39(2), 175–191. <https://doi.org/10.3758/BF03193146>

Fishbein, M., & Ajzen, I. (2010). *Predicting and changing behavior: The reasoned action approach*. New York, NY: Psychology Press. <https://doi.org/10.4324/9780203838020>

Florek, M. (2011). No place like home: Perspectives on place attachment and impacts on city management. *Journal of Town & City Management*, 1(4), 346-354.

Forsyth, D. R., van Vugt, M., Schlein, G., & Story, P. A. (2015). Identity and sustainability: Localized sense of community increases environmental engagement. *Analyses of Social Issues and Public Policy*, 15(1), 233–252. <https://doi.org/10.1111/asap.12076>

Geonet. (2020). *Recent quakes*. Retrieved April 6, 2020, from

<https://www.geonet.org.nz/earthquake>

Hochheimer, C. J., Sabo, R. T., Krist, A. H., Day, T., Cyrus, J., & Woolf, S. H. (2016). Methods for evaluating respondent attrition in web-based surveys. *Journal of Medical Internet Research*, 18(11), e301. <https://doi.org/10.2196/jmir.6342>

Joffe, H., Rossetto, T., Solberg, C., & O'Connor, C. (2013). Social representations of earthquakes: A study of people living in three highly seismic areas. *Earthquake Spectra*, 29(2), 367-397. <https://doi.org/10.1193/1.4000138>

Johnston, D., Becker, J., McClure, J., Paton, D., McBride, S., Wright, K., ... Hughes, M. (2013). Community understanding of, and preparedness for, earthquake and tsunami risk in Wellington, New Zealand. In H. Joffe, T. Rossetto, & J. Adams (Eds.), *Cities at Risk* (Vol. 33, pp. 131–148). https://doi.org/10.1007/978-94-007-6184-1_8

- Kristal, A. S., & Whillans, A. V. (2020). What we can learn from five naturalistic field experiments that failed to shift commuter behaviour. *Nature Human Behaviour*, 4(2), 169–176. <https://doi.org/10.1038/s41562-019-0795-z>
- Kumashiro, M., & Sedikides, C. (2005). Taking on board liability-focused information: Close positive relationships as a self-bolstering resource. *Psychological Science*, 16(9), 732–739. <https://doi.org/10.1111/j.1467-9280.2005.01603.x>
- Khan, S., Crozier, M. J., & Kennedy, D. (2012). Influences of place characteristics on hazards, perception and response: A case study of the hazardscape of the Wellington Region, New Zealand. *Natural Hazards*, 62(2), 501–529. <https://doi.org/10.1007/s11069-012-0091-y>
- Lewicka, M. (2010). What makes neighborhood different from home and city? Effects of place scale on place attachment. *Journal of Environmental Psychology*, 30(1), 35–51. <https://doi.org/10.1016/j.jenvp.2009.05.004>
- McClure, J., Spittal, M. J., Fischer, R., & Charleson, A. (2015). Why do people take fewer damage mitigation actions than survival actions? Other factors outweigh cost. *Natural Hazards Review*, 16(2), 04014018. [https://doi.org/10.1061/\(ASCE\)NH.1527-6996.0000152](https://doi.org/10.1061/(ASCE)NH.1527-6996.0000152)
- McKenzie-Mohr, D. (2000). New ways to promote pro-environmental behavior: Promoting sustainable behavior: An introduction to community-based social marketing. *Journal of Social Issues*, 56(3), 543–554. <https://doi.org/10.1111/0022-4537.00183>
- Mikulincer, M., Shaver, P. R., Gillath, O., & Nitzberg, R. A. (2005). Attachment, caregiving, and altruism: Boosting attachment security increases compassion and helping. *Journal of Personality and Social Psychology*, 89(5), 817–839. <https://doi.org/10.1037/0022-3514.89.5.817>
- Mishra, S., Mazumdar, S., & Suar, D. (2010). Place attachment and flood preparedness. *Journal of Environmental Psychology*, 30(2), 187–197. <https://doi.org/10.1016/j.jenvp.2009.11.005>

- Najafi, M., Ardalan, A., Akbarisari, A., Noorbala, A. A., & Elmi, H. (2017). The theory of planned behavior and disaster preparedness. *PLoS Currents*, 9.
<https://doi.org/10.1371/currents.dis.4da18e0f1479bf6c0a94b29e0dbf4a72>
- Newell, R., & Canessa, R. (2015). Seeing, believing, and feeling: The relationship between sense of place and geovisualization research. *Spaces and Flows: An International Journal of Urban and ExtraUrban Studies*, 6(4), 15–30. <https://doi.org/10.18848/2154-8676/CGP/v06i04/15-30>
- Newell, R., & Canessa, R. (2017). Picturing a place by the sea: Geovisualizations as place-based tools for collaborative coastal management. *Ocean & Coastal Management*, 141, 29–42.
<https://doi.org/10.1016/j.ocecoaman.2017.03.002>
- Newell, R., & Canessa, R. (2018). From sense of place to visualization of place: Examining people-place relationships for insight on developing geovisualizations. *Heliyon*, 4(2), e00547.
<https://doi.org/10.1016/j.heliyon.2018.e00547>
- Pardini, A. U., & Katzev, R. D. (1983). The effect of strength of commitment on newspaper recycling. *Journal of Environmental Systems*, 13(3), 245–254.
<http://dx.doi.org/10.2190/6PN9-MXFP-3BFF-CHHB>
- Paton, D. (2019). Disaster risk reduction: Psychological perspectives on preparedness. *Australian Journal of Psychology*, 71(4), 327–341. <https://doi.org/10.1111/ajpy.12237>
- Paton, D., Bürgelt, P., & Prior, T. D. (2008). Living with bushfire risk: Social and environmental influences on preparedness. *Australian Journal of Emergency Management*, 23(3), 42–48.
- Paton, D., Bajek, R., Okada, N., & McIvor, D. (2010). Predicting community earthquake preparedness: A cross-cultural comparison of Japan and New Zealand. *Natural Hazards*, 54(3), 765–781. <https://doi.org/10.1007/s11069-010-9500-2>
- Paton, D., & Johnston, D. (2008). *A means-end chain theory analysis of hazard cognitions and preparedness*. Wellington, New Zealand: GNS Science.
- Qualtrics. (2020). Qualtrics XM. Provo, UT.

- Reese, G., Oettler, L. M. S., & Katz, L. C. (2019). Imagining the loss of social and physical place characteristics reduces place attachment. *Journal of Environmental Psychology*, 65, 1-6.
<https://doi.org/10.1016/j.jenvp.2019.101325>
- Running, K. (2013). World citizenship and concern for global warming: Building the case for a strong international civil society. *Social Forces*, 92(1), 377-399.
<https://doi.org/10.1093/sf/sot077>
- Said, A. M., Ahmadun, F., Mahmud, A. R., & Abas, F. (2011). Community preparedness for tsunami disaster: A case study. *Disaster Prevention and Management: An International Journal*, 20(3), 266–280. <https://doi.org/10.1108/09653561111141718>
- Scannell, L., & Gifford, R. (2010). Defining place attachment: A tripartite organizing framework. *Journal of Environmental Psychology*, 30(1), 1–10.
<https://doi.org/10.1016/j.jenvp.2009.09.006>
- Scannell, L., & Gifford, R. (2017). Place attachment enhances psychological need satisfaction. *Environment and Behavior*, 49(4), 359–389. <https://doi.org/10.1177/0013916516637648>
- Sheeran, P., Klein, W. M. P., & Rothman, A. J. (2017). Health behavior change: Moving from observation to intervention. *Annual Review of Psychology*, 68(1), 573–600.
<https://doi.org/10.1146/annurev-psych-010416-044007>
- Sheeran, P., & Webb, T. L. (2016). The intention–behavior gap. *Social and Personality Psychology Compass*, 10(9), 503–518. <https://doi.org/10.1111/spc3.12265>
- Skurka, C., Quick, B. L., Reynolds-Tylus, T., Short, T., & Bryan, A. L. (2018). An evaluation of a college campus emergency preparedness intervention. *Journal of Safety Research*, 65, 67–72.
<https://doi.org/10.1016/j.jsr.2018.02.003>
- Spittal, M. J., Walkey, F. H., McClure, J., Siegert, R. J., & Ballantyne, K. E. (2006). The Earthquake Readiness Scale: The development of a valid and reliable unifactorial measure. *Natural Hazards*, 39(1), 15–29. <https://doi.org/10.1007/s11069-005-2369-9>

- Stancu, A., Ariccio, S., De Dominicis, S., Ganucci Cancellieri, U., Petruccelli, I., Ilin, C., & Bonaiuto, M. (2020). The better the bond, the better we cope. The effects of place attachment intensity and place attachment styles on the link between perception of risk and emotional and behavioral coping. *International Journal of Disaster Risk Reduction*, 51, 1-17.
<https://doi.org/10.1016/j.ijdr.2020.101771>
- Thompson, E. R. (2007). Development and validation of an internationally reliable short-form of the Positive and Negative Affect Schedule (PANAS). *Journal of Cross-Cultural Psychology*, 38(2), 227–242. <https://doi.org/10.1177/0022022106297301>
- van Valkengoed, A. M., & Steg, L. (2019). Meta-analyses of factors motivating climate change adaptation behaviour. *Nature Climate Change*, 9(2), 158–163.
<https://doi.org/10.1038/s41558-018-0371-y>
- Verrucci, E., Perez-Fuentes, G., Rossetto, T., Bisby, L., Haklay, M., Rush, D., ... Joffe, H. (2016). Digital engagement methods for earthquake and fire preparedness: A review. *Natural Hazards*, 83(3), 1583–1604. <https://doi.org/10.1007/s11069-016-2378-x>
- Walker, I., Leviston, Z., Price, J., & Devine-Wright, P. (2015). Responses to a worsening environment: relative deprivation mediates between place attachments and behaviour. *European Journal of Social Psychology*, 45(7), 833-846. <http://dx.doi.org/10.1002/ejsp.2151>
- Wallis, A., Fischer, R., & Abrahamse, W. (2021) *Place attachment and disaster preparedness: Examining the role of place scale and preparedness type*. Manuscript submitted for publication.
- Weigel, R. H., Vernon, D. T. A., & Tognacci, L. N. (1974). Specificity of the attitude as a determinant of attitude-behavior congruence. *Journal of Personality and Social Psychology*, 30(6), 724–728. <https://doi.org/10.1037/h0037540>

- Welton-Mitchell, C., James, L. E., Khanal, S. N., & James, A. S. (2018). An integrated approach to mental health and disaster preparedness: A cluster comparison with earthquake affected communities in Nepal. *BMC Psychiatry*, 18, 1-14. <https://doi.org/10.1186/s12888-018-1863-z>
- Williams, D. R., & Roggenbuck, J. W. (1989, October). *Measuring place attachment: Some preliminary results*. Paper presented at NRPA Symposium on Leisure Research, San, Antonio, TX.
- Williams, D. R., & Vaske, J. J. (2003). The measurement of place attachment: Validity and generalizability of a psychometric approach. *Forest Science*, 49(6), 830-840. <https://doi.org/10.1093/forestscience/49.6.830>
- Windsong, E. A. (2010). There is no place like home: Complexities in exploring home and place attachment. *The Social Science Journal*, 47(1), 205–214. <https://doi.org/10.1016/j.soscij.2009.06.009>
- Wullenkord, M. C., Heidbreder, L. M., & Reese, G. (2020). Reactions to environmental changes: Place attachment predicts interest in earth observation data. *Frontiers in Psychology*, 11, 1-15. <https://doi.org/10.3389/fpsyg.2020.01442>
- Xu, D., Peng, L., Liu, S., & Wang, X. (2018). Influences of risk perception and sense of place on landslide disaster preparedness in Southwestern China. *International Journal of Disaster Risk Science*, 9(2), 167–180. <https://doi.org/10.1007/s13753-018-0170-0>