

Candidate 10058

The Role of Flood Risk Perception, Place Attachment and Experience with Floods in Willingness to Invest in Protective Action

Bachelor's thesis in Psychology
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Bachelor Thesis in Psychology – PSY2900

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Preface

The framework of this study exists within an empirical research project planned by the author's supervisor. The research projects focus on the relation between citizens and consumers and the environment, as well as human factors influencing safety-related behavior. The desire for the choice of this program come from my interest in climate and how we adapt to climate-change. I participated as a part of a group of students in the bachelor thesis project termed «BA01 – What does it take to invest in protective actions? Predictors and barriers of climate change adaptation. A focus on risk communities in Norway». This paper got its ideas for hypotheses and predictions from readings articles on place attachment, risk perception and intention to enact in protective behavior for different populations. The hypotheses are based on research and conceptualized by me through discussions and guidance with supervisors. Furthermore, choice of statistical analysis was based on discussions with supervisor, which also helped with an additional tool for statistical analysis for moderation. All the analyses were performed by the author.

I wish to thank fellow students in the bachelor program for valuable discussions throughout this journey. Moreover, I also wish to thank my supervisors for their contributions and excellent guidance. Special thanks to my boyfriend, for his patience and support these past months.

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Abstract

There is a growing interest in place attachment as a coping strategy in response to natural hazards. However, research has pointed out a tendency where place attachment may be dysfunctional by reducing risk perception and mitigation to hazards. The present study aims to investigate Norwegians flood risk perception, place attachment and willingness to invest in protective action. Data were collected from 282 adult residents living in Norway. Participants were asked about their attachment to their homes, perception of flood risk and their intention to enact in protective behavior. All items were adapted from earlier research. Flood risk perception has been seen as a predictor for willingness to invest in protective behavior, this was tested and confirmed. Place attachment was negatively associated with our willingness to invest in protective action. However, there was no significant effect of place attachment as a moderator between flood risk perception and willingness to invest in protective behavior, also when controlling for experience. A multiple linear regression analysis and PROCESS by Hayes et al. (2022), were performed to determine whether risk perception and place attachment were predictors for willingness to invest in protective action, and if place attachment moderates the relationship between the two variables. The implications of these findings, strengths, and limitations are described. Future research should focus on how place attachment can be used to refer persons to target a safe place.

The Role of Flood Risk Perception, Place Attachment and Experience with Floods in Willingness to Invest in Protective Action

The intergovernmental panel on climate change, IPCC, recently published its sixth assessment report which addresses the most up-to-date physical understanding of the climate system (2022). In 2012 they already predicted that environmental hazards are going to increase in frequency and strength (IPCC, 2012). The last four decades have been warmer than any decade that preceded 1850, according to the report published in 2022. Warmer temperatures will in turn intensify wet and dry weather, with implications for flooding and drought. In the report from 2012, they predicted spring flooding to decrease due to less snowfall during the winters, but these milder winters will lead to more winter flooding. An increase in environmental hazards, such as flooding, requires more attention. Investment in security, good spatial planning, and adequate building planning are some of the elements that need to be taken care of in the face of upcoming environmental hazards. Nowadays real estate has the intention to create a good view, without consideration of the vulnerability to hazards (Førland et al., 2007). Urbanization can lead to a higher likelihood of flooding due to paving, deforestation, and removal of streams which leads to reduced runoff (Førland et al., 2007). In other words, we need to mitigate and adapt in response to these climate changes.

This study will investigate how concepts such as place attachment, flood risk perception, and willingness to invest in protective actions interact. Previous research shows a lack of knowledge about the relationship between these concepts (Anton & Lawrence, 2014). Humans form bonds with their homes and communities, and this may function as a barrier or a predictor for investing in protective actions against environmental hazards. More specifically, place attachment is defined as an unconscious internal working model which consists of positively affected experiences of a place (Morgan, 2010). Research points out place attachment as dysfunctional when it hinders people from considering future alternatives and are unlikely to leave, even when their home has stopped being manageable (Twigger-Ross & Uzzell, 1996). Most research however links place attachment to positive outcomes. Tartaglia (2012) stated that place attachment is associated with better physical and psychological health, and greater satisfaction with one's physical environment. Flood risk perception, however, is considered important in the context of flood risk management (Kellens et al., 2011). Knowledge in this area is meant to assure an improvement in the effectiveness of flood risk management (Kellens et al., 2011). Individuals tend to underestimate flood risk and challenge to cope with it. Therefore, it is important to increase the knowledge and motivate residents in risk zones to mitigate protective actions against flooding.

Theoretical Framework

Attachment Theory and Place Attachment

Bowlby was the first to introduce the concept of attachment (Bowlby, 1980). The theory of attachment is originating from observations on the effects of maternal deprivation and on the children's behavior during and after separation from mother. The attachment system function as a biologically based motivational system, which promotes survival and inclusive fitness through maintenance of closeness to a caregiver (Fearon et al., 2016). Moreover, the proximity to a caregiver ensures for the children to explore their surroundings and retreat to the caregiver when opposed to a threat for a secure base. Throughout children's first relationships and life, they develop internal working models. Internal working models are underlying psychological structures that consist of representations of the caregiver, the self, and relationship experiences throughout life (Bowlby, 1980). These models are representative in situations where they need to act rapidly and adaptively in accordance with the demands of the immediate situation.

Building upon these internal working models of attachment, place attachment is seen as: "a pattern of positively affected experiences of a place in childhood are generalized into an unconscious internal working model of place" (Morgan, 2010, p. 1). The concept of place attachment has been defined in a variety of ways due to application to different research fields (Scannell & Gifford, 2010). Therefore, Scannell and Gifford proposed a three-dimensional framework of place attachment consisting of person, process and place, to understand the concept of place attachment. The first dimension looks up the actor of the attachment. The second looks at the psychological processes of affect, cognition and behavior in attachment. The last dimension is the object of the attachment, which can be an individual's home and place characteristics. Scannell and Gifford (2010) suggest that we develop psychological bonds to places for several reasons: survival, security, and continuity. This is in accordance with Bowlby's attachment theory, where attachment not only satisfies physiological needs but also offers a sense of security and comfort (Fearon et al., 2016). Furthermore, this allows for exploration and increases the confidence of the individual. Other functions are goal support, self-regulation, and interpersonal attachment (Scannell & Gifford, 2010). Overall, place attachment can be defined as the bonding that occurs between the individual and their environment, which acknowledge that place attachment consists of places, actors and psychological processes (Altman & Low, 1992; Scannell & Gifford, 2010).

Risk Perception

The term risk perception is somewhat ambiguous and is used with different meanings. Originally risk perception has been defined as the intuitive risk judgements concerning natural or technological hazards (Slovic, 1987). Risk perception is an individual's interpretation of the risk related to the object perceived as a threat (De Dominics et al., 2015). Here, risk perception is defined individually. Raaijmakers and his colleagues (2008) emphasized a distinction between three aspects when it comes to risk perception: awareness, worrying and preparedness. Awareness is connected to if a person knows if they reside or is located in an area of risk of flooding. Worry depend on the awareness of the frequency of flooding and the severity of the consequences. Preparedness involves preparatory actions, capacity of coping with flood and the possibility of recovery afterwards. By these three factors risk perception is defined situationally. The study of flood risk perception is considered as a research on human consciousness, emotions and behaviors with regard to hazard (Kellens et al., 2011; Lechowska, 2018). Flood risk perception, and risk perception itself, is influenced by a multitude of factors (Kellens et al., 2011; Lechowska, 2018). Some of these include sociodemographic characteristics (e.g., gender and age), knowledge about hazards (e.g., man-made or a natural hazard) and previous experience with hazards (Lechowska, 2018). For instance, some research suggests that women worry more about risks than men, cited in Lechowska (2018). Furthermore, people associate man-induced disasters as more threatening than natural disasters (Baan & Klijn, 2004). The threat of flooding may be perceived by some as man-induced due to urbanization and deforestation, and by others as a naturally occurring hazard. Moreover, both direct and indirect experience with flooding has been linked to risk perception (De Dominics et al., 2015). All these factors may in return lead to biased perceptions of flood risk. Optimism bias (Gifford et al., 2009) and the crisis effect (Baan & Klijn, 2004) are two examples that illustrates how people underestimate the risk and the belief that the impact is more serious for others than themselves. Furthermore, the level of flood risk perceived by society does not coincide with the flood risk level determined by experts, whereas the society tend to underestimate the risk and challenge in managing it (Lechowska, 2018). Trust in authorities has also been seen to have a mediating role in the relationship between risk perception and preparedness (Lechowska, 2018). Moreover, Wachinger et al. (2013) findings indicated that trust in authorities (and experience) has the most impact on risk perception.

Risk perception and willingness to invest in protective action

Risk perception has been associated with a number of protective behaviors. For instance, Miceli et al. (2008) and Terpstra and Lindell (2014) reported that preparedness was positively

associated with risk perception, and most of the respondents were prepared to deal with future flood disaster. Additionally, Baan and Klijn (2004) findings indicated a positive association between flood risk perception and preventive behavior in the Netherlands. However, they mention that people seem to be fooled into thinking that the protection measures will protect them against all future floods. Nevertheless, people living in floodplains have more knowledge and are better prepared (Baan & Klijn, 2004). Despite of this, Bubeck et al. (2012) findings indicate that in reality this relationship is rarely observed in empirical studies. The relation between flood risk perception and mitigation measures have either not been found statistically significant or only a weak relation has been found. They suggest that this is because that those with higher risk perception take flood reducing measures to lower their risk perception. Furthermore, they suggested that experience with flooding can have a powerful impact on the recognition of risk and the influence on private mitigation behavior.

Place attachment and willingness to invest in protective actions

Research on the relationship between place attachment and environmental risk coping is unclear. For example, a study conducted by Zhang et al. (2014) showed that place attachment was related to place-protective behaviors, for instance protection and re/ construction of tourist sites. Another study conducted by Kaltenborn (1998) in Svalbard, which is prone to oil spills, showed that high place attachment was associated with more willingness to pro-environmental behavior, such as to clean up beaches and collect litter. However, results in Australia show that attachment does not influence rural inhabitants to consider relocating even if they are aware that their area is at risk (Boon, 2014). Findings indicated that their resilience to relocate was promoted by social connectedness and a sense of place. Another study by Twigger-Ross and Uzzell (1996) compared attached and less-attached individuals. These results indicated that attached individuals were less prepared to leave when there were threats to functional aspects of the local environment. Furthermore, Bird et al. (2011) reported that rural residents showed lower acceptance of evacuation plans in relation to place attachment. Nevertheless, urban residents reported a higher willingness to accept mitigation measures. These examples show how the relation between place attachment and willingness to invest in protective action is not clear, being either positive or negative.

Place attachment and flood risk perception

Studies on the correlation between place attachment and flood risk perception are contradictory (Bonaiuto, 2016). Billig (2006) for instance, found that individuals living in Gaza

with a strong religious ideology and place attachment had a lower risk perception. Threats to their places reduced their risk perception which influenced them to stay longer, despite the place no longer being safe (Billig, 2006). Moreover, De Dominicis et al. (2015) investigated the moderating effect of place attachment on the relationship between flood risk perception and preventive behavior. Their findings were that place attachment reduces the strength of the positive relation between risk perception and preventive behavior in contexts where the environmental risk is high. In contexts where the environmental risk is low however, there was no effect associated with place attachment, and people enact in preventive behavior according to their risk perception. Bihari and Ryan (2012) however, reported that people with past experience of wildfires had a stronger place attachment which influence their social capital and preparedness for actions, such as clearing vegetation and developing an emergency plan. In connection to the contradictory findings, Bernardo (2013) conducted a study due to the inconclusive relationship on place attachment relation to risk perception. Findings reported that place attachment may affect different levels of perceived risk. Place attachment amplifies high-probability risks and attenuates low-probability risks (Bernardo, 2013), and this continue influence the intention to invest in protective action.

Experience and its relation to risk perception and place attachment

Few studies have investigated how experience influence place attachment. Boon (2014) findings indicated that residents who had a stronger connectedness to their place, were more unwilling to relocate even though they had repeated experiences with flooding. Most studies however, investigate how place attachment affect migration from risk-prone areas. There are increasing evidence that residents do not want to move away from risk-prone areas (Anton & Lawrence, 2014; Swapan & Sadeque, 2021). Anton and Lawrence (2014) suggested that living in a risk-prone area make their places more apparent and strengthens their place attachment. These findings, together with Boon (2014), can have transferred significance to experience, whereas experience strengthens an individual's place attachment because the event makes it more apparent. Additionally, Lujala et al. (2015) emphasized personal experience as an important factor in explaining people's perception. Personal experience of damage was shown to have the greatest impact on belief that there will be more natural hazards. Lechowska (2018) suggested that experience increases a person's awareness and affect their feelings of worry in the dimensions of risk perception. Wachinger et al. (2013) concluded their article that direct experience has the largest impact on risk perception.

Aim of the study

The purpose of this study was to investigate to what extent flood risk perception and place attachment is related to willingness to invest in protective action, and if is this relation moderated by place attachment.

First, a higher level of risk perception is associated with positive effects on coping strategies toward the environmental risk (Miceli et al., 2008; Ban & Klijn, 2004), therefore the prediction is that flood risk perception will be positively associated with a willingness to invest in protective action towards the flood risk (H1).

Continuing, research suggests that place attachment is a predictor for pro-environmental behavior (Zhang et al., 2014; Kaltenborn, 1998), but not necessarily for safety measures, e.g., intention to relocate, (Boon, 2014; Twigger-Ross & Uzzell, 1996). The prediction is therefore, that place attachment will be negatively associated with willingness to invest in protective action (H2).

The main aim is to test the moderating role of place attachment. Some studies indicate that place attachment decreases an individual's risk perception, which in return leads to a decrease in willingness to invest in protective actions (Billig, 2006; De Dominics et al., 2015). The hypothesis is therefore that place attachment negatively moderates the relationship between flood risk perception and willingness to invest in protective action (H3). Specifically, the relationship between flood risk perception and willingness to invest in protective action is weaker at high levels of place attachment (see Figure 1).

At last, the study investigated the moderating effect of place attachment between flood risk perception and willingness to invest in protective action, for participants with and without experience of flooding. It is hypothesized that place attachment negatively moderates the relationship between flood risk perception and willingness to invest in protective action for the subgroup with experience of flooding (H4-1). This may be because they perceive themselves as exposed to higher risk and the moderating effect of place attachment will be magnified within this subsample, which is cited in De Dominics et al. (2015) study. Furthermore, following De Dominics et al. (2015) on low-risk contexts, the subsample without experience of flooding is predicted to show a higher association between risk perception and willingness to invest in protective action, irrespective of their attachment (H4-2).

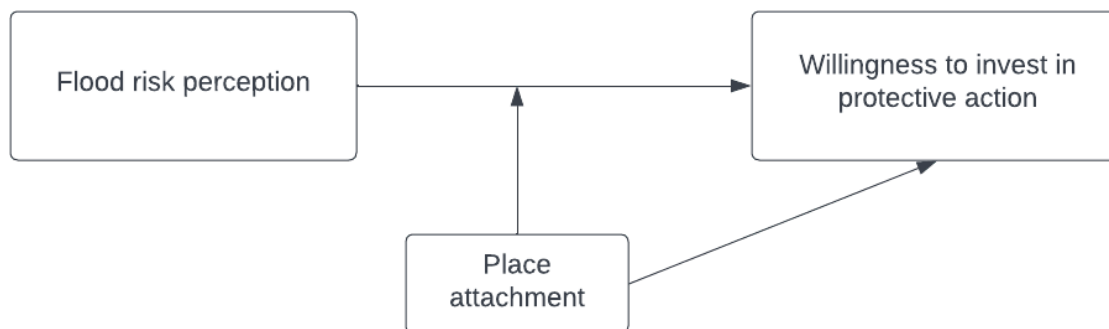


Figure 1. Illustration of the moderation on the indirect effect. It's hypothesized that the relation between flood risk perception and willingness to invest in protective behavior will be stronger for lower levels of place attachment, while it will be weaker for higher levels of place attachment.

Method

Participants

The sample size in this research project consisted of $N = 282$. Of these 42% of the respondents were male, $n = 117$, and 56% respondents were female, $n = 158$. 7 respondents preferred to not disclose this information. Participants' age ranged from 18 to 79, $M = 44.32$, $SD = 16.76$. The participants previous experience differed between direct-, indirect-, both direct and indirect and no experience with flooding. 47% had no previous experience with flooding, $n = 131$, 8% had direct experience with flooding, $n = 22$, 36% had indirect experience with flooding, $n = 100$, and 10% had both direct and indirect experience with flooding, $n = 29$. The respondents were from all regions in Norway. 18% were from Vestlandet, $n = 52$, 14% were from Trøndelag, $n = 38$, and 13% were from Oslo, $n = 36$, 10% from Viken, $n = 29$, 9% from Nordland, $n = 26$, 9% from Møre og Romsdal, $n = 26$, 9% from Troms and Finnmark, $n = 25$, and 8% from Vestfold and Telemark, $n = 23$. Only 3% came from Rogaland, $n = 8$, 3% from Agder, $n = 9$, and 4% from Innlandet, $n = 10$. Self-reported data indicated that 65% of the respondents did not live in a flood risk prone area, $n = 183$, and 35% live in a flood risk prone area, $n = 99$.

Materials

The survey was a part of the Bachelor program of psychology at the Norwegian University of Science and Technology (NTNU), and a part of a larger research project regarding the risk and management of natural disasters in Norway. Furthermore, it consisted of different

scales, including place attachment, flood risk perception and willingness to invest in protective action used in this thesis (see appendix A for more details about the items).

Place attachment was measured using items adapted by Kaltenborn and Bjerke (2002) $\alpha = .86$. Higher scores indicate stronger attachment to their places (e.g., “I identify strongly with this area” and “I feel a sense of emotional attachment to this place”). Responses were measured on a five-point Likert scale, ranging from 1 - strongly disagree, to 5 - strongly agree.

Flood risk perception was measured through 8 items adapted by Wilson, Zwickle and Walpole (2018), $\alpha = .79$. Higher scores indicate a more strongly perception towards the risk of flooding (e.g., “When you think about floods, to what extent do you feel worried?” and “How likely is it that a flood will occur where you live?”). All of the responses used a five-point Likert scale, ranging from 1 - not at all, to 5 - very much. One of the items was reversed: “I am confident that a flood will not occur where I live”.

Willingness to invest in protective action consisted of 6 items adapted by Seebauer and Babicky (2018), $\alpha = .90$. Respondents were asked to evaluate how likely they were to engage in different behavior (e.g., “I intend to prepare my home for floods” and “I am willing to coordinate with neighbors”). An additional item was added which asked participants whether they were willing to consider relocating. These responses also used a five-point Likert scale, ranging from 1 - very unlikely, to 5 - very likely.

The last variable, experience with floods, consisted of only one item where the respondents were asked to choose the one which best applies you. The alternatives were: “I have been directly affected by a flood”, “I have been indirectly affected by a flood”, “I have been affected by a flood both directly and indirectly” and “I have never been personally affected by a flood”. The alternatives were further combined into two alternatives in the analysis: no experience with flood and experience with flood to fit the testing of H4. All of the scales were originally written in English but were translated to Norwegian due to the Norwegian sample, and back translated to English to increase its validity (Cha, Kim & Erlen, 2007).

Procedure

The respondents were contacted through social media between 15th of April and 22nd of April 2022. The respondents were recruited through a network sampling and a self-selected sampling (Meltzoff & Cooper, 2018). The whole team began asking people to participate in the survey and asked them to share with their friends and acquaintances through social media, which constitutes a network sampling. This method stands in risk of narrowness from picking only people known to them and the sample may be more homogenous in composition and won't

allow for broad generalization. The survey was also shared among Facebook groups for communities throughout Norway based on their risk of flooding calculated at the website “flomhendelser.no” (eng. flooding events) and had an ongoing Facebook ad for three days. This sampling method is limited to people who have the desire and the means to respond, and therefore it is unclear whom these self-selected surveys represent (Meltzoff & Cooper, 2018).

At the beginning of the survey the researcher identified the project, research institution, the nature of the study and formalities, such as approximately time to finish the survey and information about their participation is anonymous and that their responses will be handled confidentially. Further they were asked if they were willing to give their consent to participate in the study. The entire survey took around 15 to 20 minutes to administer. The research was approved by the Norwegian Centre for Research Data (NSD) at 8th of March 2021 (see appendix B).

Analysis

Data were analyzed using the statistical analysis program, IBM SPSS, version 27.0.1.0. Descriptive statistics, reliability analysis, and multiple linear regression analysis were computed for the study variables. A moderator model (Hayes et al., 2022) was tested using PROCESS version v4. 1., with 5.000 bootstrapping technique and 95% confidence intervals adopting model 1. The outcome variable for the analysis was willingness to invest in protective action, the predictor variable was flood risk perception, and the moderator variable was place attachment.

Results

Descriptive statistics

See table 1 for descriptive statistics.

Table 1

Descriptive statistics of Place Attachment, Flood Risk Perception and Willingness to Invest in Protective Action (N = 282)

Variable	<i>M</i>	<i>SD</i>	<i>Skewness</i>
1. Place Attachment	3.94	.69	.00
2. Flood Risk Perception	2.38	.66	.00
3. Willingness to Invest in Protective Action	2.26	.99	.06

Hypothesis testing

To answer H1 and H2 a multiple linear regression analysis was used. The regressions coefficients are presented in table 2. Both of the predictor variables showed significant effect on the outcome variable willingness to invest in protective action, $R^2 = .29$, $F(2, 279) = 57.43$, $p < .001$. Flood risk perception had a significant effect on willingness to invest in protective action, $\beta = .51$, $p < .001$, which supported H1. Place attachment had a significant, negative effect on willingness to invest in protective action, $\beta = -.17$, $p < .001$, which supported H2. Flood risk perception had the biggest effect of the two variables.

Table 2

Regression Analysis Summary for Predicting Willingness to Invest in Protective Action (N = 282)

Variable	<i>b</i>	<i>SE b</i>	β	R^2
Model				.29
4. Flood risk perception	0.76***	0.08	.51***	
5. Place attachment	-0.25***	0.07	-.17***	

*Note.. *** $p < .001$, ** $p < .01$. Durbin-Watson = 1.91.*

Continuing, to test H3 a simple moderator analysis was performed using PROCESS (Hayes et al., 2022) with model 1. The interaction was not significant, $b = -.04$, 95% CI [-.238, .160], $t = -.39$, $p = .699$. The moderating effect of place attachment on the relationship between flood risk perception and willingness to invest in protective action was therefore not statistically significant. A statistical diagram of the selected model is presented in Figure 2. For low levels of place attachment, $b = .79$, 95% CI [.588, .994], $t = 7.69$, $p < .000$. For average levels of place attachment, $b = .76$, 95% CI [.615, .913], $t = 10.10$, $p < .000$. For high levels of place attachment, $b = .74$, 95% CI [.535, .940], $t = 7.17$, $p < .000$. The interactions are displayed in Figure 3. H3 was therefore not supported by the analysis.

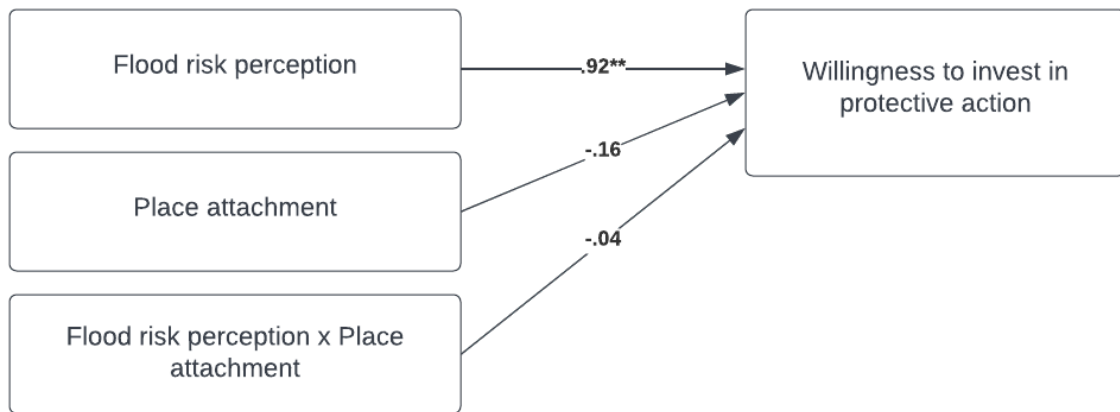


Figure 2. Note. Values denote unstandardized coefficients from model 1 in PROCESS (Hayes et al., 2022). ** $p < .05$.

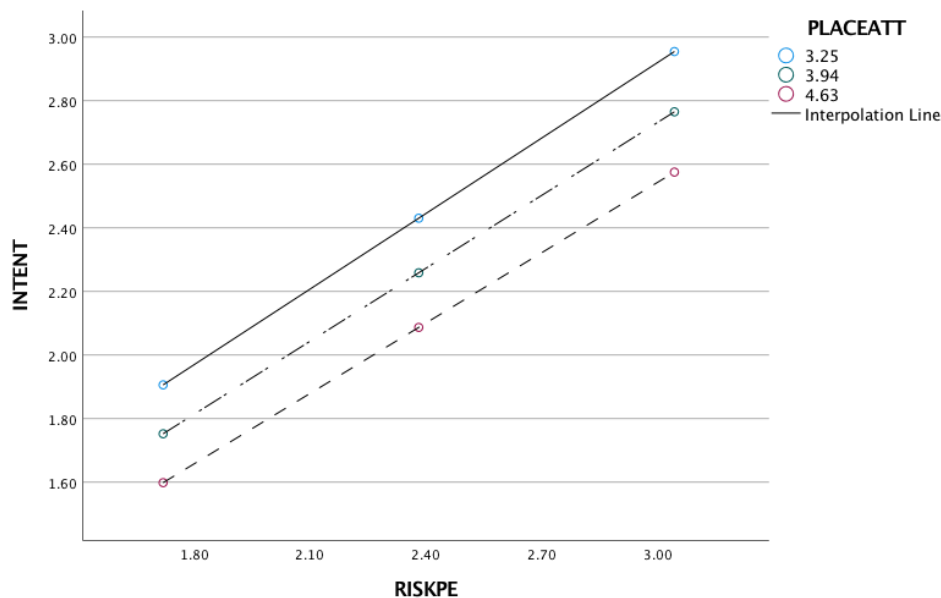


Figure 3. No interaction was found between flood risk perception and place attachment in willingness to invest in protective action.

At last, H4 was tested using PROCESS (Hayes et al., 2022) with model 1 for both subgroups (H4-1 & H4-2).

Participants with experience of flooding, $n = 151$, showed no significant interaction, $b = -.05$, 95% CI $[-.282, .184]$, $t = -.41$, $p = .679$. For low levels of place attachment, $b = .82$, 95% CI $[.570, 1.065]$, $t = 6.52$, $p < .000$. For average levels of place attachment, $b = .78$, 95% CI $[.578, .983]$, $t = 7.63$, $p < .000$. Last, for high levels of place attachment, $b = .74$, 95% CI $[.459, 1.029]$, $t = 5.16$, $p < .000$. A statistical diagram of the selected model is presented in Figure 4. These

results indicate that place attachment did not moderate the relationship between flood risk perception and willingness to invest in protective action for those with experience of flooding (H4-1 was therefore not supported).

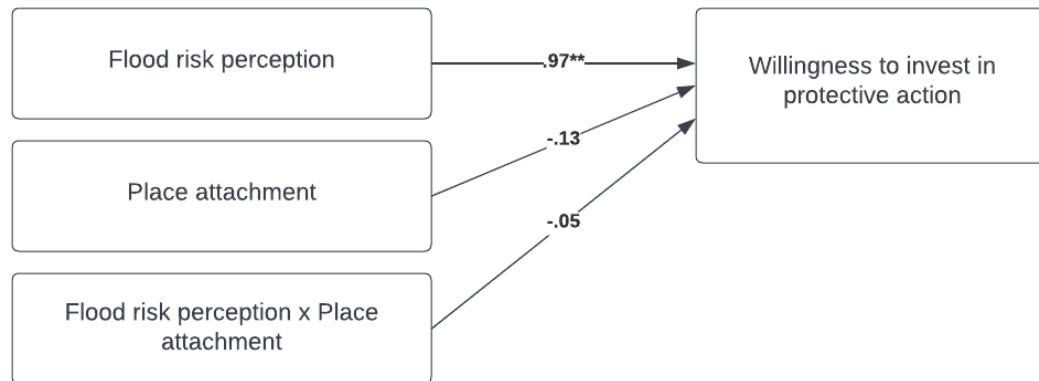


Figure 4. Note. Model for population with experience of flooding (H4-1). ** $p < .05$. Values denote unstandardized coefficients from model 1 in PROCESS (Hayes et al., 2022).

Furthermore, H4-2, $n = 131$, showed no significant interaction, $b = -.00$, 95% [-.443, .438], $t = -.01$, $p = .990$. For low levels of place attachment, $b = .78$, 95% CI [.366, 1.186], $t = 3.75$, $p < .000$. For average levels of place attachment, $b = .77$, 95% CI [.529, 1.020], $t = 6.24$, $p < .000$. For high levels of place attachment, $b = .77$, 95% CI [.459, 1.087], $t = 4.87$, $p < .000$. A statistical diagram of the selected model is presented in Figure 5. Also, for the subgroup without experience of flooding results showed that place attachment did not moderate the relationship between flood risk perception and willingness to invest in protective action. Furthermore, the relationship between risk perception and willingness to invest in protective action were not statistically significant either.

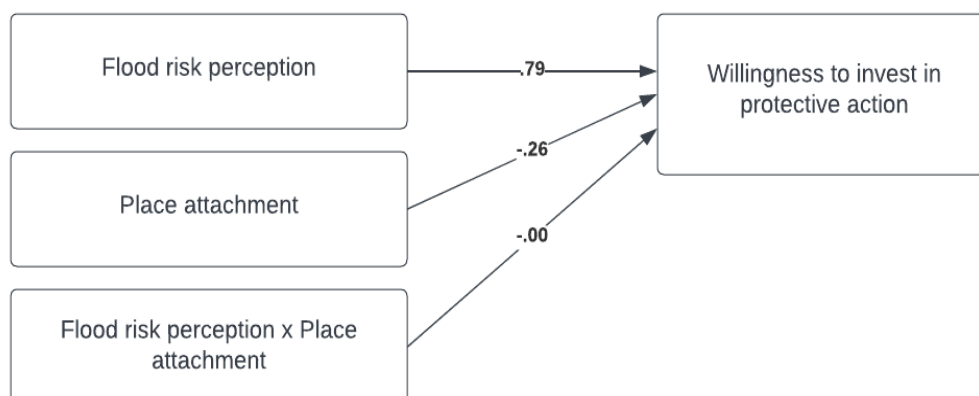


Figure 5. Note. Model for population with no experience of flooding (H4-2). Values denote unstandardized coefficients from model 1 in PROCESS (Hayes et al., 2022).

Discussion

This study aimed to understand the role of place attachment in the relation between flood risk perception and protective behavior concerning the increased risk of flooding (e.g., investing in private flood insurance and consider relocating).

Regarding H1, the predicting role of flood risk perception in the individual's willingness to invest in protective action was supported, in line with previous studies (Miceli et al. 2008; Terpstra & Lindell, 2013). Therefore, in this study, individuals who had a higher flood risk perception showed a stronger willingness to invest in protective actions. This study used a multi-dimensional construct to measure flood risk perception (Wilson et al., 2018). In particular, the affective, consequential, and probabilistic dimensions of risk perception were considered. One way to interpret the relation between flood risk perception and willingness to invest in protective action is that people take precautionary measures to decrease the high perception of flood risk (Baan & Klijn, 2004; Lechowska, 2018). On the other side, Bubeck et al. (2012) conducted a review of studies that investigated this relationship, and findings revealed that the relationship between flood risk perception and mitigation behavior is rarely observed in empirical studies. They, therefore, suggested that the responsibility of action is passed over to someone else (e.g., authorities). Moreover, research by Wachinger et al. (2013) suggests that people who trust public authorities are more likely to take warnings seriously and engage accordingly. Norway tops the list on trustworthiness in comparison to other European countries according to findings from Statistics Norway (SSB, 2016), so this may be one interpretation of the findings but is only speculated. Moreover, it is important to emphasize the conceptual distinction between the intent to act and the adoption of protective measures (Thistlethwaite et al., 2017). In this study, only willingness to invest in protective action was measured, and not actual adoption of protective actions. It can be difficult to see the actual adoption of different safety measures since this demands more resources. One study by Harries (2012) however, found that those who expected to be flooded within one year were four times more likely to intend to act, but only 31% of those adopted some of the safety measures to protect themselves or their properties. Concerning this study, we do not know if the individuals who show high willingness actually will adopt these measures in reality.

Furthermore, H2 was also supported by the analysis. Place attachment was a predictor of willingness to invest in protective action. However, as some of the previous research (Boon,

2014; Bird et al., 2011) have stated, there was a negative relationship. This means, that the stronger the place attachment, the less likely to invest in protective actions, or the weaker the place attachment, the more likely to invest in protective action. One reason why place attachment act as a barrier for protective actions may be optimism bias (Gifford et al., 2009). People tend to judge environmental risks and the impacts of climate change to be more serious and likely for other people than for themselves. Furthermore, Lujala et al. (2015), noted that we have a bias to think that natural hazards are more likely to happen in other places than where we live. Moreover, the findings may vary depending on the type of actions. For example, Zhang et al. (2014) and Kaltenborn (1998) reported a positive association between place attachment and place-protective behavior. They measured behavior as protection of places and other pro-environmental behavior, such as collecting litter. Whereas Boon (2014), and Twigger-Ross and Uzzell's (1996) findings indicated that attached individuals were more unwilling to relocate than less-attached individuals. According to Baan and Klijn (2004), "people find evacuation more troublesome and threatening than the high-water levels in the river" (p. 114), which corresponds to why people will not evacuate or consider relocating to opposing danger. Building upon Bowlby's attachment theory, Scannell and Gifford (2010) suggested that place attachment has several functions, e.g., security and comfort. When opposed to a threat the individual may seek their homes and therefore result in unwillingness to relocate since their internal models perceive their home as safe. Findings from Bernardo (2013) indicated that high-probability risks increase place attachment, and low-probability risks attenuate place attachment, and therefore an individual's intention to enact in protective behavior differs depending on how they perceive the probability of a hazard. Place attachment may therefore both function as a promoter and barrier for enacting preventive behavior.

Despite the support of the two hypotheses, there was no significant effect on the role of place attachment as a moderator when it comes to the relationship between flood risk perception and willingness to invest in protective action. This is in contrast with De Dominics et al. (2015) findings of place attachment as a negative moderator between these two variables, where place attachment reduced the strength of the positive relationship between risk perception and protective behavior for people living in a high-risk context. However, there might be several reasons for finding no moderating effect between risk perception and willingness to invest in protective behavior. De Dominics et al. (2015) measured a specific level of attachment, neighborhood attachment, in the relation between flood risk perception and preventive behavior. This study, however, did not measure a specific form of attachment. The respondents are only asked to think about their local area. This means that the respondents themselves have

to decide if they are thinking about their home, city, or neighborhood when answering the items. Further, thinking about your local area can be perceived quite different for some respondents, e.g., some may think about their local area as to where they grew up if they for example are based in a place that's just a temporary and don't have a strong sense of belonging to their new home, and some may perceive it as the place they live now regardless of how long they have lived there. It's unclear how this might affect the results.

Lastly, both experiences with flooding and no experiences with flooding had no significant effect on the moderating role of place attachment on the relationship between risk perception and willingness to invest in protective action. This is somewhat surprising due to the research on how experience magnifies risk perception (Miceli et al., 2008; Lujala et al., 2013). However, there may be confounding variables that hides the outcome of the analysis. For instance, research points out the severity of individual damage experienced shapes the perception, and therefore low-severity experienced hazards can produce a false sense of security (Miceli et al., 2008). Based on the studies on the theory of attachment (Fearon et al., 2016), it would make sense that when opposed to a threat (here: H4-1) the individual would flee to their home or place that they perceive as safe, and therefore the individual will not consider relocation. This would be an example on how place attachment is dysfunctional when it hinders people from consider future alternatives. Continuing, the crisis effect as cited in Baan and Klijn (2004) is an effect where disaster awareness peaks during and immediately after the occurrence of a hazard, but rapidly dissipate between disasters. Humans are short of memory and after some time our worry decreases and the estimation of risk of flooding is no longer optimal (Baan & Klijn, 2004) and their perception of experience with flooding may therefore vary depending on how long ago they experienced a flood. Moreover, there may be a difference between experience and the perceived impact of the experience. Some individuals who have experienced a flood may not perceive the flood as something dangerous, whereas others who have not experienced flooding may perceive the danger to be greater than those who have experienced it. However, this is only speculation and has to be investigated further to say something more concrete. On the other hand, H4-2 was not supported either by the analysis. The prediction was that the relationship between flood risk perception and willingness to invest in protective behavior would be significant, irrespective of place attachment. The relationship between flood risk perception and willingness to invest in protective action is not significant, which is quite surprising. However, the sample size may be insufficient to detect an effect between the variables. This subgroup consisted of only 131 respondents and may not reach the target effect size that's necessary to detect an effect.

Despite this, the measures used in the study show high reliability. There may exist confounding variables that haven't been identified. As mentioned, risk perception is based on different dimensions that may influence the relationship and moderation between these variables differently. Overall, there may not exist changes in the moderating role of place attachment or the changes are incorrect in the light of what's been hypothesized. To sum up, more research is needed due to the contradictory results in comparison to previous research on the moderator effect of place attachment. Moreover, if null findings represent true findings, they are equally important and valuable contributions.

Strengths and limitations

On a general basis, since this study depends on a cross-sectional design and linear regression analysis no causal inferences can be drawn. As mentioned earlier, the sample used in this study may be more homogenous in composition than would allow for broad generalization. Both because of the network sampling (Meltzoff & Cooper, 2018, p. 70) and because of the self-selected recruitment in Facebook groups and ads on Facebook. Furthermore, the research would gain more insight if there were more respondents than 282. Social desirability may also impact the data material; individuals may want to be perceived as someone prepared and intend to act upon hazards. Lastly, in total, the survey took between 15-20 minutes to finish. The length of the survey may affect the quality of the data (Lavrakas, 2008). However, the sample had a significant geographical variation with people from all regions of Norway, which is beneficial for possible generalization, and a wide range of ages was represented. The instruments used in this study are valid in the context that they have been tested in previous research and show high reliability. In retrospect, instruments that measure specifically dimensions of risk perception and type of attachment should have been utilized. Despite its limitations, the present study has provided insights into a Norwegian sample on flood risk perception, place attachment, and willingness to invest in protective action. This study's findings indicate that flood risk perception is a predictor of a person's willingness to invest in protective action, and the existence of a negative relationship between the variables place attachment and willingness to invest in protective action.

Implications

The knowledge of flood risk perception is important in achieving effective risk communication strategies and flood management (Kellens et al., 2011). Risk communication strategies should be based on affective cues, knowledge, awareness, and information regarding

the findings from this study; and further reduce the common phenomenon of underestimating (e.g., the crisis effect). Furthermore, the influence of place attachment on an individual's willingness to invest in protective actions is important when considering relocation programs. Lujala et al. (2015) suggested making households bear at least partially the cost of living in exposed areas could force better local adaptation. Since the relationship between these three variables shows inconsistent results compared with previous research, it's important to conduct more research. A better understanding of the influence of place attachment on the relationship between flood risk perception and willingness to invest in protective action will find itself necessary to inform risk evacuation, relocation programs in the face of upcoming hazards, and coping interventions (Bonaiuto et al., 2016). We are sure of the increasing risk of natural hazards (IPCC, 2012), so now we need to adapt in response to these changes.

Future research

More research is needed on the dimensions of risk perception and their influence on place attachment, for instance investigating respondents' probability estimates associations to their place attachment. As suggested by Bonaiuto et al. (2016) an interesting perspective for future research is how to guide a person escaping from a risky place to reach a safe location. The focus will instead center around how place attachment can be used to refer individuals to target a safe place. One way to do this is to make places appealing and provide opportunities. Continuing, longitudinal design could also be beneficial for further research in measuring the adoption of protective measures, instead of only intention or willingness to invest in protective behavior. Such designs might help uncover which confounding variables or contextual effects that have an impact on willingness to invest in protective action.

Conclusion

In conclusion, these finding indicate that flood risk perception and place attachment are important factors for individual's willingness to invest in protective behavior. However, place attachment as a moderator for the relationship between flood risk perception and willingness to invest in protective action was not found to be statistically significant, even when controlling for experience with flooding. Results of the present research are important for the implication of risk communication and flood management, e.g., risk evacuation and relocation programs. The limitations of the study include no causal inferences, sample size, and recruitment method. Future studies should investigate how probability estimates is associated with place attachment and target how place attachment can be used to refer individuals to safe places.

References

- Altman, I., & Low, S. M. (2012). *Place Attachment*. Springer Science & Business Media.
- Anton, C. E., & Lawrence, C. (2014). Home is where the heart is: The effect of place of residence on place attachment and community participation. *Journal of Environmental Psychology, 40*, 451–461. <https://doi.org/10.1016/j.jenvp.2014.10.007>
- American Psychological Association. (2020). Publication of manual of the American Psychological Association (7th ed.). <https://doi.org/10.1037/0000165-000>
- Baan, P. J., & Klijn, F. (2004). Flood risk perception and implications for flood risk management in the Netherlands. *International journal of River Basin Management, 2*(2), p. 113-122. DOI: 10.1080/15715124.2004.9635226
- Bernardo, F. (2013). Impact of place attachment on risk perception: Exploring the multidimensionality of risk and its magnitude. *Studies in Psychology, 34*(3), 323–329. <https://doi.org/10.1174/021093913808349253>
- Bihari, M., & Ryan, R. (2012). Influence of social capital on community preparedness for wildfires. *Landscape and Urban Planning, 106*, 253-261.
- Bird, D., Gísladóttir, G., & Dominey-Howes. (2011). Different communities, different perspectives: Issues affecting residents' response to volcanic eruption in southern Iceland. *Bulletin of Volcanology, 73*(9), 1209-1227. DOI: 10.1007/s00445-011-0464-1
- Billig, M. (2006). Is My Home My Castle? Place Attachment, Risk Perception, and Religious Faith. *Environment and Behavior, 38*(2), 248–265. <https://doi.org/10.1177/0013916505277608>
- Bonaiuto, M., De Dominicis, S., Fornara, F., & Cancellieri, U. G., & Mosco, B. (2011). Flood risk: the role of neighbourhood attachment. na.
- Bonaiuto, M., Alves, S., De Dominicis, S., & Petruccioli, I. (2016). Place attachment and natural hazard risk: Research review and agenda. *Journal of Environmental Psychology, 48*, 33–53. <https://doi.org/10.1016/j.jenvp.2016.07.007>
- Boon, H. J. (2014). Disaster resilience in a flood-impacted rural Australian town. *Natural Hazards, 71*(1), 683–701. <https://doi.org/10.1007/s11069-013-0935-0>
- Bowlby, J. (1980). *Attachment and Loss*. Vol. 3: Loss Sadness and Depression. New York: Basic Books.
- Bubeck, P., Botzen, W. J. W., & Aerts, J. C. J. H. (2012). A review of Risk Perceptions and Other Factors that Influence Flood Mitigation Behavior. *Risk Analysis, 32*(9), 1481-1495. <https://doi.org/10.1111/j.1539-6924.2011.01783.x>

- Cha, E-S., Kim K. H., & Erlen, J. A. (2007). Translation of scales in cross-cultural research: issues and techniques. *J Adv Nurs*, 58(4), 386-395. DOI: 10.1111/j.1365-2648.2007.04242.x
- Førland, E., Amundsen, H., & Hovelsrud, G. K. (2007). Utviklingen av naturulykker som følge av klimaendringer. (CICERO Report 03). *Center for International Climate and Environmental Research*. https://pub.cicero.oslo.no/cicero-xmlui/bitstream/handle/11250/191982/CICERO_Report_2007-03.pdf?sequence=1&isAllowed=y
- 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. <https://doi.org/10.1016/j.jenvp.2015.05.010>
- Fearon, R. M. P., Groh, A. M., Bakermans-Kranenburg, M. J., van Ijzendoorn, M. H., & Roisman, G. I. (2016). Attachment and developmental psychopathology. In D. Chicchetti (Ed.), *Developmental psychopathology: Theory and method*, 325-360. Hoboken, NJ: Wiley.
- Gifford, R., Scannell, L., Kormos, C., Smolova, L., Biel, A., Boncu, S., Corral, V., Hartmut, G., Hanyu, K., Hine, D., Kaiser, F. G., Korpela, K., Lima, L. M., Mertig, A. G., Mira, R. G., Moser, G., Passafaro, P., Pinheiro, J. Q., Saini, S., Sako, T., Sautkina, E., Savina, Y., Schmuck, P., Schultz, W., Sobeck, K., Sundblad, E-L., & Uzzell, D. (2009). Temporal pessimism and spatial optimism in environmental assessments: An 18-nation study. *Journal of Environmental Psychology*, 29(1), 1-12. <https://doi.org/10.1016/j.jenvp.2008.06.001>
- Harries, T. (2012). The Anticipated Emotional Consequences of Adaptive Behavior – Impacts on the Take-up of Household Flood-Protection Measures. *Environment and Planning A: Economy and Space*, 44(3), 649.668. DOI: 10.1068/a43612
- Hayes, A. F. (Edi.). (2022). *Introduction to Mediation, Moderation, and Conditional Process Analysis* (3rd. Ed.). New York: Guildford Press.
- IPCC. (2022). *Climate Change 2022: Impacts, Adaptation, and Vulnerability*. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press. In Press. p. 35. [https://report.ipcc.ch/ar6wg2/pdf/IPCC_AR6_WGII_FinalDraft_FullReport.pdf]

- IPCC. (2012). *Managing the risks of extreme events and disasters to advance climate change adaptation*. A special report of working groups I and II of the intergovernmental panel on climate change [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, UK, and New York, NY, USA, 582 pp. [https://www.ipcc.ch/site/assets/uploads/2018/03/SREX_Full_Report-1.pdf]
- Kaltenborn, B. P., & Bjerke, T. (2002). Associations between Landscape Preferences and Place Attachment: A study in Røros, Southern Norway. *Landscape Research*, 27(4), 381-396. DOI: 10.1080/0142639022000023943
- Kellens, W., Zaalberg, R., Neutens, T., Vanneuville, W. & De Maeyer, P. (2011). Perception and communication of flood risks: A literature review. *Risk Anal*, 22 (1), 24-49.
- Lavrakas, P. J. (2008). Questionnaire Length. *Encyclopedia of Survey Research Methods* (1). DOI: 10.4135/9781412963947
- Lechowska, E. (2018). What determines flood risk perception? A review of factors of flood risk perception and relations between its basic elements. *Natural Hazards*, 94, 1341-1366. <https://doi.org/10.1007/s11069-018-3480-z>
- Lujala, P., Lein, H., & Rød, J. K. (2015). Climate change, natural hazards, and risk perception: The role of proximity and personal experience. *Local Environment*, 20(4), 489–509. <https://doi.org/10.1080/13549839.2014.887666>
- Meltzoff, J., & Cooper, H. (2018). *Critical thinking about research: Psychology and related fields* (2. ed.). American Psychological Association.
- Miceli, R., Sotgiu, I., & Settanni, M. (2008). Disaster preparedness and perception of flood risk: A study in an alpine valley in Italy. *Journal of Environmental Psychology*, 28(2), 164-173. <https://doi.org/10.1016/j.jenvp.2007.10.006>
- Morgan, P. (2010). Towards a Developmental Theory of Place Attachment. *Journal of Environmental Psychology*, 30, 11–22. <https://doi.org/10.1016/j.jenvp.2009.07.001>
- 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>
- Seebauer, S., & Babicky, P. (2018). Trust and the communication of flood risks: comparing the roles of local government, volunteers in emergency services, and neighbours. *Journal of Flood Risk Management*, 11(3), 305-318. <https://doi.org/10.1111/jfr3.12313>

- Slovic, P. (1987). Perception of Risk. *Science*, 236, 280–285.
<https://doi.org/10.1126/science.3563507>
- Statistisk Sentralbyrå. (2016). Nordmenn på tillitstoppen I Europa, 16th of June. Read 5th of May 2022: <https://www.ssb.no/kultur-og-fritid/artikler-og-publikasjoner/nordmenn-pa-tillitstoppen-i-europa>
- Swapan, M. S. H., & Sadeque, S. (2021). Place attachment in natural hazard-prone areas and decision to relocate: Research review and agenda for developing countries. *International Journal of Disaster Risk Reduction*, 52.
<https://doi.org/10.1016/j.ijdr.2020.101937>
- Tartaglia, S. (2013). Different Predictors of Quality of Life in Urban Environment. *Social Indicators Research*, 113(3), 1045–1053. <https://doi.org/10.1007/s11205-012-0126-5>
- Terpstra, T., & Lindell, M. K. (2013). Citizens' Perceptions of Flood Hazard Adjustments: An Application of the Protective Action Decision Model. *Environment and Behavior*, 45(8), 993-1018. <https://doi.org/10.1177/0013916512452427>
- Thistlethwaite, J., Henstra, D., Brown, C., & Scott, D. (2017). How Flood Experience and Risk Perception Influences Protective Actions and Behaviours among Canadian Homeowners. *Environmental Management*, 61(3-4), 1-12. DOI: 10.1007/s00267-017-0969-2
- Wachinger, G., Renn, O., Begg, C., & Kuhlicke, C. (2013). The risk perception paradox – implications for governance and communication of natural hazards. *Risk Anal*, 33(6), 1049-1065. DOI: 10.1111/j.1539-6924.2012.01942.x
- Wilson, R. S., Zwickle, A., & Walpole, H. (2018). Developing a Broadly Applicable Measure of Risk Perception. *An International Journal of Risk Analysis*, 39(4), 777-791.
<https://doi.org/10.1111/risa.13207>

Appendix A.

Willingness to invest in protective action (Seebauer & Babczyk, 2018).

Indicate how likely you are to implement the following preventive measures.

(5 point Likert scale – From very unlikely to very likely)

I intend to move valuable items on a upper level in the house

I intend to prepare my home for floods.

I intend to prepare an emergency plan for all household members.

I intend to purchase a private flood insurance.

I am willing to consider relocation (ex novo).

I am willing to coordinate with neighbors (e.g., joint emergency plan, joint structural measures).

I am interested in receiving more information about the flood danger in my local environment.

Flood risk perception (Wilson, Zwickle & Walpole, 2018).

Indicate to what extent you agree with the following statements.

(5 point Likert scale – From not at all to very much)

When you think about floods, to what extent do you feel worried? (affect)

When you think about floods, to what extent do you feel anxious? (affect)

If you did experience a flood, would it have a severe effect on you personally? (severity)

How risky are floods? (general)

How likely is it that a flood will occur where you live? (probability)

If I did experience a flood, it is likely that it would negatively impact me? (severity)

I am confident that a flood will not occur where I live. (probability) (*reverse*)

When you think about floods, to what extent do you feel fearful? (affect)

Place attachment (Kaltenborn & Bjerke, 2002).

Thinking of your local area, indicate to what extent you agree with the following statements

(5 point Likert scale – From strongly disagree to strongly agree)

I feel a sense of emotional attachment to this place.

This area feels like a part of me.

I identify strongly with this area.

I enjoy living here more than I would other places in this country.

The area is important for me because of my lifestyle.

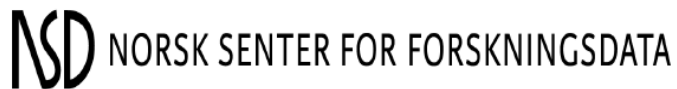
It feels meaningful to live here.

I feel safe and secure here. (perceived safety)

Appendix B.

27/05/2021

Meldeskjema for behandling av personopplysninger

**NSD's assessment****Project title**

What does it take to invest in protective actions? Predictors and barriers of climate change adaptation. A focus on the effects of flooding experiences in Norway

Reference number

564981

Registered

22.02.2021 av Amanda Elizabeth Lai - amanda.lai@ntnu.no

Data controller (institution responsible for the project)

Norges teknisk-naturvitenskapelige universitet / Fakultet for samfunns- og utdanningsvitenskap (SU) / Institutt for psykologi

Project leader (academic employee/supervisor or PhD candidate)

Amanda Elizabeth Lai, amanda.lai@ntnu.no, tlf: 40758436

Type of project

Student project, Master's thesis

Contact information, student

Majen Christine Bjerke, majenbc@stud.ntnu.no, tlf: 46854653

Project period

01.03.2021 - 31.12.2022

Status

10.03.2021 - Assessed anonymous

Assessment (1)**10.03.2021 - Assessed anonymous**

It is our assessment that this project will not process data that can directly or indirectly identify individual persons, so long as it is carried out in accordance with what is documented in the Notification Form and attachments, dated 10.03.2021, as well as in correspondence with NSD. As a result, the project does not need an assessment from NSD.

WHAT DO YOU NEED TO DO IF YOU ARE GOING TO PROCESS PERSONAL DATA?

If the project is changed in such a way that you will process personal data, you will need to notify this to NSD by updating the Notification Form. Wait for a reply before you start processing personal data.]

27/05/2021

Meldeskjema for behandling av personopplysninger

END OF FOLLOW-UP

As the project will not be processing personal data, we end all further follow-up of the project.

Good luck with your project!

Contact person at NSD: Tore Andre Kjetland Fjeldsbo
Data Protection Services for Research: +47 55 58 21 17 (press 1)

