Move out or dig in? Risk awareness and mobility plans in disaster-affected communities

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Abstract
Post-disaster migration patterns have been thoroughly studied from a demographic standpoint, but affected community residents’ perceptions of ongoing risks and their willingness to remain in an affected community remain under-researched. Using data generated by 407 surveys and 40 interviews with residents impacted by the 2013 Calgary flood, this study analyses the effects of flood experience on residents’ worry about future floods and their ensuing short-term and medium-term mobility plans. The results indicate that home flooding and evacuation orders are both predictive of worry about future floods. In turn, worry about future floods as well as age, homeownership, and place attachment are all predictive of post-disaster mobility plans. Residents discuss how the flood either strengthened or weakened their place attachment. The paper concludes by discussing the implications for social science research and for public policy that aims to mitigate disaster risk.

KEYWORDS
disaster, migration, place attachment, risk awareness

1 | INTRODUCTION

Fifty years of disaster social science have produced a sizeable body of knowledge on pre-disaster risk perceptions and household-level risk mitigation activities, people’s evacuation and displacement experiences, and macro-level demographic trends affecting post-disaster communities. Currently, researchers are expanding their understanding of disaster recovery. However, insight into how disaster-affected communities prepare for future catastrophic events is still needed. The most prominent lacuna is the question of whether experiencing a disaster increases future risk perception and, importantly, how this heightened risk perception translates into longer-term mobility plans. This article seeks to understand what factors increase flood-affected residents’ worry about future flooding and what factors encourage residents to consider relocating in order to mitigate the risk. Although these questions have been addressed by demographic research at the community and neighbourhood level, they have rarely been examined at the individual and household levels. Especially uncommon is a focus on wealthy urban areas, where residents’ migration decisions are expected to be based not only upon immediate subsistence needs, but also on non-economic and non-material factors.

The present study addresses this gap through the use of innovative mixed-method data, including both a representative survey and qualitative interviews, allowing for both context and depth, collected after the costliest disaster in Canadian history, the 2013 Southern Alberta flood. This mixed-method design provides an understanding of which disaster-affected residents intend to remain and which intend to move, as well as why and how they make their respective decisions. The analysis reveals not only the covariates and predictors of risk perception and mobility plans, but also the indicators of how residents’ worry over future flooding transforms into mobility plans.

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2 | THE SOUTHERN ALBERTA FLOOD

In June 2013, the normally arid province of Alberta experienced record-breaking rainfall of up to 8 inches in 36 hr, which caused the Bow and the Elbow, two of the province’s largest rivers, to overtop their banks. This triggered an unprecedented catastrophic flooding in Southern Alberta, where 32 states of local emergency were declared and the Canadian Armed Forces were deployed to help evacuate 175,000 people, making the event one of the largest evacuations in Canadian history. In Calgary, more than 80,000 people evacuated and the flood caused more than $5 billion in declared damages. The Insurance Bureau of Canada subsequently dubbed the flood the costliest disaster in Canadian history (CBC, 2013). Though Southern Alberta has flooded many times, those under 60 years of age only experienced one previous large flood in 2005, allowing the 2013 flood to catch many residents off-guard (Pomeroy, Stewart, & Whitfield, 2016; Sandford & Freek, 2014).

3 | LITERATURE REVIEW

Researchers have long argued that migration decisions are affected by environmental factors and risk perceptions (Hunter, 2005), as well as by a variety of structural, economic, political, and highly subjective emotional factors (Massey, 1999). As Hunter, Luna, and Norton (2015) point out, migration research has advanced beyond the simplistic push/pull explanations of migration to encompass “a greater integration of context, including micro-level, meso-level, and macro-level interactions” (377). An emerging area of research, they argue, focuses on “how amenity and quality-of-life factors shape relocation decisions among relatively affluent and privileged populations” (387).

The existing work on decision-making in the context of a disaster tends to examine how households make risk-management (Peacock, Brody, & Highfield, 2005; Taylor, Priest, Sisco, Banning, & Campbell, 2009) and evacuation decisions (Bateman & Edwards, 2002; Bowser & Cutter, 2015). In particular, we know much about risk awareness, worry, and how those factors translate into preparedness. First, we know that a host of demographic variables are predictive of flood risk awareness including age (Lazo, Bostrom, Morss, Demuth, & Lazrus, 2015), income or social class (Burningham, Fielding, & Thrush, 2008), and education (Karanci, Aksit, & Dirik, 2005), as are actual objective levels of flood risk (Kellens, Zaalberg, Neutens, Vanneuville, & De Maeyer, 2011; O’Neill, Brereton, Shahumyan, & Clinch, 2016; Wallace, Poole, & Horney, 2016). Second, we know that experience in prior events is a robust and important predictor of risk awareness (Burningham et al., 2008) and of protective action, such as evacuation (Paul, Stimers, & Caldas, 2015). On the one hand, prior experience provides knowledge which should be positively related to awareness of ongoing risk (Scolobig, De Marchi, & Borga, 2012). But on the other hand, research indicates that this awareness often does not translate into worry or preparedness (Hopkins & Warburton, 2015; Knocke & Kolivas, 2007), owing in large part to the role of emotions as an influencer of understandings and responses to risk (Bubeck, Botzen, & Aerts, 2012), although a few studies have shown that past experience does lead to greater concern (Thistlethwaite, Henstra, Brown, & Scott, 2017). When it occurs, the failure to translate experience and awareness into concern happens because individuals misunderstand the possible consequences of a flood event and cannot properly envision how it will unfold (Siegrist & Gutscher, 2008). Third, we also know that social capital and place-based social networks are predictive of risk awareness (Aldrich & Meyer, 2015), preparedness (Levac, Toal-Sullivan, & O’Sullivan, 2012; Poussin, Botzen, & Aerts, 2014), and of the willingness and ability to evacuate in advance of a flood event (Buckland & Rahman, 1999; Litt, 2008). With all this said, research in Canada indicates that residents in flood-prone areas have surprisingly low overall levels of risk awareness (Thistlethwaite et al., 2017; Thistlewaite, Henstra, Peddle, & Scott, 2017). But how does this lack of awareness prior to disasters translate into risk awareness and mobility decisions following a flood?

Existing work provides useful insight into how households balance risk-related decisions with their financial resources (Elder et al., 2007), considerations about protecting their property investments (Riad, Norris, & Ruback, 1999), and concerns about family togetherness (Haney, Elliott, & Fussell, 2007; Litt, 2008), but again, it is mostly based on pre-disaster or pre-evacuation surveys of or interviews with at-risk residents. Research on how the already-affected residents make longer-term mobility decisions is missing, although this approach would echo Hunter et al.’s (2015) call for more understanding of the temporal complexities of the environmental migration process (391).

Many analyses of post-disaster migration take an explicitly demographic perspective, analysing how patterns of destruction intersect with local demographics to trigger various types of in-and-out-migration. For instance, Elliott and Pais (2010) demonstrate that longer-term recovery displaces socially disadvantaged residents (see also Schultz & Elliott, 2013) and racial and ethnic minorities from the most impacted areas (Elliott, 2015). It has also been established that post-disaster out-migration is impacted by several macro-level variables, including the degree of house damage, housing density, and larger populations of disadvantaged residents (Collenteur, de Moel, Jongman, & Di Baldassarre, 2015; Myers, Slack, & Singelmann, 2008). In terms of new residents’ in-migration, Fussell, Sastry, and Vanlandingham (2010) demonstrate that racial and ethnic inequalities influence these patterns, as in the case of post-Katrina New Orleans.

Largely missing from the existing demographic work, however, are household-level analyses of individual decision-making in the aftermath of a disaster. Some research provides a theoretical framework for understanding how vulnerable people make migration decisions in the face of environmental change, examining such factors as the state of the environment and individuals’ coping capacities (Reynaud et al., 2013). For instance, one study finds that, despite the inherently emotional nature of disasters, residents employ a rational-actor, cost-benefit framework when deciding whether to return.
to an affected region. For many of these affected residents, disaster transforms a physical structure from a “home” into a “house,” decreasing emotional investment in the dwelling (Henry, 2013). Along those lines, Koslov (2016) demonstrates how Staten Island residents affected by Hurricane Sandy made a case for official buyout programmes, an approach called “managed retreat.” Asad (2015), on the other hand, finds that economic concerns alone cannot explain post-disaster return decisions as many displaced residents return even if that entails paying an economic price. In other words, place attachment may trump—or at least compete with—purely economic concerns for many residents making post-disaster mobility decisions. In broad strokes, experiencing one disaster has a tangible, long-term impact on individual assessment of future risk and disasters. For instance, Siegel, Shoaf, Afifi, and Bourque (2003) find that, irrespective of the degree of property damage, those who have experienced emotional injury from a prior disaster feel more impacted by a second disaster than otherwise similar people without such prior experience.

When we move beyond rational-actor models, research demonstrates that place attachment can explain how people understand and engage with climate change (Scannell & Gifford, 2013). In the post-disaster context, Morrice (2013) highlights a “powerful emotional quality associated with how people relate to place, recognizing that return decisions are emotionally driven and not necessarily based on material constraints” (33). This is particularly true for homeowners who report a larger social and emotional place connection than renters (Windsong, 2010). Additionally, such factors as political trust (Reinhardt, 2015), emotion and nostalgia (Morrice, 2013), and connection to place (Landry, Bin, Hindsley, Whitehead, & Wilson, 2007) also play a role in return decision-making by encouraging return migration. Still, just as most work in the field, these studies rely upon the analyses of displaced evacuees’ return decisions rather than on returned residents’ longer-term mobility decisions. Thus, while disaster-affected residents often experience reinvigorated place attachment, even when economic and political pressures prevent them from returning and rebuilding (Chamlee-Wright & Storr, 2009), very few studies look at residents who have already returned and are making subsequent decisions about longer-term mobility. One notable exception is Adams’ (2016) work which demonstrates that non-migration after a disaster is related to “high levels of satisfaction, resource, barriers and low mobility potential” (429).

An emergent area of inquiry involves decision-making in the wake of government-sponsored buyout programmes. One compelling finding is that community-level resilience and social capital appear to temper residents’ willingness to accept buyout offers and relocate (Binder, Baker, & Barile, 2015). However, like most extant work, this research draws upon interviews with evacuees, assuming that evacuated residents choose to either return or relocate, and ignoring the residents who return only to begin making plans for longer-term relocation to less vulnerable places. As a result, little is known about how different disaster experiences, for example, home flooding or prolonged evacuation, affect urban residents’ future orientations, which are expected to impact residents’ decision to stay or to relocate following a catastrophic event. One exception to this knowledge gap is the study of the effects of Hurricane Katrina by Myers et al. (2008), who find that the degree of house damage is predictive of eventual relocation.

Researchers and policymakers are divided as to whether officials should encourage displaced residents’ return migration. The debate hinges on whether displacement is a long-term, secondary disaster, or a propitious opportunity to move residents from physically vulnerable places (Fernando, Warner, & Birkmann, 2010; see also Graif, 2015). In the Alberta context, while the Institute for Catastrophic Loss Reduction argues that the government should encourage more out-migration from vulnerable places (Kovacs & Sandink, 2013), such a move would be hindered by Calgary’s substantial oil wealth, since wealthier locales, which can often afford to fund their own recoveries, typically see less out-migration after a disaster (Cross, 2014).

If we hope to advance ongoing debates about whether long-term mobility mitigates risks or destroys an established community, it is important to determine what factors influence residents’ plans to leave. The understanding of longer-term mobility plans is particularly important as disaster-affected residents try to re-establish a sense of normalcy, often called “ontological security” (Hawkins & Maurer, 2011) or a “new normal” (Gotham, Blum, & Campanella, 2014: Tierney, 2013), a state that Turner (1976) calls “a stage of culture readjustment... in which prolonged analyses are not undertaken, but only the minimal recognition of changed circumstances necessary to deal with the immediately pressing problems” inherent in the post-disaster milieu (763; see also Dynes, 1993). Research on Florida’s Hurricane Andrew indicates that residential relocation is associated with higher levels of medium-term stress, isolation and social disruption (Riad & Norris, 1996), and increased economic hardship (Hori & Schafer, 2010). The importance of these relocation decisions is intensified in a neoliberal state, where the responsibility for recovery is “placed on the shoulders of neighbourhoods and citizens, without providing them the means to achieve their goals” (Kroll-Smith, Baxter, & Jenkins, 2015, 101).

If municipalities hope to retain the affected residents and attract new in-migrants, we should first examine how households and families make migration decisions after a disaster. This knowledge can help social scientists to better understand how disaster-affected residents translate risk awareness into concrete mobility plans and to create a more empirically informed theory of social action and practice in the post-disaster setting. Given the literature in the field, this article hypothesizes that:

1. Having one’s home flood and evacuating will be positively associated with worry about future flooding;
2. More worry about future flooding will be associated with less intention to remain in residents’ pre-flood neighbourhoods;
3. Place attachment will figure at least as prominently as flood impact and economic circumstances in residents’ post-disaster mobility plans;
4. Residents planning to remain will experience an enhanced attachment to their neighbourhoods, rationalizing their decisions to stay
by either the low likelihood of a future flood or the structural mitigation activities believed to make their neighbourhoods safer.

4 | DATA AND METHODS

The data used in the following analyses are derived from a survey of 407 Calgary residents living in the city's 26 flooded and/or evacuated neighbourhoods, as well as qualitative interviews with 40 flood-affected residents. In May 2014, our research team randomly selected 1,500 households from these 26 neighbourhoods for the survey, proportionally to each neighbourhood's population. The households were selected by first numbering each block within each of the 26 neighbourhoods, then numbering each house or apartment, including all four sides of a block, and finally using a random number generator to select the required number of households on each block. For example, if 50 households had to be selected from a 25-block neighbourhood to maintain representativeness, two households per block were selected. Thus, each household in the neighbourhood had an equal chance of inclusion in the final sample, and each neighbourhood was proportionally represented.

After the sampling was complete, a survey, along with an information sheet and an envelope with return postage, was mailed to each selected household. The participants were also given a form allowing them to claim a $25 gift card to RONA, a Canadian-owned home improvement chain, as a token of appreciation for their participation. The survey contained more than 100 items, including demographic information about household members. Ninety-six envelopes came back marked "return to sender," which is very common in disaster-affected areas where residents are no longer living in the house, the house is slated for demolition, or current construction is underway (Haney & Elliott, 2013). Therefore, I assume that 1,404 surveys were received by the residents, though this is surely a high-end estimate. It is likely that many envelopes reached vacant homes or apartments, but were never officially returned to sender. As a matter of fact, a few surveys were returned as undeliverable even 2 years after the initial mailing.

In June 2014, the research team began visiting the sampled households on-foot, asking residents to participate. Many residents of the sampled households completed the survey upon these visits, substantially increasing the response rate. On-the-ground data collection finished in late September 2014, yielding 407 surveys and a response rate of 25.9% according to the American Association of Public Opinion Research online calculator (AAPOR, 2016). This response rate is typical for samples drawn in disaster-affected areas, due to the challenges of surveying a displaced, residentially unstable, or returning population (Barron Ausbrooks, Barrett, & Martinez-Cosio, 2009; Haney & Elliott, 2013; Henderson et al., 2009).

The logistic models below regress several dependent variables related to post-disaster flood worry and future mobility plans on a host of independent variables. The models use demographic variables including age (and age-squared), race/ethnicity (1 = White; 0 = Not white), female (1 = Yes; 0 = No), marital status (1 = Married; 0 = Not married), parenthood (1 = Parent; 0 = Not a parent), and whether the participant has a Bachelor's degree or higher (1 = Yes; 0 = No). The models also include two dummy variables for income, with an excluded reference category. The original survey used 20 ordinal categories for household income, with each category representing a $10,000 increment: $0–9,999 coded as 0, $10,000–19,999 coded as 1, and above $200,000, which is the highest category, top-coded as 20. Since only 86% of participants provided a valid income, the income variable was imputed by the multiple imputation command available in Stata (“impute”).1 This variable was then recoded into dummy variables representing income tertiles, including $0–89,999 (the lowest income tertile), $90,000–129,999 (middle-income) and above $130,000 (the highest income tertile). The "high" and "low" variables are included in the regression models, and "middle" is excluded as the reference category. To measure pre-disaster connectedness to community, the models include variables for home ownership (1 = Yes; 0 = No), years lived in the current home, the number of neighbours known by name, whether the respondent considers themselves active in their neighbourhood (1 = Yes; 0 = No)2, whether the respondent was strongly attached to their neighbourhood prior to the flood (1 = Yes; 0 = No), and whether they considered their neighbourhood to be an excellent place to live prior to the flood (1 = Yes; 0 = No). To measure flood experience, the models include variables for home flooding (1 = Yes; 0 = No), being ordered to evacuate (1 = Yes; 0 = No), and the number of days in evacuation (0 for "never evacuated"). Finally, the models use simple dichotomous measures for respondents' beliefs about the likelihood of such events as the 2013 flood becoming more common in the future (1 = Yes; 0 = No). Table 3, which models mobility plans, also utilizes independent variables measuring the respondents' worry about future floods affecting the Calgary and their neighbourhood (1 = Yes; 0 = No). Table 1 includes the descriptive statistics and metrics for all the variables used in the models.

Using data from the City of Calgary's Community Profiles (City of Calgary, 2015), which are derived from 2011 Canadian census data, I calculated descriptive statistics for the population of residents living in these neighbourhoods. I will briefly compare them to the sample data provided in Table 1. As an example of the sample's representativeness, 66.43% of residents in the neighbourhoods used for the study have a bachelor's degree or higher, while 63% of the sample holds a bachelor's degree or higher, meaning that the sample is highly representative of the neighbourhood population in terms of educational attainment. The mean age of participants in the sample is 48 years old, compared to 39 years old in the river communities as a whole. While that appears like an oversampling of older residents, it is important to remember that the census data contain children, whereas the survey excluded children. Thus, the 8 year difference between the sample and population means likely reflects the decision to exclude children. Higher income residents are oversampled; the median household income in the 26 affected

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communities was $83,645 at the 2011 census, yet the median income in the sample was between $100,000 and $109,999. The survey also contains a disproportionate number of women (65% of the sample compared to 50% of the neighbourhood population). In short, there is an overrepresentation of both women and higher earning residents, a common finding in research done in post-disaster communities. Haney and Elliott (2013) suggest this occurs because of the comparatively easier time wealthier residents have returning after a disaster and, therefore, receiving the invitation to participate.

To augment the regression results, the article utilizes qualitative data gleaned from 40 in-depth interviews with the affected residents, whose names have been changed to ensure confidentiality. I recruited participants through the community associations in the 26 flood-affected neighbourhoods. All community associations were sent an email describing the interview, and giving the criteria for inclusion (must have been an adult neighbourhood resident at the time of the flood and must be affected by the flood in some way). The neighbourhood associations then distributed the call to their members, posted it in their community halls, and otherwise disseminated recruitment information. Interested residents contacted me via phone or email. Most of the 40 participants understood “flood affected” to mean that their home flooded. As a result, 39 out of the 40 interview participants had flooded homes.

| Dependent variables | Min | Max | Valid N | Mean | SD |
|---------------------|-----|-----|---------|------|----|
| Worried about neighbourhood | 0 = No | 1 = Yes | 406 | 0.495 | – |
| Worried about Calgary | 0 = No | 1 = Yes | 405 | 0.731 | – |
| Plan to remain 1 year | 0 = No | 1 = Yes | 407 | 0.820 | – |
| Plan to remain 5 years | 0 = No | 1 = Yes | 407 | 0.555 | – |

| Demographics | Min | Max | Valid N | Mean | SD |
|---------------|-----|-----|---------|------|----|
| Age | 18 | 99 | 399 | 47.81 | 16.02 |
| White | 0 = No | 1 = Yes | 398 | 0.905 | – |
| Female | 0 = Male | 1 = Female | 401 | 0.648 | – |
| Married | 0 = No | 1 = Yes | 400 | 0.560 | – |
| Parent | 0 = No | 1 = Yes | 407 | 0.253 | – |
| Bachelor's or higher | 0 = No | 1 = Yes | 407 | 0.631 | – |
| Income | 0 = $0–9,999 | 20 = $200,000+ | 348 | 10.63 | 6.32 |
| Low ($0 to $80,999) | 0 = No | 1 = Yes | 407 | 0.3833 | – |
| High ($130,000 and higher) | 0 = No | 1 = Yes | 407 | 0.3415 | – |
| Homeowner | 0 = No | 1 = Yes | 407 | 0.754 | – |
| Years in home | 0 | 50 | 403 | 11.66 | 11.27 |

| Flood experience | Min | Max | Valid N | Mean | SD |
|-----------------|-----|-----|---------|------|----|
| Flooded in 2013 | 0 = No | 1 = Yes | 405 | 0.230 | – |
| Ordered to evacuate | 0 = No | 1 = Yes | 404 | 0.740 | – |
| Evacuation in days | 0 | 396 | 403 | 12.26 | 47.89 |

| Place attachment | Min | Max | Valid N | Mean | SD |
|-----------------|-----|-----|---------|------|----|
| Active in Neighbourhood pre-flood | 0 = No | 1 = Yes | 407 | 0.241 | – |
| Attached to Neighbourhood pre-flood | 0 = No | 1 = Yes | 407 | 0.676 | – |
| Neighbourhood is excellent place to live | 0 = No | 1 = Yes | 406 | 0.732 | – |
| # of Neighbours Known | 0 | 100 | 396 | 11.67 | 14.17 |

| Future risk | Min | Max | Valid N | Mean | SD |
|-------------|-----|-----|---------|------|----|
| Floods more common in future | 0 = No | 1 = Yes | 405 | 0.403 | – |

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A member of the research team then met the participant at a local café, coffee shop, community centre, or library to conduct the interview. With consent, interviews were tape-recorded and then transcribed verbatim. Lastly, they were thematically coded in NVivo by two independent coders to allow for inter-coder reliability. The interviews took place in the Fall of 2015, about 2 years after the flood and about a year after the survey completion, and lasted for approximately 90 min. They focused on the participants’ neighbourhood dynamics, their flood experiences, environmental and political views, and longer-term mobility plans. To thank the participants, we offered them a $50 RONA gift card.

5 | FINDINGS

5.1 | Risk perception and worry

Presumably, experiencing a disaster encourages residents to think more critically about environmental and climate-related issues, particularly whether climate change will translate into more events like the 2013 flood. To determine who is most likely to worry about these issues, the following table presents two logistic regression models, measuring whether participants worry about future events like the 2013 flood affecting (a) their neighbourhood and (b) the city of Calgary. Overall, half of the sample (49.5%) report feeling worried about future floods affecting their neighbourhoods, while most (73%) worry about future floods affecting Calgary.

Table 2 provides results from logistic regression models of these two variables. In the first model, women are 83% more likely to worry about future floods affecting their neighbourhoods than men (odds ratio = 1.831). This finding is consistent with the extant eco-feminist research indicating that women perceive more vulnerability to natural hazards than men (Boudet et al., 2014; Marshall, 2004; see also Nagel, 2015).

Table 2 provides results from logistic regression models of future flood concern.

| Dependent variable | Worried about neighbourhood | Worried about calgary |
|--------------------|----------------------------|-----------------------|
|                    | b  | SE(b) | Exp(b) | b  | SE(b) | Exp(b) |
| Age                | 0.026 | 0.052 | 1.026 | −0.026 | 0.053 | 0.974 |
| Age^2              | −0.000 | 0.000 | 0.999 | 0.000 | 0.001 | 1.000 |
| White              | −0.194 | 0.431 | 0.823 | 0.181 | 0.445 | 1.199 |
| Female             | 0.605** | 0.257 | 1.831 | 0.487* | 0.266 | 1.627 |
| Married            | 0.339 | 0.294 | 1.404 | −0.089 | 0.307 | 0.915 |
| Parent             | −0.363 | 0.315 | 0.696 | 0.031 | 0.338 | 1.031 |
| Bachelor’s or higher | 0.041 | 0.271 | 1.043 | 0.246 | 0.282 | 1.280 |
| High income        | −0.677** | 0.332 | 0.508 | −0.575 | 0.366 | 0.562 |
| Low income         | −0.781** | 0.339 | 0.458 | −0.802** | 0.367 | 0.448 |
| Homeowner          | −0.333 | 0.352 | 0.717 | −0.319 | 0.386 | 0.727 |
| Years in home      | −0.015 | 0.017 | 0.985 | −0.005 | 0.017 | 0.995 |
| # Neighbours known | 0.011 | 0.011 | 1.011 | 0.003 | 0.012 | 1.003 |
| Flooded            | 1.72*** | 0.366 | 5.594 | 0.221 | 0.363 | 1.248 |
| Asked to evacuate  | 0.518* | 0.288 | 1.680 | −0.059 | 0.304 | 0.943 |
| Days evacuated     | 0.004 | 0.004 | 1.011 | 0.003 | 0.003 | 1.003 |
| Active in          | −0.526 | 0.323 | 0.591 | 0.349 | 0.342 | 1.418 |
| neighbourhood      |     |       |       |     |       |       |
| Attach to          | −0.457 | 0.300 | 0.633 | 0.220 | 0.310 | 1.246 |
| neighbourhood      |     |       |       |     |       |       |
| Neighbourhood      | 0.661** | 0.311 | 1.937 | 0.556* | 0.315 | 1.743 |
| excellent          |     |       |       |     |       |       |
| Floods more common | 1.19*** | 0.254 | 3.299 | 1.19*** | 0.288 | 3.298 |
| Constant           | −1.219 | 1.260 | 0.295 | 0.951 | 1.293 | 2.589 |
| \(\chi^2\)        | 99.77*** |       | 41.28*** |     |       |       |
| \(df\)            | 19    |       | 19    |     |       |       |
| Pseudo R^2         | 0.1976 |       | 0.0993 |     |       |       |
| Valid N            | 364   |       | 364   |     |       |       |

***p < 0.01, **p < 0.05, *p < 0.1.
future flooding than the residents who did not flood (odds ratio = 5.594). This figure suggests that direct disaster experience and material losses trigger an increased feeling of vulnerability to future disasters (see Burningham et al., 2008). Similarly, those ordered to evacuate are some 68% more likely to worry about their neighbourhoods’ future flooding than those who did not evacuate (odds ratio = 1.680). This result is likely due to both the evacuees’ residence in the most vulnerable neighbourhood areas and their evacuation experience making a future flood seem more plausible or imminent. Income also matters, as both those who are higher income and those who are lower income are less likely than the middle-income group to worry about future flooding affecting their neighbourhood.

Those who rated their pre-disaster neighbourhoods as “excellent” places to live are 94% more likely to fear future flood events—almost twice as likely as those who rated their neighbourhoods as less than excellent (odds ratio = 1.937). In other words, more place attachment results in more worry over flood risk as those who enjoy living in their neighbourhoods have more to lose, socially and emotionally, from future floods. Not surprisingly, those who thought floods would become more common were three times more likely to worry about future flood events affecting their neighbourhoods (odds ratio = 3.299). The participants who believed climate change would cause more disasters are the ones most likely to worry about those disasters striking their neighbourhoods. In this way, climate change beliefs translate into greater localized concerns.

However, according to the second model, direct flood experience, such as home flooding and evacuation order, is not predictive of more worry about floods affecting Calgary. Although many city neighbourhoods are at risk of future flooding, the worry associated with that risk manifests itself on the neighbourhood level, a finding that parallels that of Barr (2008), who argues that, environmentally, people worry most about the events that are both geographically and temporally near. Those who believed that such events as the 2013 flood would be more common are three times more likely to worry about those events affecting Calgary (odds ratio = 3.298).

The interview data provide insight into why residents worry about future disaster risk. As Bryan explains,

> A couple of my neighbours are genuinely concerned and they’re not wrong. I personally don’t believe I will see that event in my lifetime. So I don’t talk about future disasters. I mean, I’ve got more equipment and I am better prepared than I was last time, but I don’t believe I’ll see it again. But I’ve covered my ass.

Several participants, though understanding of their neighbours’ worry about future flooding, claimed that they personally did not worry. As Peter stated, “Yeah, I’m not worried about it. If it happens, it happens,” which suggests not only a lack of worry, but perhaps also a sense of fatalism. The most common reason for the lack of worry was the doubt that another disaster like the 2013 flood would occur again, a finding that echoes the existing research on residents’ misinformation about actual flood risk (Lata & Nunn, 2012) and their misunderstanding of the “1-in-100-year” calculation of flood frequency (Ludy & Kondolf, 2012). Even though this term indicates a 1% chance of flooding each year, many residents nevertheless believe that it indicates a flood happens only every 100 years. As Ludy and Kondolf (2012) find, even most high-income, well-educated people living in flood-prone areas are unfamiliar with this form of risk analysis and communication prior to a flood event. This leads to flawed analyses of risks during and after an event, as well. Bell and Tobin (2007) find that the 1% language of risk is more effective than the 1-in-100-year parlance for communicating risk, although surprisingly ineffective for motivating protective or mitigative action. Thus, Irene claimed,

> I’m not too worried anymore. I don’t think it’s going to ever happen again here. And I might be blind but I don’t think it will. I think we learned enough. The province has learned enough and I think the city’s learned enough, that it will never happen again. And I hope I’m right.

Such misunderstandings carry important financial ramifications, of course, as a house in a 1-in-100 year flood risk zone has a 26% chance of flooding over the course of a 30-year mortgage. Nevertheless, many of the interview participants either misunderstood their risk or engaged in wishful thinking.

Several participants talked about the pervasive dread of future flooding lurking in the recess of their minds. As Leila recounted,

> It is always in the back of your mind, like I said, every spring runoff. I am not really ... I am a little bit more on edge during spring, and everybody on the street is. There is probably – it sounds terrible – a little bit more drinking of wine that goes on during that time, and if there is rain there is a little bit more of watching the river, a little bit more of seeing how high it is coming up on the lawn – because it always comes up on spring run-off anyways. So you are on edge.

Despite this worry, many participants reported actively working on erasing the flood risk from their minds, a phenomenon that Burningham et al. (2008) dub the "ostrich effect." While Roxanne admitted to trying to "put her blinders up," Nicole said that she

> [tries] to put it in my mind that it was a one hundred year flood, and hopefully if the statistics are correct it will only come, hopefully, in another hundred years. I don't think it came right on the hundred years, maybe it was eighty nine years or something – close to a hundred. But by then I am not going to be alive, so you know, hopefully nothing [will happen].

Relatedly, some participants also acknowledged the decreasing worry about flood risk and increased complacency as the 2013 flood
recede into history. Despite self-reminders about the infrequency of catastrophic flooding, explicit attempts to ignore flood risk, and the acknowledgement of seasonal variation in worry, most of the interviewees reported being “always worried” or “very concerned.”

5.2 | Mobility plans

While the above models capture risk perception and worry, it is also prudent to ask how flood-affected residents plan to adapt or respond to perceived flood risk. In particular, the factors that predict who plans to remain in their neighbourhoods and who plans to move elsewhere are important. Table 3 models two questions: whether the participants anticipate living in their pre-flood neighbourhoods (a) 1 year and (b) 5 years after the survey (i.e., in summer 2015 and 2019).

The descriptive statistics indicate that 81.8%, or the vast majority of participants, intended to remain in their neighbourhoods in the next year, though this number drops to 56% for the next 5 years. Even among those who flooded in 2013, 79% intended to remain in their neighbourhoods in the ensuing year, while 52% intended to remain for at least 5 years. Table 3 models resident plans to remain in their pre-flood neighbourhoods 1 and 5 years after the survey (respectively, 2 and 6 years after the flood).

The results in Table 3 indicate that age is a significant predictor of mobility plans. The age-squared predictor tests for a curvilinear effect and, indeed, both age and age-squared are significant. The positive effect of age indicates that as people age, their odds of intending to remain in their neighbourhoods increase, but the negative effect of age-squared indicates that the magnitude of this effect decreases at higher ages. Homeownership decreases mobility plans, as homeowners are 2.5 times more likely than renters to intend to remain in their neighbourhood 1 year after the survey (odds ratio = 2.485), and 2.4 times more likely to be there 5 years later (odds ratio = 2.389). This finding probably relates to the affected properties’ decrease in value (Bin & Polasky, 2004), which renders them harder to sell, as well as to homeowners’ increased emotional and social investments in the neighbourhoods where they have purchased homes (Windsong, 2010). The perception of one’s neighbourhood being an excellent place to live increases the odds of planning to stay in one’s neighbourhood, both in the short and medium term (odds ratios of 2.764 and 2.473). However, the worry about future flood affecting one’s neighbourhood significantly decreases these odds; those who harbour such worries are 67% less likely to see themselves in their neighbourhood after 1 year (odds ratio = 0.328) and 50% less likely to see themselves in their neighbourhood after 5 years (odds ratio = 0.503). These results indicate that risk perception and worry are significant and robust predictors of post-disaster mobility plans; worrying about future flooding, even when controlling for place attachment and other relevant predictors, is highly indicative of intentions to leave a flood-affected area. In contrast to work indicating the importance of variables such as gender, parenthood, and social class or income (Haney et al., 2007) for taking non-structural mitigative actions (such as evacuating or moving), there is no evidence that these demographic variables matter for mobility intentions in this sample of Calgarians living in flood-affected areas. Finding similar to Binder et al. (2015).

The qualitative findings reveal that while flood experience prompted some residents to ponder avenues for mobility, it entrenched other residents into their communities and enhanced their desire to reinvest themselves in their neighbourhoods. Out-migration desires were often fuelled by economic preservation. As one survey participant told us, he wanted to sell while his house still had some value. Decisions to dig in and persist, however, were often explained by increased place attachment and connection to one’s neighbours.

As expected, many flooded residents said that they wished to move to less risky locations and never again live so close to a river. As Scott stated,

We would never have bought our house had we known that. Never. And we will never again buy next to a river. I think it is a mistake. The river needs room and the developers should not ... the city should not allow it first off. It is the government’s fault. I believe it is the city government: city government allowed that development to occur and the developers did it, so I am very, very unhappy about that.

Eager to blame developers and the city government for allowing development in flood-prone areas of the city (see Tierney, 2014), Scott primarily based his long-term mobility plans on disaster risk reduction. This Disaster Risk Reduction strategy is explicitly adopted and endorsed by the United Nations (UNISDR, 2015) and emphasizes identifying risks, reducing social vulnerabilities, and moving both people and property further from natural hazards while de-emphasizing pure hazard response and simple structural mitigation efforts (Aitsi-Selmi, Egawa, Sasaki, Wannous, & Murray, 2015; Briceño, 2015).

Although some affected residents wanted to remain in their neighbourhood, they perceived older age as a hindrance to this decision. According to Christian, “You get tougher until you turn... Fifty-Five-ish and then most people begin to get less tough. And so that, that’s happened to me... So we’re moving out... I would say the people who cannot handle stress should not live... in more, in risky communities.” For others, the material impact of the flood provoked a sense of dread over future floods and, therefore, a desire to move. When asked where he saw himself living in the future, Matthew succinctly said, “Not in a floodplain. (laughing) It’s impacted me that way. Ummm, [my neighbors are] nice but they uhhh... not in a floodplain.”

At the same time, the flood hardened other residents’ resolve to remain in their neighbourhood. As Peter revealed, “We were thinking of moving. I think the flood, the impact of the flood, as I said it made me realize I’m going to stay right where I am. So, because of that sense of community that I have.” According to Peter, the flood prompted neighbours to reach out to one another and help one
another, resulting in place-based social networks too important to sacrifice by relocating.

Those who did not want to move were confident that either the flood would not occur again or that they would be better prepared to face it if it did. According to Irene, "I don't believe it's going to happen again, but we'll be more aware if it does happen, and we will move out. But I think if it ever happens again, I think the— the people and the government will be a little more on top of it that they were this time. And I think they'll let people know it's coming before it's coming." Frank believed that the post-2013 household-level mitigation activities had decreased the risk:

It didn't impact where [we intend to live] because we're rebuilding right on the same site!

How? We built up eight feet higher and we are doing slab on grade – no basement ….. We are going to definitely appreciate the property even more now that we have done the mitigation, and appreciate the power that that river can have, and you know, if we do have another flood we are going to be the ones going out and helping the neighbors.

Finally, for other participants, the flood reinvigorated their place attachment and strengthened their resolve to rebuild their neighbourhood social fabric. According to Emily, "I can't see anyone moving from the neighbourhood – why would you? This is a great neighbourhood."

| Dependent variable | Plan to remain 1 year |  | Plan to remain 5 years |  |
|--------------------|----------------------|---|-----------------------|---|
|                    | $b$ | SE($b$) | Exp($b$) | $b$ | SE($b$) | Exp($b$) |
| Age                | 0.149*** | 0.057 | 1.160 | 0.121** | 0.049 | 1.128 |
| Age$^2$            | $-0.001^*$ | 0.001 | 0.999 | $-0.001^*$ | 0.000 | 0.999 |
| White              | $-0.123$ | 0.513 | 0.885 | $-0.513$ | 0.432 | 0.599 |
| Female             | 0.077 | 0.325 | 1.080 | $-0.271$ | 0.255 | 0.762 |
| Married            | 0.001 | 0.383 | 1.000 | 0.207 | 0.289 | 1.230 |
| Parent             | 0.076 | 0.415 | 1.080 | 0.129 | 0.311 | 1.137 |
| Bachelor's or higher | 0.606* | 0.350 | 1.831 | 0.235 | 0.268 | 1.265 |
| High income        | $-0.477$ | 0.452 | 0.620 | $-0.113$ | 0.326 | 0.893 |
| Low income         | $-0.296$ | 0.428 | 0.744 | $-0.013$ | 0.337 | 0.987 |
| Homeowner          | 0.910** | 0.414 | 2.485 | 0.870** | 0.364 | 2.389 |
| Years in home      | $-0.006$ | 0.021 | 0.994 | 0.004 | 0.016 | 1.004 |
| # Neighbours known | 0.001 | 0.015 | 1.000 | 0.006 | 0.010 | 1.006 |
| Flooded            | $-0.061$ | 0.415 | 0.941 | $-0.255$ | 0.332 | 0.774 |
| Asked to evacuate  | 0.252 | 0.355 | 1.287 | 0.350 | 0.287 | 1.420 |
| Days evacuated     | $-0.002$ | 0.003 | 0.998 | $-0.001$ | 0.003 | 0.999 |
| Active in neighbourhood | $-0.896^*$ | 0.411 | 0.408 | $-0.099$ | 0.308 | 0.905 |
| Attach to neighbourhood | $-0.308$ | 0.376 | 0.735 | 0.470* | 0.287 | 1.601 |
| Neighbourhood excellent | 1.016*** | 0.377 | 2.764 | 0.906*** | 0.302 | 2.473 |
| Floods More common | 0.396 | 0.329 | 1.487 | 0.247 | 0.256 | 1.280 |
| Worried about neighbourhood | $-1.115^***$ | 0.409 | 0.328 | $-0.687^*$ | 0.307 | 0.503 |
| Worried about calgary | $-0.003$ | 0.435 | 0.997 | 0.275 | 0.320 | 1.317 |
| Constant           | $-2.891^*$ | 1.413 | 0.047 | $-4.183^***$ | 1.238 | 0.015 |
| $\chi^2$          | 51.51*** | 75.79*** |
| df                 | 21 | 21 |
| Pseudo $R^2$       | 0.1508 | 0.1518 |
| Valid N            | 364 | 364 |

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.
The findings of the study provide support for all four of the hypotheses provided earlier in the article. They indicate that gender and direct material flood experience, specifically home flooding and being ordered to evacuate, are significant predictors of worry over future flooding (consistent with Hypothesis #1). This worry, in turn, is a significant predictor of 1- and 5-year mobility plans (Hypothesis #2). Plans to leave one’s neighbourhood are somewhat buffered by place attachment and homeownership, however (Hypothesis #3). Similar to the study by Binder et al. (2015), this study shows that the demographic predictors such as gender and parenthood are unrelated to post-disaster mobility plans.

The qualitative data from the study indicate that the residents who worry about future flooding also plan residential relocations into less hazardous locations. By contrast, a non-trivial segment of the interviewees believe that future floods are unlikely and, should they occur, either the floods will not be as extensive and destructive as the 2013 flood or the participants will be better equipped to handle them. For those residents who do not worry about future flooding, residential relocation would logically seem unnecessary. Additionally, for many, their new-found or reinvigorated place connection prompts them to stay, regardless of potential future flood risk (Hypothesis #4).

These findings resonate with the call by Hunter et al. (2015) for a more temporally nuanced understanding of environmentally induced migration decisions, as they illuminate how residents returning after an environmental disaster make longer-term mobility plans. Mobility decisions cannot be explained simply by cost-benefit, rational-actor models of behaviour (i.e., Henry, 2013; Riad et al., 1999). Indeed, several common variables related to economic concerns, such as income and home flooding, are not statistically related to 1- or 5-year mobility plans. Instead, place attachment, expressed through perceptions of one’s neighbourhood as an excellent place to live, the strength of local social networks, and local civic engagement, are significant predictors. The models also reveal that those who believe flooding will become more common in the future exhibit higher levels of worry about future floods. However, only worry about one’s neighbourhood flood risk—not municipal flood risk—is associated with mobility plans. These results emphasize the centrality of neighbourhood place attachment and neighbourly networks not only for bringing disaster-affected residents home, but also for encouraging them to make longer-term commitments to their flood-affected neighbourhoods. While research has focused on climate change and migration in the Global South and in subsistence farming communities (Nawyn, 2016), the present article demonstrates how residents in wealthier, urban centres of the Global North may respond to environmental hazards and change. Whereas many people around the world are prompted to migrate by considerations of income or subsistence, the residents of wealthier places like Calgary are primarily motivated by non-economic, cultural, and network-related factors.

Just as all studies, the present study carries some limitations and caveats. First of all, there is the issue of intention vs. action: people do not always move when they say they will, and many move unexpectedly, without prior planning (Lu, 1989). Therefore, the present study can only gauge residents’ intended mobility plans, not their actual mobility decisions. Secondly, the article utilizes a modest sample of survey data (n = 407), and I would welcome a much larger study on residents’ post-disaster mobility plans. It is highly probable that many of the non-significant coefficients in this study would be significant in a larger sample. The article only interprets the significant findings, despite recent cautions from the American Statistical Association about the limits of significance (Wasserstein & Lazar, 2016). Thirdly, although the survey participants are representative of the flood-affected neighbourhoods, the interview participants may not be. They were recruited through community associations, so it is unlikely that civicly disengaged residents would have received the recruitment information. Given this selection method, it is likely that the interviews oversampled for residents who are civicly engaged. But, since the interviews did not focus specifically on civic engagement (but rather, on mobility plans and worry, as well as environmental concerns and practices—which will be the focus of future papers), resultant bias is somewhat minimized. Fourth, it is important to note that the flood-affected Calgary neighbourhoods have been largely untouched by home buyout programmes, which distinguishes this case from the case of Hurricane Sandy (Koslov, 2016) and other disasters. Although the Alberta government has bought a handful of the most vulnerable properties, the vast majority of flood-affected residents have not been offered a chance to participate in a buyout programme and must, therefore, make relocation decisions that involve selling their homes at post-flood market value.

These findings are particularly important in the Albertan and Canadian contexts. Just as in many other places, floods are poised to become much more common, with the Institute for Catastrophic Loss Reduction and the Insurance Bureau of Canada predicting that Alberta will see a 10% increase in severe weather events as temperatures rise by as much as 4°C by 2050 (Sandford & Freek, 2014), twice the global rate of increase. The present study is an important step in helping social scientists determine how and why larger demographic trends such as out-migration occur in a post-disaster context. Although the findings are drawn from a sample of flood-affected residents, it should also help us understand residential mobility decisions in many types of disasters, albeit probably only in wealthier cities of the Global North where local social networks and place attachment can afford to trump purely economic considerations. With that said, the findings may not be as useful for understanding mobility decisions when hazards linger (such as chronic contamination) long after the acute disaster stage and residents understandably worry about the human health effects of remaining (Edelstein, 2004). The findings can also help researchers understand how the combination of individual and neighbourhood factors play a role in facilitating or preventing post-disaster migration. In particular, this should be of interest to researchers developing mechanisms that could encourage residents to return, rebuild, and reinvest themselves in their pre-disaster communities, thereby strengthening...
place-based social capital. The study can also assist applied practitioners and government officials involved in buyout programmes in better understanding residents’ needs and concerns after a catastrophic event.

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ENDNOTES
1 Sensitivity analyses, available upon request, indicate that these missing cases are mostly missing at random and whether a participant provided a valid income is not statistically related to any of the demographic variables (except marital status), nor is it predictive of any of the dependent variables in the models.

2 In Calgary, the locus of this activity is the neighbourhood. In fact, each of Calgary’s approximately 150 neighbourhoods maintains its own community association, many of which have their own community centre, hosts events and workshops, has its own hockey rink, children’s soccer league, and so on. These associations require volunteers as board members, event organizers, coaches, maintenance people, and so on. The City of Calgary maintains an office to coordinate and oversee the activities of these community associations. They are also joined by the non-profit Federation of Calgary Communities. Given this structure, community (neighbourhood) associations are an important facet of life in Calgary that involve many residents. Therefore, to most Calgarians, being active in the neighbourhood equates to being active in the association and its activities.

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