Plans and Prospects for Coastal Flooding in Four Communities Affected by Sandy

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ABSTRACT

The risk of coastal flooding is increasing due to more frequent intense storm events, rising sea levels, and more people living in flood-prone areas. Although private adaptation measures can reduce damage and risk, most people living in risk-prone areas take only a fraction of those measures voluntarily. The present study examines relationships among individuals' beliefs and actions regarding flood-related risks based on in-depth interviews and structured surveys in communities deeply affected by Superstorm Sandy. The authors find that residents recognize the risk of coastal flooding and expect it to increase, although they appear to underestimate by how much. Although interview participants typically cited climate change as affecting the risks that they face, survey respondents' acceptance of climate change was unrelated to their willingness to tolerate coastal flooding risks, their beliefs about the effectiveness of community-level mitigation measures, or their willingness to take individual actions. Respondents who reported greater social support also reported both greater tolerance for flood risks and greater confidence in community adaptation measures, suggesting an important, but complex role of personal connections in collective resilience—both keeping people in place and helping them to survive there. Thus, residents were aware of the risks and willing to undertake both personal and community actions, if convinced of their effectiveness, regardless of their acceptance of climate change.

1. Introduction

Storms and floods are the most frequent and costly weather-related disasters in the United States, accounting for 71.1% of the damage caused by extreme weather events between 1980 and 2011 (Smith and Katz 2013) and an estimated $626.9 billion (U.S. dollars in 2011) in economic losses. Those impacts are expected to increase with climate change due to more frequent intense storms (Grinsted et al. 2013; Holland and Bruyère 2014) and sea level rise (Kopp et al. 2014; IPCC 2013), along with continued development in flood-prone areas (Crossett et al. 2013).

The management of flood risk has long focused on large-scale engineering projects, such as sea walls and levees, designed and implemented by government agencies (Lonnquest et al. 2014). Recently, there has been a shift toward a more integrated approach, which includes flood prevention and damage alleviation through small-scale measures taken by communities and households, such as flood protection devices (e.g., flood vents), adaptive building uses, and flood insurance (Interagency Climate Change Adaptation Task Force 2011; McDaniels et al. 1999; Samuels et al. 2006). The success of these programs depends on local residents' willingness and ability to undertake those measures. Although individual adaptation measures have demonstrated ability to reduce flood damage (Kreibich et al. 2005; Schanze 2008), relatively few people take them voluntarily (Kunreuther 1996).

A recent review found that individuals' willingness and ability to take such measures was unrelated to their

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perceptions of flood risk (Bubeck et al. 2012). The authors speculated that once individuals have adopted some adaptation measures, however effective, they may treat the risks as under control and do no more. The review found less willingness to act among individuals who estimated higher costs for these measures, preferred public flood defense measures, or saw government as responsible (see also Kellens et al. 2013). Conversely, and echoing findings with respect to climate change perceptions (Lee et al. 2015), the review found greater stated willingness to adopt individual adaptation measures among people who viewed them as effective, who knew more about flooding hazards, and who had experienced flooding directly.

Indeed, there is a growing body of evidence that experience, both direct and observed, influences acceptance of climate change (Reser et al. 2014) and the related events of flooding (Taylor et al. 2014) and extreme weather (Capstick and Pidgeon 2014; Howe and Leiserowitz 2013; Lujala et al. 2015). For example, people who have experienced damage that they attribute to climate change see greater future risks (Akerlof et al. 2013), such as flooding and landslides (Lujala et al. 2015). In a national survey of U.K. residents, Taylor et al. (2014) found that self-reported "heat-wave discomfort" was associated with greater acceptance of climate change. Rudman et al. (2013) found greater support for politicians who supported climate change among New Jersey residents after Hurricane Irene and Superstorm Sandy. Before the storms, acceptance of climate change was the best predictor of that support; afterward experience was.

Although studies find consistent results regarding the role of experience in personal adaptation and risk perceptions, the same cannot be said regarding the role of social support, such as having a sympathetic friend to hear problems or family members able to help with transportation or childcare. Some studies find that people with greater social support are more likely to take protective measures before, during, and after disasters (Riad et al. 1999; Kaniasty 2012). For example, Riad et al. (1999) found perceived social support predicted whether individuals evacuated in advance of Hurricane Hugo (1989) and Hurricane Andrew (1992). That support might include having a place to go, receiving needed information, and having someone to talk to (Kaniasty and Norris 1995). Other studies, though, have found that people sometimes take risks when they can treat others as a safety net (Hsee and Weber 1999; Weber and Hsee 1998; Schneider et al. 2014). It is unclear how these processes will balance out with respect to coastal flooding risk.

The present work asks how risk perceptions and social support are related to the adaptation behavior of residents of two New Jersey counties (Monmouth and Ocean) that were devastated by Superstorm Sandy in late October 2012 (Blake et al. 2013). Sandy was the most costly U.S. storm since 1990, other than Hurricane Katrina (Crossett et al. 2013), with a damage estimate of $68 billion (U.S. dollars in 2013) (Sullivan and Uccellini 2013). At the time of our study (summer 2014), these communities were still dealing with the storm's aftermath. These counties continue to be at risk, as they are predicted to be increasingly vulnerable to future coastal flooding and storm surge risks because of sea level rise, given their location and topography (Strauss et al. 2012; Hauer et al. 2016). We report an initial exploratory study with qualitative open-ended interviews, followed by a structured survey assessing how social support and risk perceptions are related to the adaptation behavior of these individuals, who have experienced coastal flooding directly.

2. Qualitative open-ended interviews

a. Methods

We recruited 14 New Jersey residents from Highlands and Sea Bright, in Monmouth County, and Little Egg Harbor and Tuckerton, in Ocean County (Fig. 1)[1] using snowball sampling methods (Goodman 1961). Participants were recruited with the help of New Jersey Future (www.njfuture.org), a nonprofit, nonpartisan organization that brings together residents, community leaders, and public officials to promote responsible land-use policies. New Jersey Future introduced the first author to key informants in the community, who then helped set up interviews with community members. The interviews were conducted in May 2014 and took place at community centers or other locations convenient for participants (e.g., a café) and were conducted by the first author. The interviews lasted approximately an hour and were audio recorded for later transcription. They began with general questions and continued to more specific ones related to decisions facing community members, allowing respondents to direct the flow and express themselves in their own terms (Morgan et al.

[1] Highlands, New Jersey, is a coastal community of approximately 5000 fulltime and seasonal residents, who are mostly white (93%), with a median household income of approximately $75 000 (U.S. Census Bureau 2014). Sea Bright, New Jersey, is a smaller coastal community adjacent to Highlands, with approximately 1400 people, who are mostly white (95%) with a median household income of about $74 000. Little Egg Harbor, New Jersey, is the largest coastal community in our study, with approximately 20 000 residents, who are mostly white (94%) with a median household income of about $59 000. Tuckerton, New Jersey, is adjacent to Little Egg Harbor and has approximately 3400 residents, who are mostly white (94%) with a median household income of about $53 000.

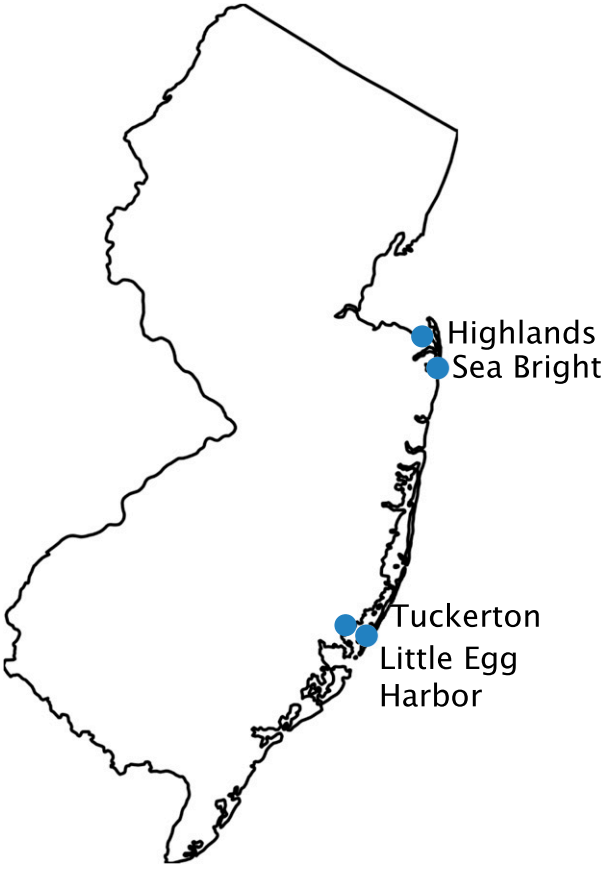

FIG. 1. Map of communities included in this study.

2002; Bruine de Bruin and Bostrom 2013). Carnegie Mellon's Institutional Review Board for the Protection of Human Subjects approved the research protocol. Informed consent was secured from participants, who were not compensated.

1) PARTICIPANTS

All participants were full-time residents of one of the four communities, with most having lived there at least 20 years (and some all their lives). According to self-reports, their average age was 62.4 years [standard deviation (SD) = 8.3]; 69.2% had at least a college degree; 30.1% worked in public service (government, police, local government), 23.1% in education (high school, college), 23.1% in other professions (speech therapist, building owner), 15.4% in real estate, and 15.4% in service industries; and 41.6% were female.

2) INTERVIEW PROTOCOL

The interview protocol was informed by nine informal interviews with emergency planning and preparedness experts working in coastal communities in New Jersey and New York, eliciting their perceptions of the issues to address with residents. These interviews provided an informal version of an "expert model" for structuring the interviews around topics potentially relevant to adaptation behavior. The interview protocol was pilot tested with Carnegie Mellon University (CMU) students and resiliency planners familiar with coastal NJ communities. It had three parts, eliciting beliefs about 1) coastal flooding, 2) responsibility for preparing for those risks, and 3) the costs and benefits of possible protective measures.

The interview began with six open-ended questions eliciting respondents' beliefs about coastal flooding: Please tell me about sea level here in [community]. Tell me what might cause sea level here to become lower/higher in the future than it is today. Tell me what causes coastal flooding in [community]. Tell me about the types of weather events that could result in coastal flooding in [community]. How will sea level affect coastal flooding, when [weather event] happens? What would be different if sea level were lower/higher than it is today? Next, participants rated three statements (1 = completely disagree, 7 = completely agree) about who should be responsible for preparing for the risks, then explained their answers: I believe that state and local government are responsible for helping me prepare for the risk of coastal flooding, I believe that the federal government is responsible for helping me prepare for the risk of coastal flooding, and I believe that preparing for the risk of coastal flooding is entirely my own responsibility. Finally, they were asked what do you think is the best way to respond before a coastal flood due to [weather event]? That weather event was the interviewee's response to the earlier question tell me about the types of weather events that could result in coastal flooding in [community].

At the end of the interview, participants answered demographic questions.

3) ANALYTICAL APPROACH

All interviews were digitally recorded and transcribed. In analyzing them, we read each transcript to identify key themes and developed a master list of codes. Two coders (the first author and a trained CMU undergraduate) independently coded the transcripts into those themes. The results reflect our interpretation of participants' narratives. We used it to inform the design of our structured survey, including which questions to ask and what language to use. (A complete list of codes and frequency of mentions is in Table A1 in appendix A.) We first report emergent themes regarding the risks [section 2b(1)] and responsibility for managing them [section 2b(2)], then follow with themes related to place and social support [section 2b(3)], and conclude with the measures that participants identified, for short- and long-term protection [section 2b(4)].

b. Results

1) UNDERSTANDING OF COASTAL FLOODING

(i) Residents see themselves as at risk for major coastal flooding

Participants distinguished major and minor (nuisance) flooding, reporting that major flooding happens when ''perfect storm'' factors come together (8 = number of interviewees mentioning the topic), as when nor'easters bring heavy precipitation (9), high winds (northwesterly) cause increased wave action (3), or high tides occur during a full moon (7). Many see themselves as facing risk for coastal flooding (6 s). In the terms of one participant, ''You live in a coastal town, so it's kind of expected that if you can afford to live near the ocean you have to know that there's certain risks'' [participant (p) 3].

(ii) Residents see flooding risk as increasing, which may or may not be due to climate change

Many noted what they have read about sea level rise (10) and climate change (8). When talking about increased risk (8), some cited direct personal experience (6) during time spent on or near the water (e.g., fishing, swimming). One long-time resident (p4) said, ''visual appearance says to me that the water is higher than it had been before. It doesn't get as low as it used to be. So, I'm not saying that it's always higher, but I think on average we have less beach to look at than we did [before].''

Residents suggested several reasons for increasing risk. Some invoked climate change (8 mentions), ''it is the slow, slow warming of the polar ice caps'' (p13), noting changes over their lifetimes:

> I don't remember the winters being this crazy when I was younger. Not that they didn't snow, but it just didn't—I feel like it snows much earlier and much later and much more frequently. It was so cold that we actually had snow on the ground for months, which hasn't happened in a really long time. So I feel like patterns are definitely changing, and I would imagine that we would have more nor'easters in about 30 years or before then. (p2)

Others invoked aspects of the built environment (5), such as increased building in areas vulnerable to coastal flooding. A few mentioned subsidence (2), poor or aging infrastructure (e.g., sea walls, sewer systems; 1), or erosion (1), whereby sand or dirt underneath homes is sucked out by wave action.

(iii) Residents see dire consequences of flooding

All participants mentioned flooding risks as a threat to their community: ''It has an impact on the infrastructure. It's like a decay, right? Water got to where it never was and then you don't know if you have rot, mold, decay of materials. There's a lot of concrete here. If it gets undermined, it starts to lean. It becomes a maintenance challenge'' (p1). All described physical, financial, or psychological damage during and after Sandy. In one particularly emotional interview, a husband described what happened to his wife's belongings when Sandy hit:

> We packed our mementos in plastic bins. . .and when the water came in, it tumbled over the shelving, which tumbled over the tubs and the tubs' lids fell open. . .what was worse, I think, is the fact that her father was killed in the war. And, all his mementos were there. So she never knew her father other than what was left by her mother. And, it's all gone. (p5)

Indeed, it is such psychological trauma that made some residents (3) say that they would consider moving should another Sandy-like storm happen again.

Residents mentioned the threat to their community's social and economic viability. One worried that ''we'd have to give up our houses, we'd all have to move'' (p7). Some feared that their community would be lost, forcing people to leave entirely or use neighboring towns for services. One resident, though, suggested that those who could not afford to stay would move out and be replaced by people with greater financial resources, thereby improving the overall economy:

> So I think it's going to bring more income into the area. Sea Bright has always been somewhat of a wealthy town where the people have the resources to rebuild. But some of the areas in town, these are older families that have been there and maybe they cannot afford to stay. But I think money will come in, eventually rebuild the town to where it's more of [an] affluent area. . .I think it is part of a progression, I think it was the economic stimulus, if you would, has done. If you look at Long Bridge, I do not [want] to compare Sea Bright to Long Bridge, but before Pier Village was in there, that was just a local community. They weren't really damaged by higher tides, but somebody came in and bought the whole area and now it's more desirable. It may not be fair that people were forced to leave, but as an economic thing, they added a lot of money to the tax base for the town and there's a lot of nice housing. (p3)

2) VIEWS ON THE RESPONSIBILITY FOR PREPARING FOR THE RISKS OF COASTAL FLOODING

Most participants reported feeling personally responsible for preparing their homes and family for coastal flooding (9), with some explicitly saying that the responsibility comes with their decision to live in a place

at risk (7). They saw state and local authorities as sharing responsibility, mentioning tasks such as providing information (6), creating building codes and making sure they are enforced (1), performing local preparedness measures (e.g., building and maintaining major infrastructure; 3), helping citizens (1), and providing shelter for those who need it (1). They saw federal authorities [e.g., Federal Emergency Management Agency (FEMA)] as being responsible for providing resources for recovery but leaving the actual work to local authorities (2). When asked to rate responsibility for preparing on a scale of 1 = not at all responsible to 7 = completely responsible, residents rated themselves as being most responsible [$n = 9$, mean (M) = 5.55, SD = 1.62], followed by state and local authorities ($n = 9$, $M = 4.82$, SD = 0.78) and federal authorities ($n = 9$, $M = 3.59$, SD = 1.46).

3) Views on place and social support

Most participants (10) stressed the importance of having someone to help evacuate or provide a safe place to go in determining whether they took protective measures in advance of the storm: ''I made sure that my neighbor, who is a senior citizen with Alzheimer's, that she was going to be some place safe and she's got a friend that's in a retirement community and she stayed there, where she continued to stay for 10 months'' (p10). Another said humorously, ''But my family would all be 'Come stay with us! Or just leave your dog with us because we like that dog better.' But I think that you'd be surprised in the amount of places you can find help'' (p2). People also described (5) how crucial such support was for dealing with the aftermath of a storm event:

> But we had to. . .we had to. . .move on after three days of crying. You just, I just got up on the fourth day and just said, ''Okay, it's [my possessions are] gone. You have to move on.'' You just...and fortunately, our children were very supportive. Our children came right away, they took off from work. My daughter- and son-in-law came up from Maryland. My daughter's father-in-law came up. And we just started the cleanup. And fortunately, my daughter told me not to go downstairs until they got some of the bad stuff out. And my son-in-law set up a generator. And I kind of fed the neighborhood. I had a grill and I kinda made grilled cheese sandwiches and made soup for the people on the block that didn't have food and didn't have electricity. And I kept busy that way until I was able to handle going downstairs. And my son and his boys came on the weekend. And I just, we just started as a family cleaning up and the neighbors helped neighbors, and our block. . .our block was really wonderful. (p6)

Such support appeared to help residents feel and perhaps be more resilient: ''I have a good family structure. I have a good structure of friends. I think this is all very important. There are many people who don't have that option and I think they would be the ones who would fall through the crack. I think I would be able to recover, personally. Sometimes you have to take life with what it throws at you. It's the old adage of turning lemons into lemonade'' (p9). It may have contributed to their commitment to stay (9) and rebuild at the same location if needed (3) because they love the place (3): ''I'm committed to stay here. I see people that keep waders on the porch in case that day happens. I want to be here'' (p1). If not able to stay, one resident would ''move to another beach community'' (p2).

4) Views on ways to prepare for the risks of coastal flooding

Participants distinguished measures aimed at both imminent and long-term threats. For imminent threats, they mentioned diverse things that they could acquire as ways to prepare for imminent threats, including a small boat (3), candles (1), an electric generator (5), gasoline or other fuel (2), lamps (1), radio (1), sandbags (1), wood (1), woodstove (1), safe-boxes for valuables (1), extra cash (for when ATMs, computers, and the Internet go out; 1), and a landline (1). Some described actions such as subscribing to a service that provides current risk information (6), copying important documents (1), creating an emergency evacuation plan (9), putting valuables in higher places at home (8), and moving cars and boats to higher ground (7). For long-term threats, they suggested purchasing flood insurance (1), putting homes on pilings (11), flood proofing (1), and protective landscaping (1). Several mentioned moving away as a way to deal with increasing flood risk (9): ''You know, I'd probably move, I think, inland, you know, to an area where I felt that flooding wasn't going to be an issue'' (p14).

c. Discussion

We interviewed 14 long-term residents of coastal communities strongly affected by Sandy. As summarized in Fig. 2, they saw themselves as at risk for coastal flooding, with that risk increasing, which some attributed to climate change and others to changes in the natural or built environment, often citing personal experience. Most saw the risks as posing both tangible threats (financial damages) and intangible ones (social viability of their community). They expressed strong attachment to the place and their lives there, which included responsibility for preparing for the risks. Nearly all pointed to social support as playing an important role in evacuation decisions as well as in their ability to cope with the aftermath of the storm. Most offered practical measures for addressing both imminent and long-term

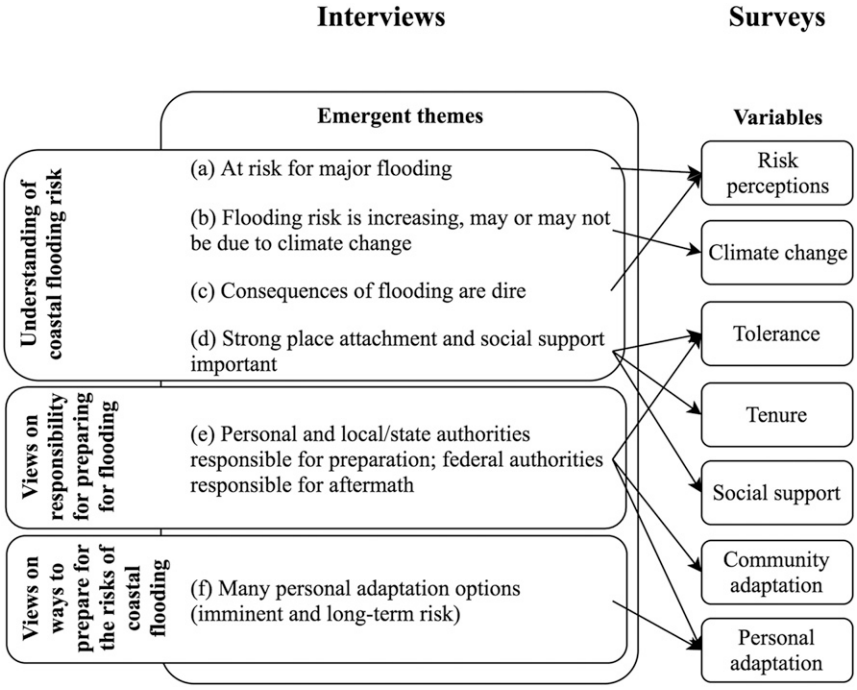

FIG. 2. Major themes identified during the interviews and how they informed the design of the survey.

threats. We designed a survey to assess the prevalence of these beliefs and the relationships among them.

3. Quantitative approach: Surveys

a. Methods

Participants were again recruited from Highlands, Sea Bright, Little Egg Harbor, and Tuckerton. After discussions with local public officials, community leaders and researchers working in the region, we decided to conduct the survey completely online in order to have the best chance of reaching dislocated residents. Given high Internet penetration in the area, most residents should have access. We posted recruitment advertisements on town homepages and town Facebook pages. Nonetheless, we cannot claim a representative sample.

b. Participants

We recruited 224 residents. According to their self-reports, they were 49.7% female, with an average age of 56.5 (SD = 12.9), 50.0% holding at least a college degree (BA, BS), and 50.0% having an annual household income of at least $76 000 (U.S. dollars). They reported their political affiliation as Independent (33.5%), Republican (31.4%), Democrat (15.4%), or other (2.7%), with 17.0% preferring not to answer. Many (42.9%) reported having at least one person over the age of 64 living at home, a few (19.1%) reporting at least one child (17 years old or younger) living at home. Most reported being Caucasian (90.5%), followed by Native American (2.1%), other (2.1%), and Latino (1.1%), with 2.1% preferring not to answer. The most popular source of information about events or news was the Internet (76.2%), followed by newspapers (63.5%), friends or family (61.9%), radio (37.6%), other media such as television (19.6%), work (18.5%), and school (5.3%). The median time in their current home was 13 years. Nearly all are homeowners (97.0%), with most reporting that their local residence is their primary (69.6%) or secondary home (20.0%).

c. Survey protocol

The survey was pilot tested with Carnegie Mellon University students and resiliency planners at New Jersey Future (www.njfuture.org) familiar with New Jersey shore residents. The design of the survey was informed by the literature and the themes that emerged from the interviews. Figure 2 shows how each such theme is represented in the survey. The survey instrument had seven sections in the following order: personal adaptation behavior, risk perception, tolerance for flooding risk, views about community adaptation, social support, climate change acceptance, and tenure of

residence. The survey concluded with demographic questions, including ones related to flooding experience.

The seven sections were as follows:

- Personal adaptation. We assessed personal adaptation in two ways: Sandy actions and intentions to act. For the former, respondents first read the following: On October 29, 2012, Sandy made landfall near Brigantine, New Jersey. Think back to the days leading up to Sandy's landfall, and the days that followed. Think about the flooding that resulted, and what happened to you because of it. Residents then read the following: In 1 or 2 sentences, tell us any ways you would prepare for a future flood that you didn't do before Sandy. Responses were coded as 0 = no, will not take action, for responses such as no or taking action will not make a difference, and 1 = yes, will take action, if respondents listed any action (e.g., move vehicle, raise home on pilings).
- Risk perception. A composite score (Cronbach's $\alpha = 0.86$) for risk perception was created by averaging residents' responses to the following questions (1%–100%): What were the chances of such [Sandy-like] flooding in a typical year, 30 years ago? What do you think the chances are of such flooding happening in the next year? What are the chances of such flooding in a typical year, 30 years from now? What do think the chances are of such flooding happening at least once in the next 30 years?
- Tolerance. A composite score [$r(209) = 0.62, p < 0.001$] for tolerance was created by averaging residents' responses to the following questions (1%–100%): What would the yearly [Sandy-like] flood risk have to be before you and your family decide to move from this area? What would the chances of a flood over the next 30 years have to be before you and your family decide to move from this area?
- Community adaptation. A composite score (Cronbach's $\alpha = 0.88$) for feelings about adaptation was created by averaging residents' agreement with the following statements (1 = very strongly disagree, 7 = very strongly agree): preparing for flooding risk reduces property damage if a flood were to happen, preparing for flooding risk makes the community more resilient, preparing for flooding risk reduces mental health problems if a flood were to happen, preparing for flooding risk makes people want to move away from here, preparing for flooding risk makes people not want to move here, preparing for flooding risk decreases my property value, preparing for flooding risk hurts the local economy, and preparing for flooding risk causes my flood insurance costs to increase. The negative framing of the last five statements reflects how these concepts were expressed in the interviews. They were reversed coded so that higher agreement indicates positive feelings about adaptation, and lower agreement indicates negative feelings.
- Social support. Respondents completed an adapted version of Krause's (2001) social support scale, measuring social networks (family, friends, confidants), received support (emotional, tangible, informational), satisfaction with support, and negative interactions, responding to 14 questions. Example questions include the following: If you were sick in bed, how much could you count on the people around you to help out? Told you what they did in a stressful situation that was similar to the one you were experiencing? The response options were 1 = never, 2 = once in a while, 3 = fairly often, and 4 = very often. We created a mean index of these responses as a measure of social support, with a Cronbach's alpha of 0.94.
- Residence tenure. As an assessment of depth of place attachment, we asked residents in total, how many years have you lived in this community?
- Climate change acceptance. We used one question from Maibach et al.'s (2009) Six Americas survey: ''Recently you may have noticed that global warming has been getting some attention in the news. Global warming refers to the idea that the world's average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world's climate may change as a result. What do you think? Do you think that global warming is happening?'' (1 = yes, 2 = no, 3 = I do not know; Maibach et al. 2009, p. 77).

d. Analytic approach

Statistical analyses were conducted using Stata (version 14; Stata Corp, College Station, Texas). Descriptive statistics were used to characterize respondents' experience with catastrophic flooding and personal adaptation behavior. They were also used to examine reported risk perception, tolerance for flooding, social support, community adaptation views and tenure of residence. Paired sample t tests were conducted to investigate views on whether residents see the chances of major flooding as increasing over time, comparing past versus present, past versus future, and present versus future. We also compared their reported tolerance for flood with their estimates for the chances of flooding to examine whether residents see the risks as above or below their level of tolerance.

A logistic regression analysis was conducted with personal adaptation behavior as the dependent variable,

TABLE 1. Descriptive statistics of the survey variables.

	Variables	*n*	Mean	SD	Med	Mode	Range
1	Risk perceptions (1%–100%)	220	41.9	23.7	42.9	0/50/68.5	0–100
2	What were the chances of such [Sandy-like] flooding in a typical year, 30 years ago? (past)	213	28.1	24.1	20	10	0–100
3	What do you think the chances are of such flooding happening in the next year? (present)	217	26.8	25.4	17	10	0–100
4	What are the chances of such flooding in a typical year, 30 years from now? (future)	216	54.4	29.7	51	50	0–100
5	What do think the chances are of such flooding happening at least once in the next 30 years?	214	59.1	31.8	56	100	0–100
6	Tolerance (1%–100%)	215	61.6	26.7	61.5	100	0–100
7	What would the yearly [Sandy-like] flood risk have to be before you and your family decide to move from this area?	211	57.7	29.2	58	100	0–100
8	What would the chances of a flood over the next 30 years have to be before you and your family decide to move from this area?	211	65.9	29.2	70	100	0–100
9	Residence tenure	196	19.7	13.4	16	12	2–73
10	Social support (1 = never, 2 = once in a while, 3 = fairly often, 4 = very often)	212	2.78	0.75	2.79	4	1–4
11	If you were sick in bed, how much could you count on people around you to help out?	211	3.16	0.91	3	4	1–4
12	If you needed to talk about your problems and private feelings, how much would people around you be willing to listen?	208	3.00	0.92	3	3	1–4
13	If you needed help with a practical problem, how much would people around you be willing to help?	210	3.14	0.86	3	4	1–4
14	How often has someone been right there with you physically in a stressful situation?	198	3.02	0.9	3	4	1–4
15	How often has someone comforted you by showing you physical affection?	195	2.73	1.01	3	2	1–4
16	How often has someone listened to you talk about your private feelings?	194	2.89	0.98	3	4	1–4
17	How often has someone expressed interest and concern in your well-being?	192	3.10	0.91	3	4	1–4
18	How often has someone suggested some action you could take to deal with a problem you are having?	196	2.93	0.94	3	3	1–4
19	How often has someone given you information that made a difficult situation easier to understand?	195	2.77	0.93	3	3	1–4
20	How often has someone helped you understand why you didn't do something well?	193	2.41	0.99	2	2	1–4
21	How often has someone told you what they did in a stressful situation similar to the one you were experiencing?	191	2.65	0.94	3	2	1–4
22	How often has someone provided you with transportation?	193	2.32	1.09	2	2	1–4
23	How often has someone pitched in to help you do something, like household chores or yard work?	191	2.57	1.03	2	2	1–4
24	How often has someone helped you with shopping?	193	2.01	1.1	2	1	1–4
25	Community adaptation (1 = strongly disagree, 7 = strongly agree)	213	3.40	1.6	3.25	1	1–7
26	Preparing for flooding risk reduces property damage if a flood were to happen	211	3.73	2.2	4	1	1–7
27	Preparing for flooding risk makes the community more resilient	208	3.90	1.99	4	4	1–7
28	Preparing for flooding risk reduces mental health problems if a flood were to happen	209	2.94	2.03	2	1	1–7
29	Preparing for flooding risk makes people want to move away from here[a]	208	3.10	2.16	3	1	1–7
30	Preparing for flooding risk makes people not want to move here[a]	212	3.38	2.14	3	1	1–7
31	Preparing for flooding risk decreases my property value[a]	209	3.33	2.21	3	1	1–7
32	Preparing for flooding risk hurts the local economy[a]	211	3.30	2.24	3	1	1–7
33	Preparing for flooding risk causes my flood insurance costs to increase[a]	210	3.36	2.27	3	1	1–7

[a] Note: reverse coded.

and risk perception, tolerance, social support, community adaptation views, tenure, and climate change as explanatory variables, controlling for sex, age, income, and education. We also conducted correlational analyses to identify any significant relationships between perceptions of risk, tolerance, views on community adaptation, social support, and climate change perceptions.

TABLE 2. Annual flood risk observed or estimated for the past (1985), present (2015) and future (2045). Note that, as shown in Table 2, an increase in annual risk of floods is defined as having 10% or 20% annual risk in 1985. Increases through 2015 come from observed local sea level trends; projected increases through 2045 come from local sea level projections from Kopp et al. (2014). Highlands and Sea Bright values are based on data from and projections at a tide gauge at the Battery in New York City, roughly 32 km away; Tuckerton and Little Egg Harbor values are based on a tide gauge at Atlantic City, roughly 27 km away. Flood height reference is the mean higher high water line defined over the 1983–2001 tidal epoch. Sea level/flood height/risk relationships computed following Tebaldi et al. (2012).

Location	Flood annual risk in 1985 (set values, %)	Flood height above fixed reference high tide line (m)	Flood annual risk in 2015 (%)	Projected flood annual risk in 2045 (%)
Highlands/Sea Bright	10	1.11	16 (15–17)	53 (29–100)
	20	0.95	34 (31–37)	100 (67–100)
Tuckerton/Little Egg Harbor	10	0.92	28 (26–31)	100 (84–100)
	20	0.82	60 (55–66)	100 (100–100)

e. Results

1) PREVALENCE OF BELIEFS, ATTITUDES, AND BEHAVIORS

(i) Experience and personal adaptation behavior

Nearly all respondents reported that they or someone they knew had experienced a flood (91.1%), most often Superstorm Sandy (71.8%) or Hurricane Andrew (7.0%). Few reported that they or someone they know had experienced physical or mental injury (13.1%), while almost all (94.6%) reported that they or someone they know had experienced a financial loss. Most reported that they would take personal adaptation measures to protect themselves and their families (191 out of 219 responses).

(ii) Risk perceptions and tolerance

On balance, respondents saw the annual chances of Sandy-like flooding as having been relatively high (M = 28.1%) in the past and believed those chances to be about the same today [M = 26.8%; Table 1, rows 2–3; $t(209)$ = 0.71, se = 1.64, p = 0.48; Cohen's d = 0.05]. Compared to the scientific estimates shown in Table 2, these judgments overestimate the probability for the past (10%–20% chance of flooding) but underestimate it for the present (16%–60% chance of flooding). Respondents saw the probability of catastrophic flooding 30 years from now (M = 54.4%; Table 1, line 4) as significantly higher than that of 30 years ago, $t(208)$ = 14.7, se = 1.81, $p < 0.001$, and d = 1.01, or today, $t(212)$ = 18.3, se = 1.52, $p < 0.001$, and d = 1.25. Nonetheless, that estimate was still lower than the scientific ones (53%–100%) seen in Table 2.

The distributions of these judgments (Figs. 3a–c) show a spike at 50%, which previous research has found to reflect using 50 in the sense of 50–50, to express uncertainty rather than as a numeric value (e.g., Fischhoff and Bruine de Bruin 1999; Bruine de Bruin et al. 2000). Table 1 (line 5) and Fig. 3c show that respondents' judgments for the probability of at least one flood in the next 30 years (M = 59.1%) was only slightly higher than their judgment of the annual risk at that time. This contrast replicates a familiar research result: the difficulty of estimating how risks compound over time (e.g., Cohen et al. 1971; Shaklee and Fischhoff 1990).

On average, respondents reported that they would tolerate ~58% annual chance of catastrophic flooding and ~66% chance of such flooding at least once in 30 years before deciding to move from the area (Table 2, rows 7 and 8). At the individual level, 85.5% implicitly found the current annual risk tolerable (comparing this judgment to their estimate of current annual risk), and 57.2% found the cumulative risk over the next 30 years tolerable.

Respondents who saw higher flooding risks also reported greater tolerance for it [$r(213) = 0.24, p < 0.001$].

(iii) Climate change acceptance

Most respondents reported that they accepted that climate change is happening (n = 124), with minorities reporting that they did not know (n = 39) or thought that it was not (n = 33). We found that climate change accepters, on average, give 18.4% higher probability estimates of the risk of flooding than did non-accepters {R^2 = 0.11, B = 16.7, $t(170)$ = 3.35, $p < 0.001$, 95% confidence interval [7.07, 26.35]}, controlling for age, sex, household income, and education.

(iv) Social support and tenure

Respondents see themselves as having strong social support of various forms (Table 2, rows 10–24). On average, they reported having lived in their community for about 20 years (Table 2, row 9).

(v) Judged effectiveness of community adaptation measures

Overall, respondents were unsure about the effects of community adaptation measures, with means falling below

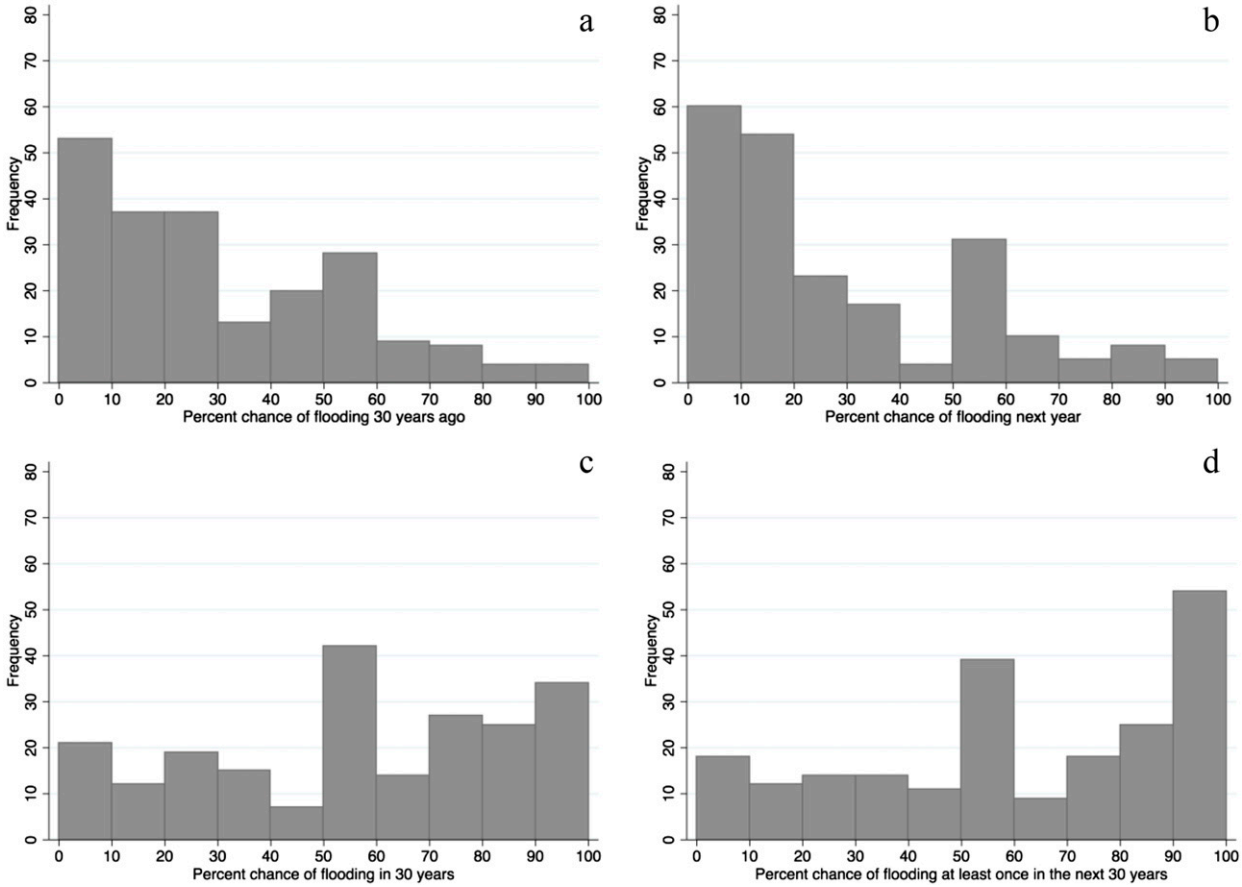

FIG. 3. Distribution of estimates for the chances of flooding in the past (30 years ago), present (next year), future (in 30 years), and at least once in the next 30 years.

the midpoint of the scale eliciting their agreement with statements asserting the effectiveness of the various measures (Table 1, rows 25–33). They expressed the least agreement with the claim that preparing for flooding risk could reduce mental health problems if a flood were to happen (Table 2, row 28). Their median judgment was at the scale midpoint for the claims that preparing for flooding risk reduces property damage if a flood were to happen and makes the community be more resilient (Table 2, row 27).

2) THE ROLES OF RISK PERCEPTIONS AND SOCIAL SUPPORT IN ADAPTATION BEHAVIOR

(i) Predicting personal adaptation behaviors

Given that almost all respondents reported taking some personal adaptation measures, there was little variance to predict. Indeed, we found only one significant predictor, in a logistic regression predicting reported intentions from risk perceptions, risk tolerance, social support, tenure, acceptance of climate change, and beliefs about the effectiveness of community adaptation measures, controlling for basic demographics (Table 3). Respondents were about 2 times more likely to report personal adaptation measures as their reported social support increased by 1 unit (e.g., going from once in a while to fairly often).

(ii) Correlates of social support

Respondents reporting greater social support also held more positive views about the effectiveness of community adaptation measures [$r(211) = 0.16$, $p = 0.03$] and were somewhat more tolerant of flooding risks [$r(211) = 0.13$, $p = 0.06$]. Moreover, those with greater social support were also more likely to see community adaptation as resulting in greater community resilience [$r(211) = 0.14$, $p = 0.02$], less property damage [$r(211) = 0.17$, $p = 0.02$], and fewer mental health problems should flooding occur [$r(211) = 0.18$, $p = 0.01$].

4. Discussion and conclusions

In both in-depth interviews and a structured survey of individuals in communities deeply affected by Superstorm Sandy, we found strong awareness of the risk of coastal

TABLE 3. Summary of logistic regression analysis for variables predicting personal adaptation behavior (n = 171), controlling for demographics. Note that the controls are sex, age, income, and education (omitted from the table); e^B = exponentiated B, and B represents the unstandardized regression coefficient. Climate change predictors (yes, it is happening, no, it is not happening, and I do not know) coded as 1 for yes and 0 for no. Yes, it is happening is the reference category. A Hosmer–Lemeshow chi-square value of 7.12, df = 5, and p value of 0.52 suggests a good fit.

Predictor	B	SE(B)	e^B	p	95% CI	
					Lower	Upper
Risk perceptions	0.01	0.01	1.01	0.24	−0.01	0.04
Tolerance	−0.02	0.01	0.98	0.13	−0.04	0.00
Social support	0.75	0.05	2.12	0.05	0.02	1.48
Community adaptation	−0.03	0.17	0.97	0.85	−0.36	0.30
Tenure	−0.02	0.02	0.98	0.26	−0.05	0.01
Climate change						
No, it is not happening	0.52	0.78	1.68	0.50	−1.00	2.04
I do not know	0.14	0.65	1.15	0.83	−1.13	1.41
Constant	−0.87					

flooding and the expectation that it would get worse. In the interviews, most respondents cited climate change as a factor. In the survey, most respondents reported believing that climate chance was happening. Those who did not (16.8% of respondents) had appreciably lower perceptions of the risk. However, nonbelievers reported the same tolerance for risk and judged the effectiveness of community adaptation measures similarly.

Compared with scientific estimates (Table 2), survey respondents tended to overestimate the annual probability of flooding 30 years ago, correctly estimate that risk today, and underestimate the risk 30 years hence. They greatly underestimated the probability of experiencing at least one flood in the next 30 years (seen as a certainty by only one-third of respondents; Fig. 3d), capturing the difficulty of estimating cumulative risk.

Nearly all respondents in the interviews reported personal experiences, such as direct observations of rising sea level and changing weather patterns that they interpreted as evidence of increasing risk. For example, ''What is causing it? I can't really say. It could be just a natural cycle. It could be contributed to global—ice melting or whatever. But either way, it is happening. . .something is different in the last 52 years in this area'' (p8). In the survey, one respondent in seven reported that the current annual flooding risk was higher than their tolerable level; about 43% thought that it would be higher than their tolerable level in 30 years. Most reported that the annual chance of flooding would have to be at least 50% before deciding to move (Fig. 4a).

Respondents' tolerance was marginally higher for those who reported greater social support. It was unrelated to how long they had lived in the area or their acceptance of climate change. Those reporting higher social support also reported taking more personal protective measures and seeing community adaptation measures as more effective. In contrast, responses to the questions about personal and community measures were unrelated to acceptance of climate change or how long they had lived in the community. Thus, people with stronger social support may be more tolerant of flooding risk because of the ''cushion'' that it provides (Hsee and

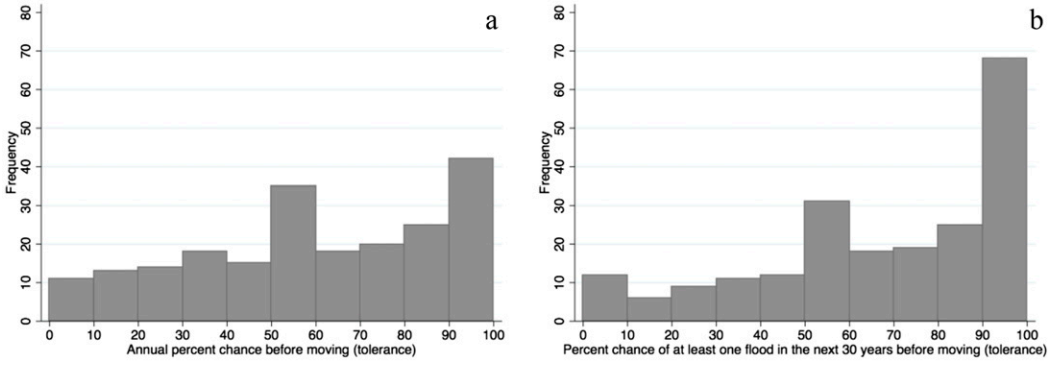

FIG. 4. Distribution of estimates of annual chances and chances of at least one flooding event happening in the next 30 years before residents would consider moving.

TABLE A1. Shows counts and frequency of mentions per code identified in the interviews.

Code Name	Code	Subcode	Subcode description	Count	Percent Respondents
Proximal flood cause	PFC	combination	A perfect storm or perfect alignment of factors	2	33%
	PFC	fullmoon	Full moon	3	50%
	PFC	heavyprecipitation	Heavy precipitation	1	17%
	PFC	hurricanes	Hurricanes	4	67%
	PFC	nor'easters	Nor'easters	4	67%
	PFC	storms	Storms in general	5	83%
	PFC	winds	Changing winds	2	33%
	PFC	tides	Tides	5	83%
Distal flood cause	DFC	climatechange	Climate change	4	67%
	DFC	erosion	Coastal erosion	1	17%
	DFC	risingland	Rising land (pumping fluids into aquifers, etc.)	1	17%
	DFC	sealevel	Increase sea level	5	83%
	DFC	subsidence	Subsidence	3	50%
Distal drivers	DD	ccextreme	Extreme weather events due to climate change	1	17%
	DD	ccglacial	Glacial melt due to climate change	1	17%
	DD	ccicecaps	Polar ice caps melting	2	33%
	DD	ccvariability	Increase variability (e.g., increased rain in some places) due to climate change	1	17%
	DD	ccwaterexpansion	Water expansion due to climate change		
	DD	landerosion	Coastal erosion due to wave action	1	17%
	DD	landsubsidence	Land sinking due wave action		
Drivers cause	DC	buildingpractices	Where people have chosen to build		
	DC	humancarbon	Burning fossil fuels, which releases carbon dioxide into the atmosphere		
	DC	naturalcycle	Natural cycle of temperatures	2	33%
	DC	naturalearth	Earth's movements (e.g., change in tilt or rotation)	1	17%
	DC	waveaction	Wave action		
Drivers cause chances	DCC	predictaccurate	We can predict what will happen with some accuracy	1	17%
	DCC	predictinaccurage	We can't predict what will happen with accuracy	1	17%
Drivers cause mistrust	DCM	ccchangeterm	Change in terminology from global warming to climate change is confusing	1	17%
	DCM	ccnothappened	Prominent figures have said that it was going to happen but it hasn't happened in the way they said it would (e.g., Al Gore: ''ice caps are going to melt in 2013'')	1	17%
	DCM	ccpolitical	It is a political issue, not fact so there must be two sides of the story	1	17%
Climate change acceptance	CCB	naturaladaptexperience	For those who think climate change is natural, humans have already experienced climate change like this so we can deal with it	1	17%
	CCB	naturaladapthandle	For those who think climate change is natural, we can handle the challenge (e.g., through technology)	1	17%
	CCB	naturaladapttime	For those who think climate change is natural, we have time to adjust	1	17%
	CCB	naturalcycle	For those who think climate change is natural, this is a natural cycle where temperatures have increased and will decrease in our lifetime	1	17%
	CCB	riskeverywhere	There is risk everywhere		
	CCB	riskmanageable	The risk of climate change and its impacts are manageable		
	CCB	riskoverblown	The risk of climate change is overblown (cites examples of other risk)	3	50%

TABLE A1. (*Continued*)

Code Name	Code	Subcode	Subcode description	Count	Percent Respondents
Proximal flood response	PFR	evacuate	Evacuate	1	17%
	PFR	stay	Do not evacuate	2	33%
Proximal flood response driver	PFRD	evacuateprevexperience	People will evacuate because of previous experience	1	17%
	PFRD	evacuateplan	People will evacuate because they have a place to go	10	71%
	PFRD	evacuateresources	People will evacuate because they have the resources to do so	10	71%
	PFRD	evacuatefinancial	People will evacuate because they have money	1	17%
	PFRD	stayprotect	People stay because they believe their very presence will save their belongings	1	17%
	PFRD	stayallown	People stay because all they own is in their home	1	17%
	PFRD	staynoplan	People stay because they have nowhere to go	1	17%
	PFRD	staymobility	People stay because they aren't mobile	1	17%
	PFRD	staylanguage	People stay because they do not speak English and are not aware of the risk	1	17%
	PFRD	staylooting	People stay because they fear looting	1	17%
	PFRD	staypets	People stay because they do not want to leave their pets or they can't take their pets with them to a shelter	1	17%
Distal flood response	DFR	move	Move to a new location	4	67%
	DFR	rebuild	Rebuild in the same location	2	33%
	DFR	stay	Stay in the same location	3	50%
Distal flood response drivers	DFRD	moveother	Move for other reasons	5	83%
	DFRD	movepsychological	Move because can't handle psychological trauma	3	50%
	DFRD	moveriskincrease	Move because the risk of flooding is higher	4	67%
	DFRD	rebuildfamily	Rebuild because of family	2	33%
	DFRD	rebuildnearwater	Rebuild because love living near water	2	33%
	DFRD	rebuildnowhere	Rebuild because nowhere else to go	1	17%
	DFRD	rebuildraisespirits	Rebuilding helps morale, raises spirits	2	33%
	DFRD	rebuildroots	Rebuild because love place (roots)		
	DFRD	stayother	Stay for other reasons	2	33%
	DFRD	stayfamily	Stay because of family	—	
	DFRD	staynearwater	Stay because love living near water	2	33%
	DFRD	staynowhere	Stay because nowhere else to go		
	DFRD	stayroots	Stay because love place (roots)	2	33%
	DFRD	rebuild	Rebuild	5	36%
Proximal flood prepare	PFP	boat	Boat	2	33%
	PFP	candles	Candles	1	17%
	PFP	cash	Have extra cash		
	PFP	copydocuments	Remove or copy important documents	1	17%
	PFP	floodproof	Flood proof home/garage	1	17%
	PFP	gasoline (fuel)	Have extra gasoline or fuel		
	PFP	generator	Have an electric generator	3	50%
	PFP	highground	Move valuables to high ground in home	5	83%
	PFP	lamps	Lamps	1	17%
	PFP	landline	Landline (more robust than cellphone)		
	PFP	landscaping	Protective landscaping		
	PFP	plan	Emergency plan (where to go)	4	67%
	PFP	radio	Radio	1	17%

TABLE A1. (*Continued*)

Code Name	Code	Subcode	Subcode description	Count	Percent Respondents
	PFP	removevaluables	Remove valuables from home if possible	1	17%
	PFP	sandbags	Sandbags	1	17%
	PFP	vehiclemove	Move cars and boats to higher ground	4	67%
	PFP	warningservice	A service that provides up-to-date information about an imminent threat	2	33%
	PFP	wood	Wood for fire (or wood stove)	1	17%
	PFP	woodstove	Woodstove	1	17%
Distal flood prepare	DFP	buildinginct	Better incentives for building to stringent code		
	DFP	buildinglocation	Do not build homes in places that are vulnerable to flooding	1	17%
	DFP	buildingreg	Stronger building codes		
	DFP	bulkheads	Bulkheads	2	33%
	DFP	buyouts	Offer buyouts for homes in vulnerable locations	1	17%
	DFP	communitycenter	Offer an area for people to flee the storm	3	50%
	DFP	floodinsurance	Purchase flood insurance	2	33%
	DFP	floodvents	Flood vents		
	DFP	levees	Levees		
	DFP	pilings	Raise homes onto pilings	6	100%
	DFP	seawalls	Sea walls	4	67%
Preparation efficacy beliefs	PEB	notwork	Preparation efforts will not result in greater resiliency	3	50%
	PEB	infeasible	Certain preparation efforts are infeasible	2	33%
	PEB	work	Preparation efforts will result in greater resiliency	2	33%
	PEB	mightwork	Preparation efforts might result in greater resiliency	3	50%
Proximal before event information	PBEI	eventdo	People want to know what they should do in response to the event (where to go to shelter, etc.)	2	33%
	PBEI	eventwhat	People want to know what the event will look like, what will happen (need a deeper appreciation of the risk)	1	17%
	PBEI	eventwhen	People want to know when the event will occur	3	50%
	PBEI	eventwhere	People want to know the place(s) that will be impacted		
	PBEI	preparehow	People want to know how to prepare for an event (resources available, etc.)		
	PBEI	preparewhat	People want to know what to do to prepare	1	17%
Proximal during event information	PDEI	nothing	People do not need information during an event	1	17%
Proximal after event information	PAEI	afterdo	People want to know what they should do to get back in their home safely (e.g., remove insulation to prevent the growth of mildew)	2	33%
	PAEI	afterresources	People want to know how to access resources to help them after an event (flood insurance claims, etc.)	1	17%
	PAEI	afterwhen	People want to know when it is safe to return	1	17%
	PAEI	afterwhere	People want to know where they can go for services (food, etc.)	3	50%
Distal before event information	DBEI	risk	People want to know what the risk is of flooding events	1	17%

TABLE A1. (*Continued*)

Code Name	Code	Subcode	Subcode description	Count	Percent Respondents
	DBEI	riskdo	People want to know what they can do to respond to the risk appropriately		
	DBEI	riskwhatdone	People want to know what is being done to mitigate the risk		
Responsibility prepare	RP	federaladvicelow	Federal not responsible for giving direct advice	3	50%
	RP	federalrecovery	Federal responsible for helping with recovery	1	17%
	RP	federalunderstandlow	Federal does not know local needs and situation	2	33%
	RP	individualpreparehome	Individuals are responsible for preparing their homes; especially if they choose to live in a place that is at risk	4	67%
	RP	state/localadvice	State/local responsible for providing information	3	50%
	RP	state/localbuildingcodes	State/local responsible for creating building codes that are appropriate for vulnerable areas		
	RP	state/localemergency	State/local responsible for local preparedness (major infrastructure, etc.)	2	33%
	RP	state/localhelp	State/local responsible for helping citizens (fire, police, emergency managers, etc.)		
	RP	state/localshelter	State/local responsible for providing shelter to those who need it		
	RP	state/localunderstand	State/local knows local needs and situation	2	33%
Responsibility beliefs	RB	individualother	People think that other people are not as responsible as they are	2	33%
Information channel	IC	facebook	Facebook		
	IC	flyers	Flyers	1	17%
	IC	internet	Internet	3	50%
	IC	loudspeaker	Loud speaker (e.g., someone driving around town with a loudspeaker)		
	IC	newspaper	Newspaper		
	IC	phone	Telephone	1	17%
	IC	radio	Radio	2	33%
	IC	siren	Siren/alarm		
	IC	textmessages	Text messages	1	17%
	IC	tv	TV	3	50%
	IC	tweets	Tweets		
	IC	verbal	Verbal (person to person)	1	17%
Information type	IT	animation	Animated maps (e.g., weather channel)	1	17%
	IT	maps	Flood risk maps (e.g., FEMA maps)	3	50%
	IT	numbers	Numbers that express probability	4	67%
	IT	words	Words that describe the risk	4	67%
Information source	ICM	family	Family	6	100%
	ICM	federalauthorities	Federal authorities	1	17%
	ICM	friends	Friends	1	17%
	ICM	insurancerepresentatives	Insurance	3	50%
	ICM	localauthorities	Local authorities		
	ICM	meteorologists	Meteorologists	5	83%
	ICM	mortgagebroker	Mortgage broker		
	ICM	neighbors	Neighbors	1	17%
	ICM	school	School		
	ICM	work	Work		
Information source trust	IST	federalauthoritynounderstand	Federal authorities do not understand situation and needs of local communities	3	50%
	IST	federalauthoritytrustworthy	Federal authorities are trustworthy	3	50%

TABLE A1. (*Continued*)

Code Name	Code	Subcode	Subcode description	Count	Percent Respondents
	IST	federalauthroitydobest	Federal authorities do the best they can	1	17%
	IST	insurancerepshelp	Insurance representatives are helpful		
	IST	insurancerepslowclaims	Insurance representatives want to make sure that they do not have to pay claims (they try this)	1	17%
	IST	insurancerepssavemoney	Insurance representatives want to save money		
	IST	localauthoritiesdobest	Local authorities do the best they can	1	17%
	IST	localauthoritieshelp	Local authorities are helpful	2	33%
	IST	localauthoritiescommunity	Local authorities are members of the community	1	17%
	IST	localauthoritiestrustworth	Local authorities are trustworthy	6	100%
	IST	localauthoritiesunderstand	Local authorities understand the situation and needs of local communities	2	33%
	IST	meteorologistentertain	Meteorologists are for entertainment	2	33%
	IST	meteorologistsdobest	Meteorologists do the best they can	2	33%
	IST	meteorologistsgoodasinformation	Meteorologists are only as good as the information they receive	2	33%
	IST	meteorologiststrustworth	Meteorologists are trustworthy	3	50%
	IST	meteorologistswrong	Meteorologists are often wrong	1	17%
	IST	meterologistsradiovstv	Meteorologists on the radio are more trustworthy than on the TV	2	33%

Weber 1999; Weber and Hsee 1998) but also because of their engagement with personal and community actions. For example, respondents who reported greater social support also rated community protective action as increasing community resilience, while reducing mental health impacts and property damage. These complex roles of social support (less willing to leave, more willing to adapt in place) and attachment to place warrant future study, as do potentially related factors such as social norms and feelings of self-efficacy.

Limitations

One limitation of our results is that the sample is not representative but was recruited from individuals with direct experience with the event through personal contacts, town websites, and web-based newsletters. We did not send surveys by mail as many residents were not living in their homes, which were still being repaired from Sandy damage, or had their primary residence elsewhere. Thus, we obtained a sample of interested and affected parties (Stern and Fineberg 1996). We can only speculate on how the kinds of individuals not represented here might have responded. For example, residents who have left the area, or are not connected to the community sources that we used for recruiting, might report less social support, lower risk tolerance, and less belief in the effectiveness of community action.

A second limitation is our relatively small sample size ($n = 224$), whose members varied little on some critical measures (e.g., personal action), thereby precluding more complex statistical models (which require variance to predict). A third limitation is that we do not know respondents' exact location and hence could not calculate a scientific risk estimate for each to compare with their judgments (which was part of our original plan), leaving us with the ranges shown in Table 2. Given the overall patterns observed here, more detailed study of how local conditions affect judgments is warranted (e.g., are they related to local terrain, views of the ocean?).

A final observation is that participants' reported political ideology was unrelated to any attitude or behavior reported here, despite being been an important predictor of climate change acceptance and, to a lesser extent, of mitigation-related behaviors in other studies (Hornsey et al. 2016). Speculatively, political ideology may matter less when it comes to practical matters of adaptation behavior than it does on principled matters of mitigation policies (Wong-Parodi and Fischhoff 2015).

Our findings suggest that local residents are aware of the risk of flooding and expect it to get worse, although without fully appreciating how bad it might be. They feel responsibility for preparing for that risk but are uncertain about the value of most community protective measures. Social support appears central to their thinking, leading some residents to take measures because those are the right things to do but without confidence in their efficacy. During the interviews, participants who had little difficulty listing things that they could do often wondered about the options for people with fewer financial or social resources ["people who don't have as much as other people" (p9)] and other constraints (elderly, nonnative English speakers, one-story homes, etc.).

TABLE B1. Summary of correlations between community adaptation beliefs, flooding risk, and risk tolerance.

Community adaptation beliefs	Flooding risk		Risk tolerance	
	r	*p*	*r*	*p*
Preparing for flooding risk reduces property damage if a flood were to happen	0.06	0.51	0.09	0.18
Preparing for flooding risk makes the community more resilient	0.01	0.93	0.05	0.52
Preparing for flooding risk reduces mental health problems if a flood were to happen	−0.01	0.83	0.06	0.44
Preparing for flooding risk makes people want to move away from here	−0.12	0.09	0.03	0.64
Preparing for flooding risk makes people not want to move here	−0.09	0.17	−0.09	0.22
Preparing for flooding risk decreases my property value	−0.09	0.21	0.02	0.75
Preparing for flooding risk hurts the local economy	−0.03	0.63	0.04	0.60
Preparing for flooding risk causes my flood insurance costs to increase	0.00	0.97	0.14	0.05

Providing all residents with practical options (Margolis and McCabe 2003) is a challenge for planners and officials (Armitage et al. 2011). Those efforts might consider the role of social processes in facilitating in individual and community actions—both to reduce the risk of flooding and to speed recovery from it in the face of increasing risk due to climate change.

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APPENDIX A

Codebook

The counts and frequency of mentions per code TA1 identified in the interviews are listed in Table A1.

APPENDIX B

Summary Correlations

A summary of correlations between community adaptation measures, flooding risk, and risk tolerance is presented in Table B1.

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