Should I stay or should I go? An experimental study of health and economic government policies following a severe biological agent release

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Abstract Extensive research has explored policy challenges associated with preparing and responding to a large-scale biological release. A key component in recovery strategy development that has received less attention is the understanding of government policy influence on the impacted populations' migratory decisions. This study experimentally manipulates health and economic government policies during response and recovery to assess the extent to which public migration is contingent on the level of government intervention. Set immediately following a large-scale anthrax release in San Francisco, we use a five episode video scenario to describe details about the environmental impacts of the disaster, emergency response procedures, and clean-up operations. Within these video segments, the extent of government involvement in economic and health risk policies is manipulated. Using these manipulations as predictors, we track how varying levels of government risk signals influence migration behavior at three distinct decision points during disaster recovery. In addition, two belief scales and two scales of emotion (affect) are included as predictors to explore the potential for their mediating role in explaining intentions to migrate. We find that the decision to migrate is highly context-sensitive, with each decision point showing a unique combination of significant predictors influencing decision making. At 19 days following the anthrax release, the health risk policy manipulation has both a direct and indirect effect on migration behavior. At 3 months, the influence of the health risk policy manipulation is mediated by beliefs, and at 1 year, only indirect effects associated with affect and beliefs influence migration.

Keywords Risk perception · Anthrax · Population migration · Terrorism · Disaster recovery

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1 Introduction

In recent history, anthrax infection has been an environmental threat largely in rural areas. Illness occurred when wild and domesticated animals either ingested or inhaled the spores while grazing. On rare occasions, diseased animals spread anthrax to humans either by direct contact (e.g. through broken skin) or by consumption of a diseased animal. Of more recent concern is the threat of anthrax infection to urban communities. As evidenced by the 2001 anthrax incidents in the United States, the release of anthrax caused widespread anxiety and required lengthy and costly remediation for enclosed, indoor areas. Weaponized anthrax is also capable of aerosolized transmission and mass production (Kortepeter and Parker 2009). When properly weaponized this agent is invisible, odorless, tasteless, and easily re-aerosolized, presenting the potential to cause large disease outbreaks in urban environments (Weis et al. 2002).

Of those infected by anthrax, 80 % are estimated to die (Runge 2008). Furthermore, once dispersed, anthrax spores are very difficult to dispose of and may remain deadly until the affected area—especially indoor areas—can be decontaminated (Weis et al. 2002). Federally mandated clean-up standards are quite exhaustive, costly, and time-consuming, with estimates for decontamination of a major city taking up to 10 years (Franco and Bouri 2010). The

potential for massive loss of life coupled with long-term contamination could attach a negative stigma to the region, making habitation of the area unattractive.

The 2001 U.S. anthrax attack and numerous drills for weapons of mass destruction have shown that it is difficult to prepare fully and respond completely to a large-scale anthrax disaster (Hillel et al. 2004; Gursky et al. 2003; Department of the Army 1977). There are inevitably direct costs to property and immediate effects on productivity, as well as longer term decontamination and clean-up costs. There are also ongoing effects on productivity, as well as indirect costs of overly cautious public responses to terrorism (Giesecke et al. 2012). To minimize lengthy and costly consequences of an anthrax release, officials at local, state, and national levels recognize the importance of coordinating preparedness, response, and recovery strategies.

A key component in the development of recovery strategies is understanding how government policy influences behavior, particularly migratory decisions (Tierney et al. 2006). Research suggests that public attitude and behavior is largely influenced by the various risk signals implicit in official government advisories and policies (Burns and Slovic 2007; Pidgeon et al. 2003; Slovic 1987). The 1906 San Francisco earthquake is a good historical example of how risk signals influence public attitudes and behavior. Government officials strategically minimized the risk signals associated with the earthquake and emphasized those related to the thirty-plus fires (resulting from the earthquake). Shifting the focus of the disaster from earthquake to fire, a more familiar and preventable event, the local government was successful in calming the fears of those considering either migrating out of San Francisco, as well as those elsewhere thinking of migrating to San Francisco. By minimizing the disastrous consequences of the largely unfamiliar, unpredictable, and unpreventable earthquake, the local government officials minimized risk signals that influence public attitudes and decision making.

Our research uses a video-based simulation of media news reports about a terrorist-caused anthrax release in a U.S. urban area to study the impact of health and economic policies on the affect, beliefs, and migration intentions of the targeted population (Rosoff et al. 2011, 2012a, 2012b). The scenario unfolds over 1 year and is presented in discrete episodes describing the disaster, the government's emergency medical and law enforcement response, and plans for clean-up and rebuilding. Within the scenario, two types of government policies during response and recovery are experimentally manipulated: (1) health risk and (2) economic risk. The policy manipulations are designed to address different levels of government response policies, a critical factor thought to impact risk perception and decision making. The details of each of the scenarios are kept constant except for the manipulated variables.

Due to the complex and ever-changing developments of a large-scale disaster, analysis of respondents' migratory intentions is conducted as three discrete time periods (19 days, 3 months, and 1 year following the anthrax release) and treated as three unique decision frames. Our research assumes that each decision frame is contextually sensitive and qualitatively unique and focuses on the influence of the policy manipulations on cognitive and affective responses, as well as intentions to migrate within each time period.

We anticipate that the type of government action and the extent of government commitment to that action provide important clues to the public as to the level of risk associated with a disaster. As such, we hypothesize that during the response phase, the stronger the risk signals demonstrated by government action, the more protected the population will feel and, in turn, the more likely they will be to remain in the region. Conversely, during the recovery phase, greater government involvement implies too much protection at a time when the situation is expected to be more manageable. As a result, the residents will perceive government actions as an indicator that the region is unsafe and in turn are more likely to migrate out of the area.

We also believe that while the manipulations shape migration decisions, changes in beliefs and affect are potential mediating variables for explaining migration intentions at various post-event points in time. We expect that following the anthrax release, government policies signaling high risk will result in more negative reactions to the situation, as well as attenuated beliefs about personal safety and government confidence. Such reaction to the uncertain and unpredictable consequences of anthrax is believed to contribute to increased intentions to leave the region. Yet, as evidence of recovery increases and risk signals dissipate, public confidence is expected to grow, positive affect is predicted to increase, and negative affect is predicted to decrease, driving increased intention to remain and return to the region.

The next section of this paper describes the anthrax release scenario simulation and details of the methodology used to gather respondents' emotions, beliefs, and migration decision making. Section 3 reports the findings of our experiment, emphasizing the recovery phase of the scenario. Section 4 summarizes our findings and discusses how government policies and actions impact respondents' migratory decisions following an anthrax release.

2 Methods

A scenario simulation of an anthrax release in San Francisco with two manipulated variables was developed to evaluate the role of risk signals on public behavior using a

3 (economic risk policy) by 3 (health risk policy) independent groups (between subjects) factorial design across 5 episodes. Subjects were randomly assigned to one of nine unique study conditions. The scenario was developed to capture the aftermath of the event over a simulated 1 year to allow for the evaluation of the dependent variables over the five episodes (a repeated measure factor). These episodes act as news updates taking place 93 h, 9 days, 19 days, 3 months, and 1 year after the anthrax release.

2.1 Design overview

In 2006, the Department of Homeland Security (DHS) began the Interagency Biological Restoration Demonstration (IBRD) project to improve local, regional, and national response plans in the event of a large-scale biological agent release. The IBRD project culminated in a simulation of a massive anthrax release in a major city. To test the limits of the country's preparation for an anthrax release, the depicted scenario contained an extremely large death toll and economic cost. The anthrax scenario developed for the IRBD project was adapted for use in this San Francisco-based experiment. Resulting in casualties upwards of 54,000 individuals along with 100,000 infected individuals, a disaster of this size could be considered a "worst-case credible threat".

As suggested by construal theory (Fiedler 2007), we sought to maximize the realism of the disaster scenario and engage respondents emotionally. The scenario is presented as a series of news updates. In addition, we use every opportunity to show footage of familiar San Francisco communities and landmarks. This increases the realism of the videos and minimizes psychological distance from the simulated anthrax release events (Trope and Liberman 2010; Bar-Anan et al. 2006).

The first three episodes constitute the "response phase" while the last two are set during the "recovery phase." The response phase is marked by ongoing emergency medical and evacuation services with ever-increasing death tolls and infection rates. The recovery phase features a calmer San Francisco, still reeling from the disaster's human and economic impacts, but linked to a low likelihood of harm for those who were not infected in the first few days.

Government emergency response policies related to health and economic risk are manipulated independent variables, each with three levels of involvement: low, medium, and high. Within our scenario, the medium level of each manipulation closely resembles current government response plans; therefore, the extreme conditions can be interpreted as departures from a typical response. With respect to health risk policy, the government shows high levels of involvement when, for example, emergency managers over-prepare for antibiotic distribution with additional treatment sites, or when public health officials decide that food products containing harmless traces of anthrax be destroyed. Low involvement is demonstrated when the smallest recommended supply of antibiotics is mobilized to protect the affected region, or when Hazmat responses to ongoing anthrax scares are less urgent.

The three levels of economic risk are similarly manipulated to capture how varying levels of government involvement in economic recovery affects respondents' decision making. Within this domain, the government expresses its maximal commitment to San Francisco's economic recovery through the use of financial incentives and grants. High levels of involvement are demonstrated through early and sustained financial support, with government funds assisting in immediate migration costs as well as long-term tax incentives, mortgage and rent assistance, and substantial grants for businesses choosing to remain. Low levels of involvement are characterized as economic assistance that is slow to arrive, stoicism on behalf of the government in response to a massive housing crash, and an underlying stance that the region will recover if left generally to its own devices. A summary of the scenario and the manipulations used at each time point are provided in Tables 1, 2 and 3.

The scenario simulation describes events through five video segments over the first year following the anthrax release. Respondents completed the scenario simulation exercise in one session (about 40 min, including responses). Through the use of freely accessible video clips from the internet and careful editing, the written script for the news report was aligned with images of San Francisco and anthrax.

2.2 Participants

In August 2011, respondents in San Francisco and nearby communities were recruited using the Qualtrics online survey panel and Amazon's Mechanical Turk Web site to participate in the San Francisco scenario simulation exercise. The Qualtrics panel members opened the link to the online survey which, with help from Qualtrics' survey administrators, included questions to determine whether respondents were paying attention to the video presentations. Qualtrics was responsible for omitting respondents who did not complete the survey or failed the attention check questions. Qualtrics received a payment for access to their panel and handled the compensation of respondents. In the end, Qualtrics reported that 416 members from the Bay Area successfully completed the survey. In the case of Amazon Mechanical Turk participants, 50 respondents who lived in the qualifying area were recruited and completed the same survey provided to Qualtrics panel members (none of the qualifying participants were omitted). Each Amazon Turk respondent was paid $2 for their

Table 1 Summary of anthrax release scenario

Scene	Time line	Synopsis of scene
1	93 h after release	Homeland security announces that there has been an anthrax release in San Francisco and South San Francisco near San Francisco International Airport. Fourteen people have already died, and 250 more are infected. Up to 500,000 San Franciscans are believed to be exposed to anthrax; this number is difficult to determine as the exact boundaries of the contaminated areas are unknown. The residents of San Francisco in downtown are being told to evacuate. A 60-day antibiotic treatment is being prescribed to any resident of the San Francisco area that may have been exposed to anthrax since the release four days prior
2	9 days after release	Local supplies of antibiotics are depleting quickly. Antibiotics from the federal stockpile are expected to arrive to the region shortly. The death toll has reached 12,000, with 80,000 believed to be infected. Decontamination and treatment centers are inundated with San Francisco residents seeking help. In addition, many of the reported deaths are due to residents being unable many to get antibiotics in time. Results are also concerned about antibiotic side effects, and consequently, some are refusing to comply with the 60-day regimen
3	19 days after release	The death count is over 54,000, with an additional 10,000 infected. Thousands of residents are leaving San Francisco daily, and as a result, there are massive traffic jams on all major roads leading out of the city. Local residents are being reported as either evacuating their homes, staying in San Francisco or heading to shelters offered by the Red Cross. Overall, infection rate has fallen drastically and is expected to continue falling. Now that the medical situation appears to be improve, infrastructure problems are becoming more apparent, for example, lack of provision of basic services such as trash clean-up
4	3 months after release	The terrorists responsible for the anthrax release are apprehended. The city of San Francisco is now focusing on clean-up and recovery. The federal government has funnelled tens of millions of dollars into the recovery of San Francisco, but local businesses are still struggling to stay afloat. The decontamination of homes and businesses is ongoing in and around hot zones. Property values are being reported as continuing to fall steadily since the release. Vaccination programs offered by the federal government are an ongoing initiative that is important to protecting the residents of San Francisco from the long-term danger of secondary contamination
5	1 year after release	The downtown hot zone is slowly reopening after cleaning and testing by the Environmental Protection Agency (EPA). Estimates for the complete decontamination of San Francisco range from 4 to 8 years. Federal economic aid is ongoing and being targeted to workers, homeowners, and business owners. There is also ongoing financial support for those who stayed in Bay Area. The long-term economic effects are being felt by region. In addition, stress-related problems (including post-traumatic stress disorder) are also plaguing San Francisco Counseling and community programs paid for by the federal government are attempting to help the region recover

participation. Ultimately, a total sample of 466 adults were recruited to participate in the scenario simulation exercise.

2.3 San Francisco anthrax release scenario

The San Francisco scenario is presented as five local news updates, the first of which involves DHS announcing the release of anthrax 93 h prior. At this point, the extent of the damage caused by the release is unknown, but government agencies are working to capture those responsible, identify contaminated sites, and mobilize federal antibiotic stockpiles. Initial assessments have identified a few sites testing positive for anthrax spores. All persons who have been in these areas over the previous 4 days are instructed to go to the hospital and start taking antibiotics immediately. Fourteen people are reported to have died and thousands are believed to be infected. Nine days after the release, 12,000 people have died, and many more are hospitalized. Local supplies of antibiotics are running low, but federal stockpiles are planned to arrive soon. The situation is expected to worsen as more people begin to show symptoms of infection. By the 19th day post-release, over 54,000 people have died. The rate of deaths and new infections is slowing, revealing a devastated city infrastructure. At 3 months

following the release, the risk of anthrax infection is very low, despite the occasional scare. Clean-up of public and residential property continues as the government offers some assistance to combat falling home values. One year after the release, very few contaminated areas have reopened; full decontamination is expected to take another 4–8 years. Long-term economic impacts of the release are being felt across the region as businesses struggle to regain losses inflicted by the disaster. Government assistance programs target workers, home owners, and business owners that stayed in the Bay Area throughout the disaster and offer incentives aimed at rebuilding the economy. An overview of the scenarios generated by the 3 (economic risk policy) by 3 (health risk policy) design is presented in Tables 1, 2, and 3.[1]

2.4 Measures

To assess reactions to the anthrax release, respondents are asked a series of questions after each episode. Respondents are instructed to answer all questions as if the events they

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[1] Copies of the videos developed for the scenario simulation are available upon request to rosoff@usc.edu.

Table 2 Summary of the government health policy manipulation

Level	Scene	Health manipulation
Low	2	Public health officials admit the number of distribution sites needed has been underestimated, but there are no additional resources in place to correct for this problem
	3	Food reported as exposed to anthrax is field tested and found not to be dangerous to humans
	4	The threat of anthrax infection outdoors has ended, and San Francisco residents are being urged to carry on with their normal lives
	5	Clean-up standards have been lowered, and Hazmat Crews are prepared to respond to and manage all reported anthrax-related infections
Medium	2	Public health officials admit the number of distribution sites needed has been underestimated, but now, they are working rapidly to correct this problem
	3	Food reported as exposed to anthrax is field tested and found not to be dangerous to humans. However, it is unclear if the food will return to store shelves. Also, in recent weeks, residents of San Francisco have been warned of the ongoing possibility of tainted produce reaching store shelves
	4	Warnings are issued about the potential for, but unlikely occurence of secondary contamination from spores in the environment. For safety reasons, San Franciscans are instructed to take precautions, such as wear long clothes, never walk outside in bare feet, and carefully wash and dress minor wounds with antibiotic ointments
	5	Officials are considering lowering clean-up standards, and while Hazmat Crews are prepared to respond to and manage all reported anthrax-related infections, authorities are hesitant to interrupt business by evacuating the area
High	2	Public health official's overestimate the number of distribution sites needed. They also have flown top anthrax experts to San Francisco to help make life-saving policy decisions
	3	Food reported as exposed to anthrax is field tested and not to be dangerous to humans. Despite this, the food was destroyed and barred from store shelves. Also, in recent weeks, residents of San Francisco have been warned of the ongoing possibility of tainted produce reaching store shelves
	4	The threat of anthrax infection outdoors has ended and San Francisco residents are being urged to carry on with their normal lives
	5	Ongoing health concerns are apparent to officials. Officials are continuing to take threats seriously, having Hazmat evacuate surrounding areas before testing each site. This has slowed business and the clean-up process, but officials are resolute in their zero tolerance policy

are about to watch actually occurred and to imagine how they would personally respond to the scenario. Table 4 outlines all the questions posed to respondents in the San Francisco experiment.

After each episode, respondents are asked to evaluate their migration decision on a 5-point Likert agreement scale from 1 (strongly disagree) to 5 (strongly agree). Following the first 3 episodes (93 h through 19 days) only, respondents are asked to indicate their level of agreement with the phrase "I would *LEAVE* the Bay Area at this point in time." Once respondents decided to leave San Francisco, they are not asked again whether they would return until the fourth episode (3 months after the release). Following the fourth and fifth episodes (3 months and 1 year after the release), respondents are asked to indicate their level of agreement either with the phrase "I would *LEAVE* the Bay Area at this point in time" or "I would *RETURN* to the Bay Area at this point in time." The question respondents received is contingent upon whether the respondent indicated she/he was in the Bay Area or not in the previous episode. Independent of question wording, a response of strong agreement or agreement indicates that the respondent is making a transition, that is, leaving or returning

from their current location. All other responses are recorded as no change in location.

In addition, included as a pre-measure and following each episode is a version of the Positive Affect–Negative Affect Scale (PANAS) to measure self-reported emotionality throughout the scenario (Watson et al. 1988). In order to avoid participant fatigue, an abbreviated 10-item PANAS was employed focusing on risk perception and public response related to disasters and terrorism which used the full 20-item PANAS (Rosoff et al. 2012a). The positive emotions included are "enthusiastic," "inspired," "strong," "determined," and "active," each rated on a 6-point scale then aggregated for an overall positive affect score. Negative emotions included are "distressed," "upset," "nervous," "afraid," and "scared," also on a 6-point scale and aggregated. To ensure that our constructed scales are credible, Cronbach's alpha (a measure of how closely related a set of items are in a group) is assessed at each time period to account for changing circumstances in affective responses throughout scenario development. Cronbach's alpha for the positive affect subscale ranges from 0.87 to 0.93 and for the negative affect subscale from 0.91 to 0.96.

Table 3 Summary of the government economic policy manipulation

Level	Scene	Economic manipulation
Low	2	The federal government is reserving Federal Emergency Management Agency (FEMA) aid until it is clear that it is needed
	3	Following grim economic reports, disgruntled business owners and employees make a united appeal to Washington to request for financial assistance
	4	As property values continue to fall, the federal government has so far failed to respond to the worsening housing crisis
	5	Federal disaster relief funds are now finally being put in place in the Bay Area. Plans are underway to provide financial support to the region, but no details are known yet
Medium	2	FEMA resources and relief funds have been released to the Bay Area to supplement the aid from California emergency funds
	3	Following grim economic reports, government officials in Washington make promises of no-interest loans for business owners and expanded unemployment benefits for those forced out of work
	4	As property values continue to fall, the federal government has pledged to partially subsidize mortgage payments through sizeable tax breaks for homeowners who decide to remain
	5	Disaster unemployment assistance is still available to those who have been out of work. Economic injury disaster subsidies are available to businesses to help recoup some of the losses. In addition, financial assistance has helped San Francisco residents with rent and mortgage payments, as well as low-cost loans, capital investment grants to local businesses, and unprecedented low tax rates in the region
High	2	FEMA resources and relief funds have been released to the Bay Area to supplement the aid from California emergency funds. Debit cards worth $500 also are being distributed to those near the attack sites to cover relocation and temporary living expenses
	3	Following grim economic reports, Washington was quick to respond, already delivering funds from the US Small Business Administration to reimburse any financial losses due to the anthrax attacks and to assist business owners and homeowners in temporarily relocating outside the contaminated areas
	4	As property values continue to fall, the federal government has fully subsidized mortgage payments for homeowners who decide to remain
	5	An array of economic incentives for those who remain in the Bay Area is being offered by the federal government. Large subsidies for employees, homeowners, small business owners, and corporations continue to pump tens of millions of dollars into the region. Government officials are committed to fully repairing the regional economy

Measures of the public's perception of the government response to the anthrax release also are obtained. At 19 days, 3 months and 1 year following the anthrax release, respondents are asked questions assessing their perception of (1) government commitment to economic recovery and health safety measures and (2) lasting feelings of safety. Perceptions of the efficacy of government policies and actions are measured using a 5-point Likert scale consisting of the following four items: (1) I feel the government is spending enough money on health concerns following the anthrax release, (2) I feel the government is spending enough money on economic concerns following the anthrax release, (3) I feel confident the Bay Area economy will recover, and (4) I approve of the government's response following the terrorist release. Chronbach's alpha ranged from 0.80 to 0.86 over the three time points (19 days, 3 months, and 1 year), suggesting high reliability (internal consistency), for the aggregate measure of perception of government efficacy. Lasting feelings of safety is measured at each of the three time points using a 5-point Likert scale consisting of the following two items: (1) I would feel safe walking around in my own neighborhood, and (2) I would feel safe walking around in San Francisco. This scale is based on an a priori assumption that respondent will feel less safe when government policies result in strong risk signals (Paxson and Rouse 2008).

At 3 months and 1 year following the anthrax release, additional questions are included to assess participants' reactions to the anthrax crisis. Respondents indicate agreement versus disagreement on a 5-point Likert scale regarding the following intentions: (1) whether they will continue going to work, (2) whether the anthrax release poses a serious risk to them and their families/friends, and (3) whether they will send their kids to school during the crisis if the schools remain open.

At the close of the survey, basic demographic information is collected, along with personality variables which are excluded from the present analyses. Table 5 includes a summary of the demographic information collected.

3 Results

During the first 19 days following the anthrax release, respondents indicated whether they would stay or leave the region. As shown in the transition state diagram in Fig. 1, nearly half of the respondents (44 %) intend to leave as soon as the release is announced to the public (Day 4). As

Table 4 Summary of experimental protocol and measures

Data collection	Measures
Pre-measure	PANAS 10-item
Scene 1	PANAS 10-item
(93 h after release)	Initial reactions to anthrax crisis, 5-point Likert (e.g. : I would continue going to work or school if open.)
	Relevant uncertainties, 6-point importance ranking (e.g. : risk of exposure to anthrax)
	Personal objectives, relative ranking
	Decision to leave/stay
	(If decided to leave) Plans for housing/work
Scene 2	PANAS 10-item
(9 days after release)	Ongoing reactions to anthrax crisis, 5-point Likert (e.g. : I believe the anthrax release poses a serious risk to me.)
	Relevant uncertainties, 6-point importance ranking (e.g. : risk of exposure to anthrax)
	Decision to leave/stay
	(If decided to leave) Plans for housing/work
Scene 3	PANAS 10-item
(19 days after release)	Lasting feelings of safety, 5-point Likert (e.g. : I would feel safe walking in my own neighborhood)
	Perception of the government, 5-point Likert (e.g. : I approve of the government's response to the anthrax release)
	Personal objectives, relative ranking
	Decision to leave/stay
Scene 4	PANAS 10-item
(3 months after release)	Lasting feelings of safety, 5-point Likert
	Perception of the government, 5-point Likert
	Relevant uncertainties, 6-point importance ranking
	Personal objectives, relative ranking
	Decision to leave/stay/**return**
Scene 5	PANAS 10-item
(1 year after release)	Lasting feelings of safety, 5-point Likert
	Perception of the government, 5-point Likert
	Relevant uncertainties, 6-point importance ranking
	Personal objectives, relative ranking
	Reaction to proposed government incentives, 6-point Likert (ex: subsidies for the clean-up of private property)
	Decision to leave/stay/return
	(If decided to return) Plans for housing/employment
Demographics and additional variables	Incentives for working in San Francisco, pay raise
	Personality scales: self efficacy, death anxiety, neuroticism
	Age
	Sex
	Marital status
	Years living in the Bay Area
	Housing status (homeowner, renter, etc.)
	Parenthood status
	Employment status
	Income bracket
	Proximity to release sites (zip code and commute)
	Plans for migration (if necessary)
	Reaction to additional incentives for those who did not return

**Table 5** Demographic information for San Francisco respondents

Demographic variable	Variable response category	Percentage of sample
Demographics (N = 466)		
Age	18–29	32
	30–44	28
	45–64	31
	65 and older	9
Sex	Male	47
	Female	52
Marital status	Single, living alone	40
	Single, lives with SO	14
	Married	32
	Divorced/separated	11
	Other	3
Time living in Bay Area	<1 year	9
	1–3 years	10
	4–6 years	7
	7–10 years	6
	More than 10 years	66
Monthly household income	Up to $3000/month	18
	$3000–$5999/month	26
	$6000–$8999/month	8
	Over $9000/month	5

Due to respondents' omitted results, not all percentages will add to 100
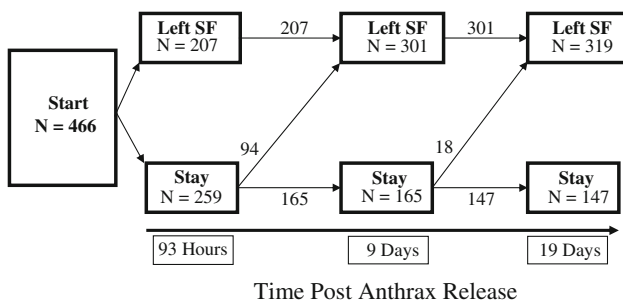
Fig. 1 The dynamics of evacuation and return behavior during the response period in San Francisco. After 93 h, 207 have left the city, 259 have stayed. After 9 days, 301 have left the city, 165 have stayed. After 19 days, 319 have left the city, 147 have stayed

the death toll begins to mount on Day 9, the proportion of respondents leaving approaches two-thirds (65 %). Interestingly, over the next 10 days, the vast majority of those still in San Francisco indicate a willingness to remain in the city, with evacuation totals increasing by only a small amount (68 %). During recovery (3–12 months), respondents who evacuated indicated whether they would return to the region or not, and those who did not evacuate indicated whether they would continue to remain in the
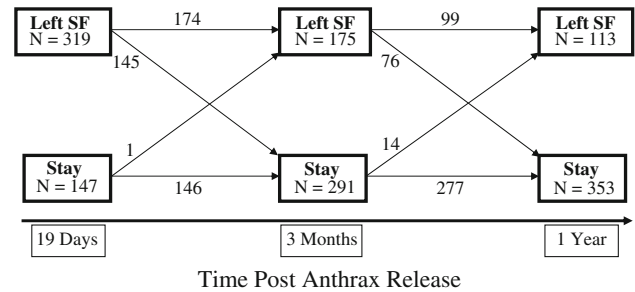
Fig. 2 The dynamics of evacuation and return behavior during the recovery period in San Francisco. After 19 days, 319 have left the city, 147 have stayed. After 3 months, 175 have remained outside the city, 291 have stayed or returned. After 1 year, 113 have remained outside the city, 353 have stayed
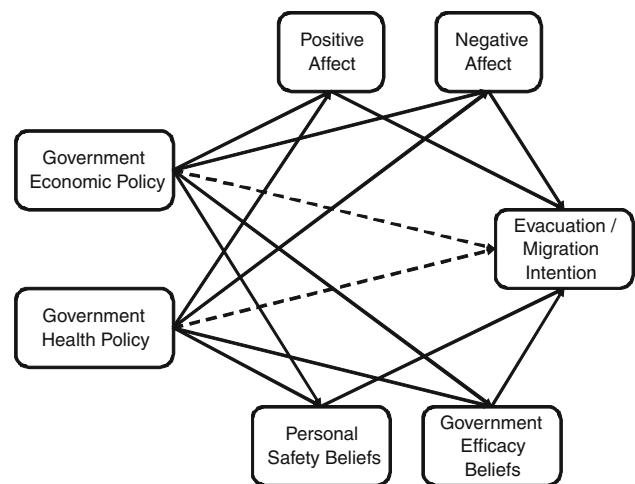
Fig. 3 Overview of mediating model tested at each of the three time periods (19 days, 3 months, and 1 year). Analyses tested whether affect and beliefs mediate the effect of government health and economic risk policies on evacuation and migration behavior at each of the three time periods

region or leave. The pattern of responses during recovery is presented in a transition state diagram in Fig. 2. After 3 months, 38 % indicate an intention to remain outside the region; after a year, the percentage of respondents staying away from San Francisco drops to 24 %.

Evacuation/migration behavior is analyzed separately within each of three time periods to address the specific context of each decision point throughout the response and recovery phases of the anthrax disaster (19 days, 3 months, and 1 year after the release). Analyses are conducted at each of the 3 time periods to test the mediating model summarized in Fig. 3.[2] Four separate sets of analyses are conducted to test whether affect and beliefs mediate the

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[2] Additional analyses were run using gender, income, age, and whether or not the participant had children as covariates/potential moderators, and no significant results were found.

effect of government health and economic risk policies on evacuation and migration behavior at each of the three time periods.

1. Test whether the manipulation of health and economic risk has any impact on decisions to evacuate or migrate from the region, independent of beliefs and affect.
2. Test of whether manipulation of health and economic risk has any impact on beliefs and affect.
3. Test of whether beliefs and/or affect has any impact on decisions to evacuate or migrate from the region, independent of health, and economic risk.
4. Test of whether the manipulation of health and economic risk has any impact on decisions to evacuate or migrate from the region, controlling for effects of beliefs and affect.

Figure 3 represents a fully saturated model, indicating significant relationships resulting from the tests in 1–3 above. The dashed arcs indicate that the direct effects of health and economic risk are no longer significant once the indirect effects of health and economic risk, via belief and affect, are accounted for. In the analysis plan summarized above, the manipulated variables are treated as ordinal variables (low, med, high), represented by polynomial (linear and quadratic) contrasts. The mediating variables, belief, and affect are treated as continuous interval-level variables. Both positive and negative affect scores are derived from summing individual PANAS items at each time period. Intention to leave or stay in the city is treated as a dichotomous (binary) variable, ($0 =$ remain in the city at this time; $1 =$ leave the city at this time). The two 3-category manipulations (economic and health risk policy) are represented as 2 polynomial contrasts: (1) linear (Lin) contrast: low versus high and (2) quadratic (Quad) contrast: med versus low and high. The demographic variables listed in Table 5 are similarly distributions in each of the 9 study conditions and are not included in the model summarized in Fig. 3.

3.1 Days after the release

As summarized in Fig. 4, intentions to leave the city at the height of the crisis (19 days) are predicted by the government health policy manipulation, both positive and negative affect, and beliefs about personal safety. The effect of the government health policy manipulation is quite strong and is a significant predictor of intentions to leave the city over and above both positive and negative affect as well as beliefs about personal safety. The government economic policy manipulation has a significant effect on beliefs about government efficacy only; intentions to leave and affect and beliefs about personal safety are not affected at the 19 day mark by the economic risk. Positive and negative
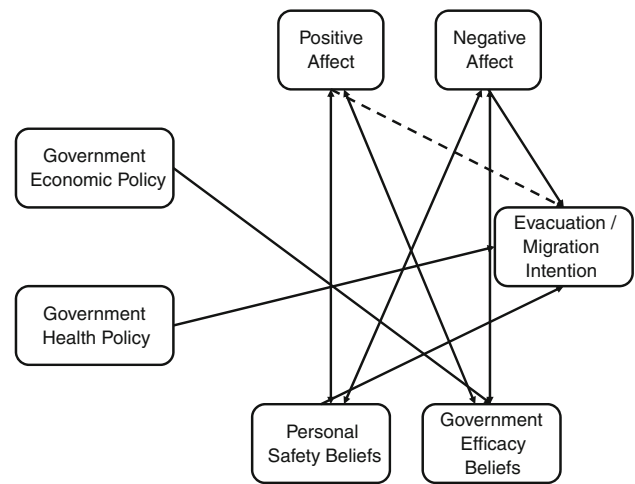
Fig. 4 Summary of findings from the mediating model at 19-day post-release. At 19 days, intentions to leave the city are predicted by the health risk manipulation, both positive and negative affect, and beliefs about personal safety

affect also were found to be correlated with beliefs about government efficacy and personal safety.

Table 6 shows the output of the logistic regression, which includes Wald statistics, significance levels, and the estimated odds factor *change* of evacuating the city *per unit increase in associated independent variable*—Exp(B)—assessed across each predictor variable and each polynomial contrast for the manipulated predictor variables at 19 days post-release. Interestingly, the nature of the direct effect of the health risk policy manipulation is quite quadratic. The quadratic effect compares the "moderate risk" group to the low- and high-risk groups. The binary logistic regression resulted in an Exp(B) of 1.42, which indicates that a respondent in the "moderate risk" group odds of evacuating the Bay Area is 1.42 times greater than odds of a respondent in either the low- or high-risk group, holding all other variables equal. The affect and belief and predictors model result in significant effects for positive affect, negative affect, and personal safety beliefs. For each 1-unit increase in the positive PANAS, we would expect odds to evacuate to decrease by a factor of 0.95 and for each 1-unit increase in the negative PANAS, we would expect odds to evacuate to increase by a factor of 1.12. For each 1-unit increase in the personal safety beliefs scale, we would expect odds to evacuate to decrease by a factor of 0.65.

Table 7 shows the results of 3×3 Analysis of Variances (ANOVAs) predicting affect and beliefs from the 2 manipulated factors. The economic risk manipulation significantly predicts responses to the government efficacy beliefs scale but not to beliefs about personal safety or either PANAS subscale. The direction of this effect suggests that as government involvement in economic-related

Table 6 Binary logistic regression models predicting evacuation, 19-day post-release

Predictors (19 days)	Wald statistic	Significance (p)	Exp(B)
Manipulations only			
Economic risk policy	0.47	0.79	
Lin: Low versus High	0.03	0.87	0.97
Quad: Med versus High and Low	0.43	0.51	1.12
Health risk policy	6.70	0.035	
Lin: Low versus High	3.54	0.06	0.72
Quad: Med versus High and Low	3.96	0.046	1.42
Affect/beliefs only			
Positive affect	4.98	0.026	0.95
Negative affect	34.82	0.000	1.12
Government efficacy beliefs	1.28	0.258	0.96
Personal safety beliefs	42.53	0.000	0.65
Full model			
Economic risk policy	2.32	0.31	
Lin: Low versus High	0.06	0.80	0.95
Quad: Med versus High And Low	2.23	0.14	1.34
Health risk policy	10.61	0.005	
Lin: Low versus High	6.00	0.014	0.61
Quad: Med versus High and Low	5.95	0.015	1.63
Positive affect	0.78	0.38	0.98
Negative affect	20.62	0.000	1.10
Government efficacy beliefs	0.57	0.45	0.97
Personal safety beliefs	30.21	0.000	0.68

Table 7 3 × 3 ANOVAs predicting affect and beliefs at 19-day post-release

| Predictors (19 days)	Dependent variables	F statistic	Significance (p)	eta-squared
Manipulations				
Economic risk policy	Positive affect	0.64	0.53	0.530
	Negative affect	0.39	0.68	0.676
	Government efficacy beliefs	21.82	0.000	0.000
	Personal safety beliefs	1.49	0.23	0.226
Health risk policy	Positive affect	0.22	0.80	0.001
	Negative affect	0.41	0.66	0.002
	Government efficacy beliefs	0.51	0.60	0.002
	Personal safety beliefs	0.25	0.78	0.001
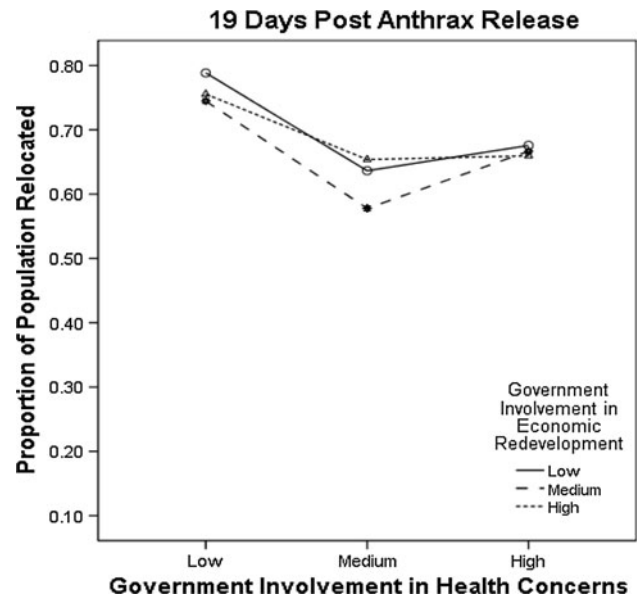
Fig. 5 Proportion of residents relocated by economic and health risk manipulation at 19-day post-release. Both the linear (low vs. high) and quadratic (med vs. low + high) contrasts for health risk manipulation are significant

risk policy increases, respondents show greater belief in government efficacy following the release. The health manipulation did not significantly predict either affect or beliefs.

The bottom section of Table 6 summarizes the full logistic regression model, predicting evacuation from both economic and health risk policy manipulations, affect, and beliefs at 19 days. Both the linear and quadratic effects of the health manipulation are significant. The linear effect compares the low involvement group to the high group, suggesting that someone in the high involvement group would have odds of evacuating 0.61 times lower than someone in the low involvement group. The moderate involvement group remains the most likely to evacuate, with odds 1.63 times greater than the average person in either of the other groups. Both of these effects are clear in the 3 × 3 graph of cell means presented in Fig. 5. The inclusion of more predictors reduced the strength of the positive PANAS as a predictor and is no longer significant. The negative PANAS scale remains a significant predictor showing the same direction of influence on evacuation behavior. The belief scales also remain in a similar position; no effect of government efficacy beliefs on evacuation behavior and a significant effect of personal safety beliefs on evacuation behavior—the safer respondents feel, the less likely they are to evacuate.

There is a significant positive correlation between positive PANAS and personal safety beliefs and government efficacy beliefs; $r = 0.170$ $p < 0.01$ and $r = 0.247$ $p < 0.01$, respectively. There also is a significant negative
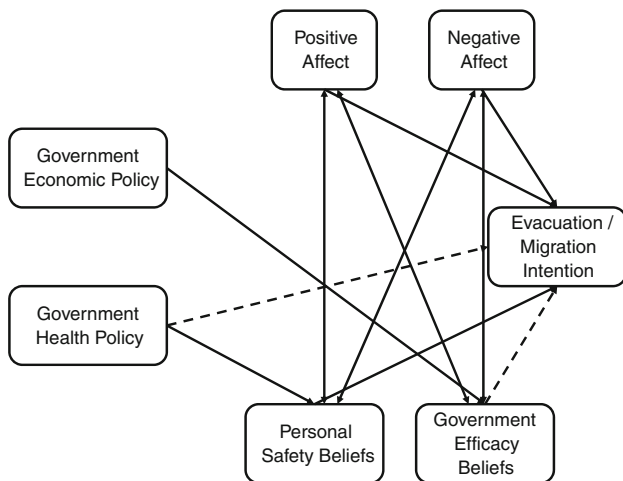
Fig. 6 Summary of findings from the mediating model at 3-month post-release. At 3 months, intentions to remain outside the region are predicted by the health risk manipulation, both positive and negative affect, and beliefs about personal safety and government efficacy

correlation between negative PANAS and personal safety beliefs and government efficacy beliefs; $r = -0.158$ $p < 0.01$ and $r = -0.322$ $p < 0.01$, respectively.

3.2 Three months after the release

As summarized in Fig. 6, intentions to remain outside the region at 3 months are predicted by the government health policy manipulation, both positive and negative affect, and beliefs about personal safety and government efficacy. The effect of the government health policy manipulation does not remain a significant predictor of intentions to remain outside the city over and above affect and beliefs (dashed line). Manipulation of government economic policy had a significant effect on beliefs about government efficacy only; intentions to leave and affect and beliefs about personal safety are not affected at the 3 month mark by the government economic policy manipulation. There also continues to be significant correlations between the PANAS and beliefs about government efficacy and personal safety.

Table 8 shows Wald statistics, significance levels, and the estimated odds factor *change* of being out of the city *per unit change in associated independent variable*—Exp(B)—assessed across each predictor variable and each polynomial contrast for the manipulated predictor variables at 3-month post-release. The logistic regression model predicting evacuation behavior using the government economic and health policy manipulations as the only independent variables shows overall significance of the health policy manipulation as well as a significant linear effect. Comparing the low involvement group with the high involvement group, we see that higher levels of involvement predict odds of evacuation 1.72 times higher than low

Table 8 Binary logistic regression models predicting evacuation, 3-month post-release

Predictors (3 months)	Wald statistic	Significance (*p*)	Exp(B)
Manipulations only			
Economic risk policy	0.03	0.98	
Lin: Low versus High	0.03	0.86	1.03
Quad: Med versus High and Low	0.00	0.97	1.01
Health risk policy	12.25	0.002	
Lin: Low versus High	10.96	0.001	1.72
Quad: Med versus High and Low	2.03	0.15	0.79
Affect/beliefs only			
Positive affect	19.36	0.000	0.91
Negative affect	32.05	0.000	1.12
Government efficacy beliefs	5.92	0.015	0.92
Personal safety beliefs	59.37	0.000	0.60
Full model			
Economic risk policy	1.54	0.46	
Lin: Low versus High	1.53	0.22	1.30
Quad: Med versus High and Low	0.02	0.90	0.98
Health risk policy	3.93	0.14	
Lin: Low versus High	3.58	0.06	1.45
Quad: Med versus High and Low	0.60	0.44	0.86
Positive affect	5.17	0.023	0.95
Negative affect	5.73	0.017	1.06
Government efficacy beliefs	3.59	0.06	0.93
Personal safety beliefs	33.53	0.000	0.65

involvement; this relationship is portrayed graphically in Fig. 7. There is no effect of the economic manipulation. The affect/belief only model shows significant effects for both affect scales and both belief scales on evacuation behavior at 3 months. For each 1-unit increase in the positive PANAS, we would expect odds of evacuation to be 0.91 times lower. For each 1-unit increase in the negative PANAS, we would expect odds of evacuation (or remain evacuated) to increase by a factor of 1.12. For each 1-unit increase in the government efficacy beliefs scale, odds of evacuation (or remain evacuated) decreases by a factor of 0.92. For each 1-unit increase in the personal safety beliefs scale, odds of evacuation (or remain evacuated) decrease by a factor of 0.60.

Table 9 shows the results of 3×3 ANOVAs at 3 months predicting affect and beliefs from the 2 manipulated factors. The economic risk manipulation significantly predicts government efficacy beliefs and nothing else; as the government is shown to be more invested in the economic recovery of the region, beliefs about government
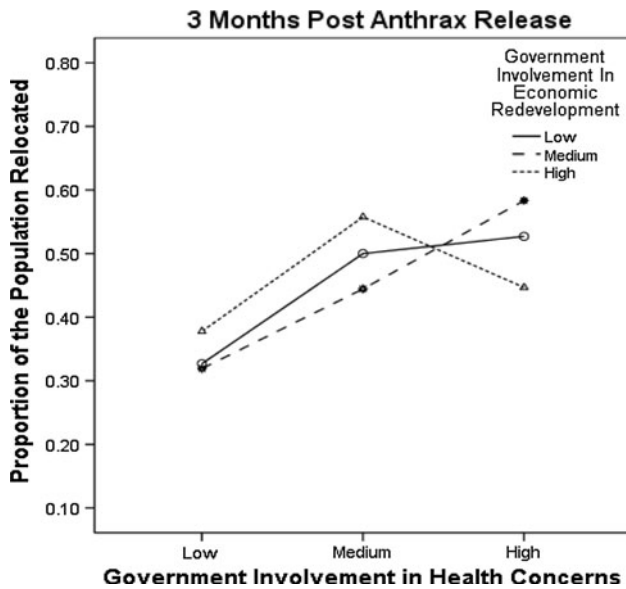
Fig. 7 Proportion of residents relocated by economic and health risk manipulation at 3-month post-release. The linear (low vs. high) contrast for health risk manipulation is significant

efficacy increase. The health risk policy manipulation significantly predicts personal safety beliefs and nothing else, when the government is more invested in health risk policy, beliefs about personal safety decrease.

The bottom section of Table 8 summarizes the full logistic regression model, predicting evacuation from both economic and health risk policy manipulations, affect, and beliefs at 3 months. Neither health risk policy nor government efficacy beliefs are significant once all predictors are included (dashed lines in Fig. 6). Both PANASs remain as significant predictors and their effects remain in the same direction; as respondents report more positive affect, they are less likely to evacuate or remain evacuated; as they report more negative affect, they are more likely to evacuate or remain evacuated. Personal safety beliefs still significantly predict evacuation behavior in the same direction—as respondents report more affirmatively that they believe they are safe, they are less likely to evacuate or have evacuated at 3 months.

There is a significant positive correlation between positive PANAS and personal safety beliefs and government efficacy beliefs; $r = 0.284$ $p < 0.01$ and $r = 0.305$ $p < 0.01$, respectively. There also is a significant negative correlation between negative PANAS and personal safety beliefs and government efficacy beliefs; $r = -0.204$ $p < 0.01$ and $r = -0.469$ $p < 0.01$, respectively.
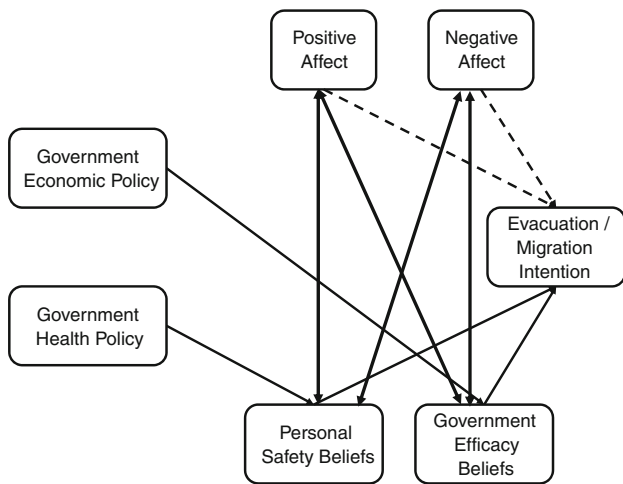
3.3 One year after the release

As summarized in Fig. 8, intentions to evacuate the region at 1 year are predicted by both positive and negative affect, and beliefs about personal safety and government efficacy. There are no direct effects of either the economic or health risk policy manipulations on either affect variable or evacuation behavior at 1 year. Manipulation of economic risk policy has a significant effect on beliefs about government efficacy only; manipulation of health risk policy has a significant effect on personal safety beliefs only. Evacuation behavior at 1 year is significantly predicted by both affect and beliefs; however, affect does not predict evacuation behavior over and above beliefs (dashed lines). The PANAS and beliefs about government efficacy and personal safety are again found to be correlated.

Table 10 shows Wald statistics, significance levels, and the estimated odds factor *change* of being out of the city *per unit change in associated independent variable*—Exp(B)—for each predictor variable and each polynomial contrast for the manipulated predictor variables at 1 year. The model predicting evacuation behavior using manipulations as the only independent variables shows no effect of either government risk manipulation. The affect/belief only model shows significant effects of both affect and beliefs on evacuation behavior. For each 1-unit increase in the positive PANAS, the odds of evacuation (or remain evacuated) decreases by a factor of 0.93. For each 1-unit increase in the negative PANAS, the odds of evacuation (or remain evacuated) increases by a factor of 1.12. For each 1-unit increase in the government efficacy beliefs scale, the odds of evacuation (or remain evacuated) decreases by a

Predictors (3 months)	Dependent variables	F statistic	Significance (p)	Eta-squared
Manipulations				
Economic risk policy	Positive affect	0.02	0.98	0.000
	Negative affect	0.27	0.77	0.001
	Government efficacy beliefs	29.07	0.000	0.117
	Personal safety beliefs	0.03	0.97	0.000
Health risk policy	Positive affect	0.03	0.97	0.000
	Negative affect	0.59	0.55	0.003
	Government efficacy beliefs	2.37	0.09	0.011
	Personal safety beliefs	8.06	0.000	0.036

Table 9 3×3 ANOVAs predicting affect and beliefs, 3-month post-release

Fig. 8 Summary of findings from the mediating model at 1-year post-release. At 1 year, intentions to evacuate the region are predicted by both positive and negative affect, and beliefs about personal safety and government efficacy. There are no direct effects of either the economic or health risk manipulations

factor of 0.90. For each 1-unit increase in the personal safety beliefs scale, the odds of evacuation (or remain evacuated) decreases by a factor of 0.61.

Table 11 shows the results of 3 × 3 ANOVAs at 1 year post-release, predicting affect and beliefs from the 2 manipulated factors. The economic risk manipulation significantly predicts government efficacy beliefs and nothing else; as the government is shown to be more invested in the economic recovery of the region, beliefs about government efficacy increase. The health risk policy manipulation significantly predicts personal safety beliefs and nothing else; when the government is *more* invested in health risk policy, beliefs about personal safety decrease.

The bottom section of Table 10 summarizes the full logistic regression model, predicting evacuation from government economic and health policy manipulations, affect, and beliefs at 1 year post-release. Neither PANASs significantly predict evacuation behavior once manipulations and beliefs are included. Neither manipulated variables significantly predicted evacuation behavior. Government efficacy beliefs and personal safety beliefs directly predict evacuation behavior, over and above the 2 manipulated government policy factors and affect. For each 1-unit increase in the government efficacy beliefs scale, we would expect a person to be 0.87 times as likely to evacuate or remain evacuated. For each 1-unit increase in the personal safety beliefs scale, we would expect a person to be 0.65 times as likely to evacuate or remain evacuated.

There continues to be a significant positive correlation between positive PANAS and personal safety beliefs and government efficacy beliefs; $r = 0.279$ $p < 0.01$ and $r = 0.309$ $p < 0.01$, respectively. There also is a significant

Table 10 Binary logistic regression models predicting evacuation, 1-year post-release

Predictors (1 year)	Wald statistic	Significance (p)	Exp(B)
Manipulations only			
Economic risk policy	0.39	0.82	
Lin: Low versus High	0.16	0.69	1.08
Quad: Med versus High and Low	0.22	0.64	0.92
Health risk policy	2.95	0.23	
Lin: Low versus High	2.83	0.09	1.37
Quad: Med versus High and Low	0.02	0.88	1.03
Affect/beliefs only			
Positive affect	9.13	0.003	0.93
Negative affect	27.65	0.000	1.12
Government efficacy beliefs	6.02	0.014	0.91
Personal safety beliefs	44.24	0.000	0.61
Full model			
Economic risk policy	3.15	0.21	
Lin: Low versus High	3.11	0.08	1.54
Quad: Med versus High and Low	0.04	0.85	0.96
Health risk policy	4.50	0.11	
Lin: Low versus High	2.06	0.15	1.38
Quad: Med versus High and Low	1.88	0.17	1.39
Positive affect	0.78	0.38	0.98
Negative affect	1.88	0.17	1.04
Government efficacy beliefs	9.09	0.003	0.87
Personal safety beliefs	25.59	0.000	0.65

negative correlation between negative PANAS and personal safety beliefs and government efficacy beliefs; $r = -0.235$ $p < 0.01$ and $r = -0.453$ $p < 0.01$, respectively.

4 Discussion

In this experiment, we employed a unique research design to determine whether risk signals associated with government policies during response and recovery to an anthrax release shape residents' beliefs, affect, and migration decision making. Of particular interest is how migration decision making varied at 19 days, 3 months, and 1 year following the anthrax release. Our results show that 68 % of respondents intended to leave San Francisco within the first 19 days after the release; however, after 1 year, the majority of respondents have either returned or elected to remain in the region with the percentage staying away dropping to 24 %. Findings indicate that respondents' migration decision was highly context-sensitive, with each

Table 11 3×3 ANOVAs predicting affect and beliefs, 1-year post-release

Predictors (1 year)	Dependent variables	F statistic	Significance (p)	Eta-squared
Manipulations				
Economic risk policy	Positive affect	0.91	0.402	0.004
	Negative affect	0.39	0.680	0.002
	Government efficacy beliefs	17.96	0.000	0.076
	Personal safety beliefs	0.97	0.379	0.004
Health risk policy	Positive affect	0.38	0.687	0.002
	Negative affect	0.23	0.796	0.001
	Government efficacy beliefs	2.04	0.132	0.009
	Personal safety beliefs	4.12	0.017	0.018

decision point showing a unique combination of significant predictors influencing decision making.

4.1 19 Days after the release: peak of disaster and beginnings of recovery

At 19 days following the anthrax release, residents' migration decisions are sensitive to the congruency between risk signals characterized by the release scenario and risk signals implied by the government's health-related policies. At this point in the scenario, the risk of anthrax infection is *high*—the disaster had reached its peak with tens of thousands of hot zone residents having migrated and the death toll having just peaked at 54,000. The respondents most likely to stay in or around San Francisco are exposed to *high* or *moderate* levels of government involvement in managing health risks. This result suggests that proactive government involvement sends risk signals reassuring the public that health precautions are in place to combat the heightened threat situation. Conversely, those exposed to *limited* government action (*lowest* level of government involvement in health risk policy) receive risk signals incongruent with the high level of inherent risk associated with the anthrax release. Perhaps, this translates into perceptions of "under protection" that results in a greater likelihood of population migration away from the impacted region (Paxson and Rouse 2008).

Study results also indicate that negative feelings and beliefs about personal safety predict migration decision making. Previous research has shown that people tend to rely on their affective reactions when making decisions (Pfister and Böhm 2008; Slovic et al. 2004; Loewenstein et al. 2001). Our findings are consistent with this hypothesis, with higher

rates of migration associated with more negative reactions. In contrast, respondents' positive affect and sense of personal safety are associated with an increased likelihood of remaining in San Francisco. While one would not expect respondents to be experiencing positive feelings at this time, there are reports of increased patriotism and camaraderie among community members post-disaster that can be interpreted as increased feelings of strength and safety (Castellanos 2010; Burke 2005; Bonanno 2004).

Lastly, we found that the extent to which respondents believe the government is committed to economic recovery and health safety measures is contingent upon the level of government involvement in economic revitalization. As found in prior studies, the more involved the government, the higher respondents' confidence is in government (Brunsma et al. 2007; Berke and Campanella 2006).

4.2 Three months after the release: the dust settles

At 3 months following the anthrax release, congruency between inherent risk signals and those conveyed by government health actions again significantly influences migration decisions; yet compared to 19 days, the inverse in residents' decision making is found. By this point, the risk associated with the disaster is *mild*, as recovery is well underway. Clean-up procedures have been in place for months, anthrax exposure and infection is described as nearly impossible, and healthcare providers are actively monitoring for the first signs of anthrax to reduce the likelihood of disease progression. Results show that those most likely to migrate are exposed to *high* levels of government involvement in health risk policy. In this case of risk signal non-congruence, government policy is perceived as doing too much when inherent risk is low, leading respondents to potentially believe that the risk of anthrax is far greater than in reality. On the contrary, when the risk signals are congruent, respondents are more likely to remain in the region. Low inherent risk coupled with government policies that send few risk signals reassures the public that the danger is minimal and the region is safe to inhabit.

Looking at more complex relationships within this decision frame, we find that perceived safety of the impacted region mediates the relationship between government health policy and respondents' migration decisions. When government involvement is *low*, respondents' personal safety beliefs are *high*, increasing the odds of remaining in the region. When government involvement is *high*, respondents are given the impression that health risks are still *high* and therefore more likely to migrate out of the region. Beliefs about government efficacy are also found to mediate the relationship between government economic policy and migration. Economic risk policies directed at reducing the uncertainty and complexity associated with a

disaster have been found to be an important contributor to predicting strong beliefs associated with a disaster (Hodgson 2007; Weick et al. 2005). Once the initial shock of the anthrax release and its aftermath begin to settle, the capability and feasibility of community economic revitalization become a priority for those residents who remain in the impacted region, (Rosoff et al. 2012b).

Findings further suggest that there is a direct effect of affect on migration; higher rates of migration away from the impacted region are associated with more negative reactions. Research has shown that lingering negative feelings of distress, anxiety, and depression are present following a traumatic event for months and even years (McArdle et al. 2012; Adams and Boscarino 2005). Coupled with concerns about resource availability and rebuilding of the region, migration is preferred for a subset of those impacted. However, it is also suggested that lower rates of migration are influenced by positive affect and beliefs about personal safety. Previous research has found that residents commonly have strong ties to their home region and are excited about being part of the rebuilding process, leading them to be "enthusiastic" and "determined" about remaining in the impacted region (Rosoff et al. 2012b). Additional research has found that people exposed to disasters are quite resilient, further increasing the attractiveness of remaining in the region (Bonanno 2004). With respect to beliefs about personal safety, residents have had time to collect the information needed by this point in time, allowing for their worries and concerns to begin to subside, such that remaining in the region is more appealing (McArdle et al. 2012).

4.3 One year after the release: road to recovery

One year following the anthrax release, government policies are found to no longer have a significant effect on respondents' migration decisions or to influence respondents affect or beliefs about the disaster. For this decision frame, San Francisco residents are well into the recovery process. The risk of new anthrax infection is limited to decontamination crews, and the focus is on revitalizing the regional infrastructure and economy. The decision for residents is less about whether to migrate, and more about whether to stay or return to the region. To this end, research has shown that a critical aspect of policy development depends on the extent to which government recovery efforts get buy-in from the community. Awareness of local residents' concerns is critical to the design and implementation of such policies (Mileti and Gailus 2005; Godschalk 2003). Prior disaster research shows that incorporating public participation into the decision making process is necessary for the successful implementation of the disaster management process (Mileti and Gailus 2005;

Patterson et al. 2010; Kweit and Kweit 2004; Pearce 2003). Similarly, our results suggest that government policies influence migration decision making through actions directed at respondents' beliefs. We find that respondents tend to feel safer and in turn are more likely remain in the region, when the government is less involved in health policy. Conversely, respondents tend to have more confidence in government and are more likely to stay and/or return to the region when the government is more involved in economic revitalization.

4.4 Limitations

There is some gap between the video-based scenario simulation we employed to evaluate whether selected manipulations affect how people respond to an anthrax release and what might occur in an actual event. For instance, while our scenario simulation approach resembles an actual news broadcast that might be aired, watching the news only captures a fraction of the experience of being in an anthrax release. There also would most certainly be a variety of news sources, as well as news outlets capturing the situation differently. There also is the potential influence of "word of mouth"; that is, what one might hear from friends and family with respect to their beliefs, emotions, and decisions they are making. Lastly, the actual release of the news broadcasts over time will actually occur in "real time" (19 days, 3 months, and 1 year after the release), as opposed to the "compressed time" used in our research design.

Our overarching goal was to create a simulation that would elicit emotion, cognitive, and behavioral responses as close as possible to those following an actual biological event. By presenting a specific scenario and the simulation in a compressed time format, we are able to control extraneous variables that might influence responses if actually spread over 1 year. In the end, our study design was formulated to maximize realism and participant involvement and to minimize attrition and extraneous influences from unrelated events in participants' personal lives if the survey were actually spread over 1 year. We certainly acknowledge limitations of the study design and believe they suggest important questions for future research.

5 Conclusions

The results of this experiment demonstrate the type of risk policy-informing insights possible from using video scenario simulation to evaluate how government policies influence the impacted population's affect, beliefs, and migratory decisions. Our findings may or may not

generalize to other disaster scenarios. However, it is useful to know about affective, cognitive, and behavioral responses to biological agent releases and worthwhile to continue exploring the predictive value of this methodology. This experiment has identified a critical policy implication to consider when assessing the response and recovery to large-scale disasters: Decision making is sensitive to context and timing. Rather than implementing a single constant policy across the entire post-release period, government actions and messages should be tailored to the developing situation. A balance is therefore needed in the development of health and economic policies to provide impacted residents with the support needed to make informed decisions about migration. On the one hand, it is important to address uncertainties about quality of life considerations and to manage expectations about financial concerns (e.g. job opportunities, affordability of the region, financial subsidies). On the other hand, the communication of information must be tempered so as to minimize unwarranted negative stigma attached to the region, and encourage positive feelings and confidence about safety and government response. This approach allows for government actions to both reflect the true state of affairs and focus on the top priorities and demands of the recovery process. Further research is needed to provide policymakers with information about public perceptions and biological disasters in the aftermath of biological disasters, such as an anthrax release. This information is critical for providing insight into how those exposed and infected by an anthrax release are likely to behave during response and recovery following the release. Such insights are crucial to the development of effective public policies related to recovery.

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