DIVERGENT RESIDENTIAL PATHWAYS FROM FLOOD-PRONE AREAS: HOW NEIGHBORHOOD INEQUALITIES ARE SHAPING URBAN CLIMATE ADAPTATION

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ABSTRACT

Flood risks are rising across the United States, putting the economic and social values of growing numbers of homes at risk. In response, the federal government is funding the purchase and demolition of housing in areas of greatest jeopardy, tacitly promoting residential resettlement as a strategy of climate adaptation, especially in cities. Despite these developments, little is known about where people move when they engage in such resettlement or how that answers to that question vary by the racial and economic status of their flood-prone neighborhoods. The present study begins to fill that gap. First, we introduce a new typology for classifying environmental resettlement along two socio-spatial dimensions of community attachment: (a) distance moved from one's flood-prone home; and (b) average distance resettled from similarly relocated neighbors. Next, we analyze data from 1,572 homeowners who accepted government-funded buyouts across 39 neighborhood areas in Harris County, Texas – Houston's urban core. Results indicate that homeowners from more privileged neighborhoods resettle closer to both their flood-prone homes and to one another, thus helping to preserve the social as well as economic value of home; whereas, homeowners from less privileged areas end up farther away from both. Implications for understanding social inequities in government-funded urban climate adaptation are discussed.

KEYWORDS: urban, environment, policy, inequality, flooding

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Whether it comes from rising seas or inland waterways, scientists agree that climate change will bring more frequent and intense flooding in the years ahead. Nowhere will these developments affect more people than in urban areas (NAS 2019), where governments worldwide are now disproportionately implementing a policy of managed retreat (Braamskamp and Penning-Rowsell 2018). In the US, that effort typically involves a local flood agency identifying areas of greatest concern and then applying for federal funds to pay homeowners in those areas to voluntarily sell their properties and resettle elsewhere. While that policy may seem rational, its current implementation obscures two important social facts. First, future flooding threatens more than just the economic value of home, it also threatens the *social* value of home bound up in community attachment, putting multiple "values at risk" (Elliott 2019) as homeowners decide not only *if* but *where* to resettle. Second, when that decision-making unfolds in highly stratified urban contexts, neighborhood inequalities forged through long and ongoing histories of racial and economic marginalization can lead to divergent residential pathways suggestive of a new and important type of environmental injustice – one that is not only federally funded but also likely to expand with the current climate crisis.

Broadly and officially, managed retreat is defined as the "the planned, purposeful, coordinated movement of people and assets away from risk" (Siders 2019: 216). In the case of urban floodplains the aim is to reduce such risk by returning purchased homes and lots to their prior undeveloped state, never to be built-on again except possibly for flood mitigation infrastructure (e.g., a new drainage system, storm water detention basin, or multi-purpose green space). Having now been used to relocate more than 40,000 households across the country, with three quarters of those transactions occurring in the urban core of US metropolitan areas (Elliott, Brown, and Loughran 2020; see also Mach et al. 2019), such resettlement now embodies a leading but understudied mode of urban adaptation (Arcaya, Raker and Waters 2020; Klinenberg, Araos and Kozlov 2020). As a recent study explains, "only a handful of buyout programs have been the focus of empirical studies or formal evaluations" (Binder et al. 2019: 127), and almost none examine where homeowners actually move, let alone sociological dimensions of that resettlement process.

This knowledge gap matters theoretically as well as practically because when housing – rather than, say, a new engineering solution – becomes the vehicle for climate adaptation, several important things happen. First, the uncertainty of new policies joins with the uncertain timing of future flooding to further threaten the economic value of people's homes – the chief financial asset for many Americans. Second, responding to that economic risk through resettlement potentially puts another value at risk: the social value of home "rooted in connections…built up over time between person and place" (Henwood et al. 2008: 433). Third, as homeowners weigh these values and options, they do so within housing landscapes forged by another powerful ecological force: *racial and economic segregation*. This is especially true in urban areas, where many of today's homes were built with the help of federal policies that not only subsidized their development but also produced enduring place-based inequities in the neighborhoods where they are located. Those inequities include unequal access to homeownership and by extension wealth gaps, as well as unjust pollution burdens, substandard public services, and other disparities that extend beyond individual households to socially stratify entire communities and their encompassing resettlement systems (Sampson 2012; Sharkey 2013).

These place-based inequities mean that the federal government's seemingly fair and rational policy of managed retreat can end up playing out quite differently when equally applied to different types of flood-prone neighborhoods. This is the central proposition we set out to test, for the first time, in the present study. To do so, we first review how the nation's leading policy of managed retreat centers the economic value of home in its official framing and implementation. Next, we extend recent theoretical work on the plurality of "values at risk" from flooding (Elliott 2019) to highlight a social value of known importance: community attachment, which we conceptualize along two socio-spatial dimensions, *place attachment* and *people attachment*. We then intersect these two dimensions to advance a new typology for conceptualizing different residential pathways that can emerge from managed retreat. Does the respective pathway, for example, lead to new housing that is relatively close by, suggesting a spatially gradual process of *retreat* implied by the policy's name? Or, does it stretch over longer distances, suggesting more distant *relocation* and community dissolution? And, how far do participants end up resettling from each other? Is that distance relatively short, suggesting a form of *collective* resettlement? Or, is that distance longer, suggesting more *individualistic* dispersion?

Answers to these questions matter because they forefront the social value of home that is simultaneously recognized to be important in people's residential decision-making and yet largely ignored in most official framings and implementations of managed retreat. We propose that this social value is important to consider not only when investigating *if* a homeowner will accept a buyout offer but also *where* that offer leads when it is accepted. Moreover, this line of investigation and how it varies across communities of differing socioeconomic status is consistent with a recent National Advisory Council (2020) recommendation for the US Federal Emergency Management Agency (FEMA) to take social equity more seriously in the implementation and evaluation of all of its programs. It also offers a new way of thinking about *adaptation privilege* (Marino 2018), namely, as the disproportionate capacity to reconcile multiple "values at risk" through government programs purported to be individualistic, rational and apolitical.

To investigate these dynamics empirically, we collect and analyze new data from Houston's urban core – often described as America's "flood capital" (Erdman and Dolce 2017), with thousands of federally funded buyouts now transacted across dozens of socially diverse neighborhoods spanning fifteen different watersheds in Harris County alone. Statistical analyses indicate that, without deliberate intent or planning, the residential pathway emerging from more racially and economically privileged neighborhoods looks more like *collective retreat*, that is, a gradual resettlement to nearby housing that facilitates ongoing attachment to former neighbors and neighborhoods. By contrast, the residential pathway emerging from less privileged neighborhoods looks more like *individualistic relocation*, which leaves residents farther not only from their former neighborhoods but also from their similarly resettled neighbors. These findings have important implications for understanding "climate gentrification" (Hauer 2017; Keenan, Hill, and Gumber 2018) and for advancing a more robust urban sociology that extends beyond traditional concerns with racial segregation and the political economy of place-making to also incorporate environmental dynamics and policies of increasing significance.

THE ECONOMIC VALUE AND RATIONALITY OF MANAGED RETREAT

To be clear, the complexities of urban flooding did not arrive with climate change. Instead, the US government has subsidized and segregated residential development in and around flood-prone cities for a long time (Chakraborty et al. 2014; Faber 2015; Smiley 2020). To protect that development, especially in areas where engineering fixes have been either ineffective or impractical, the federal government created the National Flood Insurance Program (NFIP). Yet, from its inception in 1968, the NFIP has lacked the authority to restrict new development in the floodplains it insures. As a result, the federal government now underwrites much more insurance than it charges in annual premiums

(King 2013: 16; Elliott 2017), leading the US Government Accountability Office to declare the NFIP a “high risk” program – meaning that it is financially insolvent and getting more so each year (GAO 2019).

To experts at FEMA, which assumed oversight of the NIFP from the US Department of Housing and Urban Development in 1979, this is old news. Since the mid-1980s, FEMA has been trying to reduce repetitive payouts to homeowners by incentivizing retreat from the nation’s riskiest floodplains via its Hazard Mitigation Grant Program (HMGP). That program empowers local flood control districts to identify properties most at risk of future flooding and apply for federal funds to purchase those properties. If the homeowner accepts, the property is demolished, leaving the site to return to nature or become part of a larger flood mitigation project. Since the 1990s and especially 2000 when new legislation required all states to produce local flood mitigation plans (Berke et al. 2012), federally funded buyouts have become a go-to tool for municipal governments everywhere looking to plan for future flooding via “managed retreat” – “managed” in that local experts target where the intervention will take place; and, “retreat” in that it removes people and homes from those areas once and for all.[1]

On its face, this approach to protecting people and homes by sliding both away from rising flood risk seems unequivocally rational. And to encourage that rationality, FEMA – the nation’s leading funder of managed retreat by far – strives to make the policy as seemingly apolitical as possible. It relies on local flood experts to identify areas for intervention. It mandates that such intervention not invoke eminent domain but instead

[1] Funds from FEMA’s HMGP are available following Presidential Major Disaster Declarations. To receive such funds a locally impacted jurisdiction develops an application identifying flooded areas where buyout offers will be directed. The state then works with FEMA on the local jurisdiction’s behalf to evaluate and advocate for the plan. FEMA then conducts a final review. If the application is approved, FEMA awards grant money to the state, which then administers it to the local jurisdiction for program implementation (Kinder Institute 2018).

approach individual homeowners. It promotes fair market, pre-disaster prices for targeted homes. And, it requires that all transactions be completely voluntary and consistent with the ethos of the private market, leaving each homeowner free to make their own rational decision about whether to sell and where to move when they do (de Vries and Fraser 2012; FEMA n.d.: 1-2).

At the presumed center of this rationality is economic value, which buyouts are designed to protect. For government actors, that value centers on cost-benefit calculations used to evaluate future savings to agencies that would no longer have to insure and rebuild flooded homes at subsidized rates or provide financial assistance in cases of disaster. For homeowners, that economic value is tied up in the equity they have (or expect to have) in their homes, which is threatened not just by future flood risks but also uncertain government interventions that can raise insurance costs, devalue home prices, and spur eventual outmigration and disinvestment in unknown ways. These threats can join with the high cost of in-place alternatives such as repetitive home repair or elevation to erode the economic value of one's home regardless of when predicted flooding occurs. Because buyouts are voluntary, government actors assume that homeowners who eventually participate in managed retreat are acting in their own rational interests, weighing these economic and environmental risks.

VALUES AT RISK AND COMMUNITY ATTACHMENT

Others question that framing. Marino (2018: 12), for example, contends that the centrality of individual rationality and economic value limits the "inventories of possibility that communities have to choose from when faced with [increasing flood] risk." This is especially true when communities choose not to organize, or cannot organize as effectively, as other communities around principles of private property and the market (Baker et al. 2018). Such situations raise pressing questions about the equity of managed retreat's implementation (Eriksen, Nightingale and Eakin 2015). They also point to other, non-economic values threatened by future flood risks and adaptation policies.

To make sense of these complexities, Elliott (2019: 1067) advocates for taking a socio-cultural perspective that explicitly acknowledges the multiple *values at risk* from flooding in route to investigating how they intersect to "shape how people live with and respond to environmental risks" in different community contexts. For many homeowners those values include not just the economic value of home but also the social value they attach to where it is located socially and spatially, often referred to as community attachment – long regarded as an important sociological element of community wellbeing (Kasarda and Janowitz 1974) and a topic of growing interdisciplinary interest in human geography, environmental studies, and social psychology (see Devine-Wright 2013).

A notable example of this type of social value in the case of managed retreat comes from Valmeyer, Illinois – a small town located at the base of a towering bluff along the Mississippi River (Knobloch 2005). In 1993, the river overtopped and then breeched an extensive levee system constructed by the US Army of Corps of Engineers during the 1940s. Floodwaters measured sixteen feet high and lingered in some areas for more than two months. FEMA classified ninety percent of the town's 395 structures as substantially damaged, and it soon became clear to local officials that, "if state and federal agencies offered property buyouts to residents, property owners would disperse to other surrounding towns, and it probably would spell the end of the community" (Knobloch 2005: 43). Faced with that risk, local leaders and residents organized. They formed committees, pledged to relocate together, and pooled their resources to make a down payment on a new site. Two years later, more than half of the flooded households began moving into new homes in their newly built town, now located on higher ground less than two miles away.

More than 20 years later, Valmeyer is now thriving, with a population more than a third larger than at the time of the big flood (Morrison 2020). That resilience has made the town not only a model of managed retreat but also a testament to the power of community and place in the face of rising flood risk, which has since become evident in other cases as well. Isle de Jean Charles is a small island community located 75 miles south of New Orleans, and it is rapidly sinking into the Gulf Mexico. Leveraging federal funds, the island's approximately 80 full-time residents, most of whom are members of the Biloxi-Chitimacha-Choctaw tribe, have been working with state agencies to relocate the entire community to higher ground (Davenport and Robertson 2016). In 2018, they purchased farmland 40 miles north to serve as their new site. Still, uprooting is not easy. "While most families on the island have shown interest in moving to the new location, six would prefer to stay put, citing old age and deep attachment to the island" (Baurick 2017). Among them is Chief Naquin who helped negotiate the community's retreat to higher ground.

Together, the cases of Valmeyer and Isle de Jean Charlies reveal the social power – and *value* – of both place and people in household decision-making about if and where to resettle in the face of rising flood risks. Other research indicates that those influences are not limited to risky situations or to small towns or to tribal communities; instead, they extend to the migratory decision-making of households in general, helping to explain not only why people move infrequently but also why they tend to resettle nearby when they do (Davies, Greenwood and Li 2001; Speare, Kobrin, and Kingkade 1982). Analyzing rich address-level survey data for more than 15,000 adults followed for more than two decades, Dahl and Sorenson (2010a; see also 2010b) find that people place great importance on social factors when deciding if and where to move. Especially important are proximity to one's hometown and proximity to friends and acquaintances – both of which exert a more consistent and measurable influence on eventual destinations than the prospect of higher wages.

Despite this evidence, however, community attachment represents a social value largely ignored in the official framing and execution of FEMA's buyout program, which evokes images of economically rational homeowners making highly individualistic decisions about future risks to themselves and their home equity (Lynn 2017). We contend that this social value is important to consider not only when assessing *if* a homeowner will accept a buyout but also when considering *where* that decision leads when it occurs, which experts argue is only a matter of time (see Lawrence et al. 2020).

TYPES OF RESETTLEMENT

To make sense of those dynamics, we forefront two types of social value evident in the examples above and in research on community attachment more generally: attachment to place; and, attachment to people in and from that place. We then intersect those two dimensions to produce a novel typology that identities four potential residential pathways stemming from managed retreat. That typology appears in **Figure 1**. In it, distance moved is an important axis of variation because it reflects the relative ease with which buyout participants can maintain attachments to (a) their departed neighborhood and (b) social ties still located in that neighborhood. The latter is relevant because in most cases, especially in larger urban centers, managed retreat ends up being only partial, leaving some residents behind. In that context, we conceptualize shorter distances as being more consistent with the idea of *retreat*, that is, a gradual shift to nearby housing presumed to be environmentally and thus financially safer and yet still relatively accessible to the social value still anchored in one's departed home and neighborhood. We conceptualize longer distances, by contrast, as being more consistent with the idea of *relocation*, that is, a more abrupt break from place and the people still there.

[Figure 1 about here]

The other axis of variation in our typology is eventual distance from others making a similar move from the same flood-prone area via the same policy. If that distance is shorter, then social ties among those resettling can still remain relatively close, or strong, even if the distance moved is longer. For this reason we conceptualize shorter average distances among eventual destinations as indicating resettlement that is more *collective* in nature and therefore better able to maintain the social value of home linked to people from one's departed neighborhood. We conceptualize longer distances, by contrast, as being more *individualistic*, or atomistic, in nature.

By first identifying and then intersecting these two socio-spatial dimensions of community attachment, we produce four types, or categories, of residential pathways that can emanate from areas of managed retreat. Those types are shown in the four quadrants of Figure 1, which we describe briefly for clarification.

(a) Collective Retreat. This is the residential pathway in which residents of a flood-prone neighborhood move to nearby homes relatively *en masse*. Planned or not, such resettlement allows these movers to maintain an emotional as well as social attachment to their departed place and to the people still there, as well as to similar movers from the same place. Valmeyer offers a good example, though few if any residents stayed behind. The case of New York City's Staten Island after Superstorm Sandy in 2012 offers another (Koslov 2016).

Research indicates that 79 percent of homeowners who participated in the respective buyout program there still live within the five boroughs (McGhee 2020). It also finds that many of those who resettled "still go to the same butcher, they still meet at the same seafood restaurants and eat cod sandwiches, they still see the same people on the weekend. They just don't live anymore in a house that floods" (Yoder 2019; see also Rush 2018).

(b) *Collective Relocation*. This is the residential pathway in which residents of a flood-prone area move together to a relatively distant place. A good example here is Isle de Jean Charles, where most community members are moving together to a new, planned site roughly 40 miles away (Davenport and Robertson 2016). The Alaskan village of Newtok near the Arctic circle where sea ice and permafrost are declining offers another example (Bronen 2011; see also Maldonado et al. 2013). After fighting for more than two decades to move their community to higher ground, the 375 remaining residents finally received federal funding in 2018 to develop a new village miles to the south (Cole 2018). The nearby village of Shishmaref faces similar challenges and recently reached consensus on where it wants to relocate collectively. Still, the pull of place is strong, and residents prefer not to talk about their community's resettlement as relocation. Instead, and as vice-mayor Fred Enigowuk explains, "We removed the word 'relocation' from our community and changed that to 'expansion'" (see Hofstaeder 2019: 1).

(c) *Individualistic Relocation*. This is the residential pathway in which residents of a flood-prone neighborhood disperse to a wide array of destinations that are not only relatively distant from their original, flood-prone homes but also from each other. Tacitly, this is the pathway we might presume from official pronouncements surrounding FEMA's managed retreat policy, given its highly individualistic assumptions and lack of reference to the social value of people and places departed.

(d) *Individualistic Retreat*. This is the pathway in which residents of a flood-prone neighborhood disperse to a multitude of destinations near their original, flood-prone homes, but not near one other. In this type of resettlement, attachment to place remains strong, but it is not particularly collective. Instead, at-risk homeowners scatter to numerous nearby destinations as individual circumstances, tastes, and resources allow.

NEIGHBORHOOD INEQUITIES AND TYPES OF RESETTLEMENT

Through the descriptions above, it becomes clear that the types of resettlement depicted in Figure 1 do not simply differ, they diverge. At one extreme, *collective retreat* is the least disruptive to the social value of home because it facilitates ongoing ties to both place and people – two sources of social value embedded in community attachment. It also presumably helps to protect the economic value of home by selling it to the government at a "fair" market price. In the "values at risk" framework, this residential pathway represents a preferred outcome because rather than demoting one type of value to another – e.g., the social value of home to the economic value of home – it reconciles both values in the least disruptive way. We conceptualize this outcome as a form of *adaptation privilege*. Marino (2018: 12) recently introduced this concept to draw attention to the imposition of ethnocentrism on native Alaskan communities facing increased flood risk while also calling for "further sketch[ing] out" of the term. Here, we extend that effort by conceptualizing *adaptation privilege* as an elevated capacity to mutually resolve rather than compromise the social and economic "values at risk" from flooding and associated government interventions.

Drawing from research in social stratification, disaster studies, urban sociology, and residential mobility, *we hypothesize that such adaptation privilege is distributed unequally across urban neighborhoods, where the social values of home are geographically produced and* *attached.* Here, we conceptualize neighborhoods as socio-spatial units that are constructed symbolically as well as materially through the intersecting beliefs and actions of residents, planners, realtors, developers, researchers, and others invested in their political, cultural, and economic existence. Over time, this social construction turns neighborhoods into places where the local effects of racial capitalism, urbanization, climate change, and other macro-level forces touch down to impact residents in stratified ways that become "real in their consequences" (Thomas and Thomas 1928: 572). Those consequences shape not only the formation of community attachments discussed above but also racial and economic inequities in how respective borders are constructed to enhance or diminish property values, link to school district boundaries, and other axes of social inequality. As these local dynamics intersect with a national history of redlining and other federally-led policies that have contributed to the sorting and segregation of urban housing by race and class, neighborhood inequities become enduring modes of stratification, even as individual residents come and go (Sampson 2012; Sharkey 2013).

We contend that these neighborhood inequities are particularly relevant for the implementation of managed retreat in urban areas – where the policy now predominates – for several interlocking reasons. First, the capacity to move entire flood-prone neighborhoods to nearby areas relatively *en masse* – as in the cases of Valmeyer, Isle de Jean Charles, and indigenous Alaskan communities – is rendered extremely difficult by existing high-density development and community attachments already in place in surrounding neighborhoods. Second, that difficulty is amplified for homeowners in less racially and economically privileged neighborhoods because they typically do not possess the financial, political, and organizational resources – let alone trust in government – needed to protect the social values of their homes. And third, persistent racial and economic segregation has also diminished not only the economic value of homes in less privileged areas but also affordable, socially receptive residential alternatives nearby.

We hypothesize that these social dynamics make *individualistic relocation* – rather than collective retreat – the most probable residential pathway for homeowners in less racially and economically privileged neighborhoods. That pathway is the most potentially disruptive because it subsumes the social value of home to the economic value of home and, in the process, distances homeowners not only from each other but also from the place they once called home. Support for these hypotheses, if uncovered, would not contradict the cases of Valmeyer, Isle de Jean Charles, or Alaskan villages now retreating, or even the case of Oakwood Beach on Staten Island. Instead, it would affirm them to be more exceptions than examples, further illuminating how and why collective action is so important for preserving the social values of less privileged communities now at risk not just from future flooding but also seemingly rational government policies of adaptation.

DATA AND METHODS

Address-level data appropriate for tracking the residential pathways of homeowners from residence to residence are scarce to nonexistent. We address this limitation by assembling a novel database of all homeowners who participated in federally funded buyouts of flood-prone homes in Harris County, Texas – the central county of the Houston metropolitan area and a national leader in federally funded buyouts of flood-prone properties. Flooding in Houston is widespread, occurring in 22 distinct watersheds and affecting every ethnoracial and socioeconomic group. Prior to Hurricane Harvey in 2017 and subsequent passage of a $2.5 billion flood bond in 2018, there had been more than 3,000 federally subsidized buyouts in the county. A database of these buyouts serve as the core of our analyses, with 3,076 records containing information on the buyout participant's name, price of buyout, and date of transaction. In all cases, the observed sales were voluntary due to government guidelines prohibiting the use of eminent domain, and once purchased, the homes were razed, and the lots were cleared, ensuring permanent resettlement.

For analyses, we restricted cases to those transacted by the Harris County Flood Control District (HCFCD) between January 2000, when the local policy of managed retreat began in earnest, and August 2017, just before Hurricane Harvey. Over this time period, the HCFCD used $340 million in funds to acquire more than 3,100 properties; those funds accounted for 14 percent of all HMGP funds during 2004 – 2016, making it the largest program in terms of dollars spent and properties acquired (Kinder Institute 2018). To convert those cases into address-to-address mobility data, we took a series of additional steps summarized in **Table 1**. First, we excluded records where the property owner was a corporate entity rather than an individual homeowner (n= 157). We then excluded records in which the site had no structure at the time of the buyout; often such lots were part of a planned subdivision where homes had not yet been built (n= 412).[2] Next, we excluded records with clerical errors that compromised data quality (n= 141); these included mostly duplicate records and some entries with no property owner names. These steps left us with 2,366 valid records for which to search for destination addresses, none of which were included in the original database.

[Table 1 about here]

Each search for the buyout participant's subsequent address began by looking for their name in the Harris County Appraisal District's (HCAD) online database for Tax Year 2018. The

[2] Many of these cases were identified by addresses that begin with "0," for example, "0 Little Fox, Lot 18," and verified using Google Earth's historical imagery.

HCAD database is searchable by name and includes ownership histories for each property. If there was an exact match for the participant's name in the HCAD database and the timing of entrance into the newly recorded residence roughly matched the buyout date, then the new address was entered as the buyout destination. Next, to affirm data quality and continue searching for names that did not appear in the HCAD database, we turned to the online database FastPeopleSearch.com, which allows users to conduct a public records search by individual name and then returns all addresses ever recorded as being affiliated with that person. We then used a second online database, Anywho.com, to further identify and verify each destination addresses. If an address for a participant could not be reliably located and verified around the observed buyout time, we treated the case as missing (n= 584). That number includes 211 cases in which a buyout participant's name (e.g., Pedro Martinez or Carol Moore) was too common to reliably identify their destination address because of multiple such names moving around the same time.

These methods yielded destination addresses for 1,782 buyout participants, representing 75 percent of households who accepted a buyout in Harris County prior to July 2017. For analytical purposes we examine only the 1,617 buyout participants who resettled within the nine-county Houston Metropolitan Area, consisting of Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, and Waller counties.[3] We invoke this restriction for several reasons. First, the Houston metropolitan area covers more than 10,000 square miles – roughly the size of Massachusetts – providing plenty of space over which to observe both short- and long-distance moves. Second, the reliability of our methods for locating destination addresses likely declines over more longer distances. Third, the exclusion of extreme outliers in our

[3] Among the n=175 program participants who moved outside the Houston metro area, more than 70% remained in Texas (n=126), with Bexar County (n=14), San Jacinto County (n=10), and Travis County (n=10) being the top three destinations. Among the n=49 interstate movers (less than 3% of all identified participants), 55% remained in the Census's South region, while 23% relocated to the West, 16% to the Midwest, and 6% to the Northeast.

regression analyses improves statistical inference and thus conclusions drawn. Fourth, most residential moves in the United States occur over relatively short distances. National data indicate that nearly 70 percent of all moves in the United States occur within the same county, and 98 percent occur within metropolitan areas (Marlay and Fields 2010).

Finally, among the intra-metropolitan movers in our database, we restrict our sample to those whose buyout occurred within a super neighborhood with at least five such buyouts. This restriction reduced our sample by just 46 cases but helps to ensure reliable measurement of variables described below and ensures that analyses focus on residential pathways extending from areas of general risk rather than one-off purchases of a few aberrant properties. The end result is an analytic sample of 1,572 homeowners who accepted a federally-subsidized buyout of their flood-prone homes within the urban core of Houston and subsequently resettled elsewhere within the encompassing metropolitan area.

To test for bias in this analytic sample, we returned to the full population of 2,366 developed, non-corporate buyout records with valid data. We then estimated a simple logit model in which the outcome equals one if the record is included in our analytic sample, and zero if it is not. The predictors included whether the buyout participant had a Spanish surname (a proxy for Hispanic identity) as well as the price, acreage, and number of days since the home buyout was formally transacted. In addition, we also included measures of the racial (% White) and class composition (median household income and % of residents who are homeowners) in the census tract in which each buyout occurred, measured using 2000 decennial census data and boundaries. Results (available upon request) indicate that our analytic sample disproportionately excludes participants who sold larger, less expensive properties located in more rural parts of Harris County; by contrast, it is highly representative of those in Houston's urban core. Results also indicate that Spanish surname and the amount of time since a homeowner's buyout, in addition to the racial, income, and homeownership composition of the tract in which the buyout occurred do *not* significantly predict exclusion from our analytic sample (at the $p < .05$ level). Consequently, if analyses reveal variation along these lines, we can be confident that it is not due to selection bias.

Socio-Spatial Measures of Resettlement

We measure the residential pathways that emerge from managed retreat along two socio-spatial dimensions. *Distance resettled* refers to the distance that a buyout participant moves from bought-out residence to subsequent residence. *Distance from similarly resettled neighbors* refers to the median distance that a participant's subsequent residence is located from the subsequent residences of neighbors who also resettled from the same area through the same buyout program. Here, we define neighbors as those whose buyouts occurred within the same "super neighborhood" delineated by the City of Houston or within the same small, neighborhood-like municipality that exists independently within Harris County (e.g. West University Place or Pasadena). Officially, these super neighborhoods and neighborhood-like municipalities are geographic areas in which residents, civic organizations, institutions, and businesses work together through an elected council to identify, plan, and address the needs and concerns of their community and according to the City, they encompass areas with similar physical characteristics, identity, and infrastructure.

To standardize measurement of these super neighborhoods and small, neighborhood-like municipalities, we use a crosswalk developed by the Kinder Institute for Urban Research (Kinder Institute, n.d.). That crosswalk overlays respective boundaries onto Census 2000 census tracts to construct Community Tabulation Areas (CTAs). Of the 143 CTAs, or super neighborhoods identified in Harris County, 39 had at least five buyouts between 2000 and 2017 and thus are included in our sample.

To measure distance from similarly resettled neighbors, we calculate the straight-line distances between the participant's destination address and the destination addresses of all other participants from the same super neighborhood who also resettled within the metro area. We then take the median value of those distances to compute a distinct value for each buyout participant in our analytic sample. All distances, including distance moved, are measured in straight-line miles using R and its gDistance function from the "rgeos" package (Bivand and Rundel 2019). We use straight-line, or Euclidean, distance because it is easy to calculate and highly reliable. Prior research in other metropolitan areas indicates that the mean ratio of driving distance to straight-line distance ranges from approximately 1.3 (Boehm 2013) to 1.6 (Blind et al 2018); and, nationally each trip-mile averages 1.9 minutes to complete (U.S. Department of Transportation 2020).

Measures of the Neighborhood Economic and Racial Status

In measuring the economic and racial status of buyout neighborhoods, it is first useful to visualize those spaces. **Figure 2** offers a stylized example. In it, the super neighborhood (or CTA), constitutes the largest, encompassing boundary. Along one border is flood-prone water. In Houston that water is likely to be a bayou, but elsewhere it could be a seashore, river, lake, or reservoir. Major streets form the other borders of the super neighborhood, separating it from adjacent super neighborhoods (not shown). In the flood-prone super neighborhoods under investigation, there are an average of nine to ten census tracts, averaging approximately 4,000 residents each. In that space, some tracts will experience buyouts, and some will not. The exact number and location depend on how many homes the local flood control district targets for buyout and how many homeowners accept. In the fictitious example in Figure 2, 7 homeowners accepted a buyout and subsequently resettled.

[Figure 2 about here]

To measure the economic and racial status of each area, we follow Sharkey and Faber's (2014) call to examine multiple geographic scales that might be relevant. For economic status, we use three scales, each based on the purchase price of respective buyouts adjusted to constant 2017 dollars to control for inflation. The smallest scale is that of the *specific* property. The next scale is the encompassing *census tract*, for which we compute the mean price for all buyouts therein. And, the final scale is the encompassing *super neighborhood*, for which we again compute the mean price for all buyouts therein. Here, it is worth noting that while some properties may be "grandfathered" into lower flood insurance rates reflective of lower, historical flood risk at the time of their construction (Kousky 2018; see also GAO 2013), prices offered to homeowners through HCFCD's managed retreat program are expected to reflect the home's "fair market price" prior to damages incurred from recent flooding (Freudenberg et al. 2016; see also FEMA 2019).

For racial composition, we use just the latter two scales because reliable data are unavailable for individual homeowners. The first scale measures the proportion of residents in the encompassing *census tract* who are non-Hispanic White. The second scale measures the proportion of residents in the encompassing *super neighborhood* who are non-Hispanic White (hereafter referred to simply as White). We use 2000 Census data because the buyout database does not include information on the race and ethnicity of participants and because we want to ensure that measurement occurs at a consistent point in time at the start, not end, of the observed resettlement window. We use the proportion White rather than proportions Black, Hispanic, Asian or Native American because we are primarily interested in how White racial privilege works relative to other non-White groups. We encourage future research to examine more specific racial and intersectional categories.

Analytic Approach

To analyze these data, we first use descriptive statistics and regression analyses to examine each dimension of our typology separately: distance resettled; then, average distance from similarly resettled neighbors. Each set of the regression analyses tests for the independent influence of neighborhood economic and racial status on respective outcomes at different scales, with appropriate corrections for the clustering of participants within respective neighborhood boundaries. Next, we use those results to revisit the typology presented in Figure 1, this time to help visualize our results. Finally, we review supplemental analyses conducted to assess (and affirm) the robustness of our statistical findings. Those analyses include multilevel modeling as an alternative means of accounting for the clustering of buyout participants with respective neighborhoods boundaries.

RESULTS

Distance Resettled

To start, Figure 3 displays a frequency distribution of distance moved by buyout participants in Harris County during 2000 - 2017. The mean straight-line distance is approximately 11.4 miles, which in Houston is roughly the equivalent of moving from the

Astrodome to Pearland's town center (or, in New York City, from the Upper East Side to Yonkers).[4]

[Figure 3 about here]

To account for the skew of this variable toward higher values, we take its natural log before using it as a dependent variable in the ensuing linear regression analyses. That transformation minimizes the statistical effects of outliers in the data, rendering our results more statistically conservative. It also yields more normally distributed residuals, strengthening statistical inference. In **Table 2**, we first estimate the correlations for each scale, or indicator, of economic status separately, then together. In all instances we statistically correct for clustering within the largest geographic unit observed. Results reveal several general patterns.

[Table 2 about here]

First, distance resettled decreases with economic status, regardless of the scale at which that status is measured. Second, this finding increases in statistical strength with the scale at which it is observed. That is, the economic status of buyouts in one's super neighborhood is a stronger predictor of distance moved than the price of one's own buyout. Neighborhood context, it seems, matters. This finding is evident not just in the increasing magnitude of the coefficients across Models 1 through 3 of Table 2; it is also evident in Model 4. There, the coefficient at the super neighborhood-level is the only one that is statistically significant ($p < .05$) when all three indicators are included in the model together.

[4] A common ratio of 1.5 driving miles for every straight-line mile implies an average of 17 driving miles; at a national average of 1.9 minutes per trip-mile, that equates to approximately 32 minutes, one-way.

To help visualize these findings, **Figure 4** uses results from Model 4 to graph the estimated distance resettled by the average purchase price in a super neighborhood, holding the other two indicators of economic status constant at their means. To facilitate interpretation, all estimated values are transformed back to unlogged values and displayed for the observed range of purchase prices in our sample. Here we see, for example, that the estimated distance resettled in a super neighborhood with an average purchase price of $280,000 is just 3 miles, compared with more than triple that distance in a super neighborhood with an average purchase price of just $80,000.[5]

[Figure 4 about here]

Next, we repeat similar analyses for the racial composition of respective areas, as indicated by the proportion of White residents. Here, Models 5 and 6 of Table 2 show a strong *negative* correlation with distance resettled at the tract level but not at the super-neighborhood level. Racial composition, it seems, matters more in more tightly bounded geographic spaces. This finding is corroborated in Model 7, which indicates that the tract-level measure is the only one that is statistically significant when both levels of racial composition are included in the same model.

To visualize this correlation, we proceed as we did above for economic status. That is, we transform all estimated values from Model 7 back to their unlogged values and present them in **Figure 5** for the observed range of tract-level values (from 0% to 93% White). Here, we see the same downward slope as we did for economic status. For example, the estimated distance moved from a tract that is 90-percent White is just 5

[5] These values are lower than the average of 11.4 miles reported in Figure 3 because they come from log-transformed values that were then unlogged for Figure 4, giving them a conservative bias.

miles, compared to approximately 11 miles for someone from a tract that is 10-percent White.

[Figure 5 about here]

Finally, Models 8 and 9 of Table 2 enter the strongest indicator of economic status (at the super-neighborhood level) and racial status (at the tract level) into the same model. Results in Model 8 indicate that neither is statistically significant ($p < .05$) when both are included. Further investigation indicates that this non-significance occurs because a super neighborhood's economic status is highly correlated with the racial composition of its census tracts (.43, $p < .001$), making it statistically difficult to disentangle their independent effects. This difficulty is compounded when a clustering adjustment is made to account for a lack of independence among participants within the same super neighborhood. When that adjustment is relaxed in Model 9, the coefficients retain the same values, but their p-values fall below .05, suggesting two things. First, if the sample size were increased, the coefficients in Model 8 would likely be statistically significant even with the clustering adjustment. (Current p-values are .09 and .17, respectively.) Second and more substantively, the economic and racial indicators continue to operate in the same direction, indicating that they are additive. That is, buyout participants from Whiter tracts within wealthier super neighborhoods appear to resettle the shortest distances, on average; whereas, the opposite is true for buyout participants from neighborhoods of color within poorer super neighborhoods.

Distance From Similarly Resettled Neighbors

Next, we examine the second dimension of our typology – median distance from neighbors who resettled from the same super neighborhood through the same buyout program. **Figure 6** plots a frequency distribution of this variable, revealing an average distance of approximately 14.2 miles.

[Figure 6 about here]

As above and because of its rightward skew, we take the natural log of this variable before examining it via clustered regression analysis. Results appear in **Table 3** and reveal two general patterns consistent with those above. First, each indicator of economic status is negative and statistically significant ($p < .05$). Thus, as economic status increases, distance from similarly resettled neighbors decreases. Second, the super neighborhood appears to be the level at which this tendency is strongest.

[Table 3 about here]

To visualize these correlations, **Figure 7** graphs the results from Model 3 of Table 3, with values again transformed back to non-logged values to facilitate interpretation. Here we see, for example, that the estimated distance from resettled neighbors from a super neighborhood in which purchase prices averaged $280,000 is approximately 8 miles, compared to approximately 14 miles in super neighborhoods in which purchase prices averaged just $80,000.

[Figure 7 about here]

Results for racial composition again parallel those for economic status. At both the tract and super neighborhood levels, the higher the proportion of White residents in the buyout area, the shorter the average distance to resettled neighbors. And as with distance moved, this correlation is strongest at the tract level. To visualize this correlation, **Figure 8** graphs the unlogged results from Model 7. Here, we see the same downward slope as we did for average purchase price. For example, the estimated distance from other resettled neighbors from a tract that is 90-percent White is approximately 9 miles, compared with 15 miles for those from a tract that is only 10-percent White.

[Figure 8 about here]

Finally, Models 8 and 9 of Table 3 enter the strongest indicator of economic status and racial composition into the same model. As above, Model 8 indicates that neither indicator is statistically significant ($p < .05$) when both are included in the same model together. The reason, again, is that Whiter tracts tend to be located in more affluent super neighborhoods, making it difficult to disentangle the independent effects of each factor – a difficulty that is compounded when clustering adjustments are made. When those adjustments are removed in Model 9, the coefficients again retain their same values, but their p-values again drop below .05. So, as with distance moved, variation in class and racial composition appears to be additive not just parallel. That is, buyout participants from Whiter tracts located within wealthier super neighborhoods are, on average, the ones likely to resettle closer together; whereas, participants from less affluent areas of color end up dispersing farther from not only from their flood-prone homes but also from one other.

Returning to the Typology of Resettlement

We can now return to the typology in Figure 1 and use it as a template to display the regression results above for different types of neighborhoods. For super neighborhoods, we simulate two types: one with a mean purchase price of $280,000 (middle- to upper-class); another with a mean purchase price of $80,000 (working class). Both values fall within the observed range of our data. Next, we use Model 3 of Table 2 to compute the estimated distance resettled (our x-coordinate) for each of the two neighborhood types, holding racial composition constant at its mean. Then, we use Model 3 of Table 3 to compute the estimated distance from similarly resettled neighbors (our y-coordinate) for each neighborhood type, again holding racial composition constant at its mean. Once these values are computed for our x- and y-axes, we take the exponent of each predicted value and subtract its sample mean. We then plot those de-meaned values in **Figure 9**, where the x- and y-axis now cross at their respective demeaned values of zero. On both axes, negative values now indicate lower than average values; and positive values now indicate higher than average values.

[Figure 9 about here]

To illustrate, the marker labeled "a" indicates that, on average and net of racial composition, buyout participants from a super neighborhood where the average purchase price was $280,000 resettled approximately 3.4 miles closer to their original, bought-out home *and* ended up approximately 4 miles closer to similarly resettled neighbors than the average buyout participant in our sample. Thus, relative to other neighborhoods, this more affluent type of urban community fits squarely within the quadrant of *collective retreat*; whereas, the less-affluent neighborhood labeled "b," with an average purchase price of just $80,000, falls squarely within the quadrant of *individualistic relocation*.

Next, we repeat similar calculations for racial composition. Specifically, we use Model 7 of Tables 2 and 3 to graph a tract that is 90-percent White versus one that is 10-percent White, all else equal. Again, we clearly see that the more racially privileged tract, labeled “c”, falls squarely within the quadrant of *collective retreat*; whereas, the less racially privileged tract, labeled “d”, falls squarely within the quadrant of *individualistic relocation*. If we repeated the same procedures using Model 9 of Tables 2 and 3, we would see even more extreme differences between more and less socially privileged neighborhoods.

Robustness Checks

To assess the robustness of our results, we conducted several sets of supplemental analyses. The first set deployed multilevel modeling to re-analyze our regression results. We chose not to use this method initially because, at the tract level, many of the observed neighborhoods have a relatively small number of buyout participants, which can confound multilevel estimation (Huang 2016). Overall, results from the multilevel models (available upon request) affirm the results reported in Tables 2 and 3 in terms of both the direction and level of statistical significance for respective coefficients. In fact, the results used to produce Figure 9 appear to *underestimate* the effect of a neighborhood’s economic and racial status on distance moved. For example, in Model 3 of Table 2, the estimated effect of average buyout price at the super-neighborhood level is -.038 ($p< .05$); whereas, in the corresponding multilevel model it is -.046 ($p< .01$). Similarly, in Model 7 of Table 2, the estimated effect of percent-White at the tract level is -.807 ($p< .05$); whereas, in the corresponding multilevel model it ranges from -.961 to -.982 ($p< .01$), depending on whether one higher level correction is included (for tracts) or two (for both tracts and super neighborhoods). Thus, overall, the results reported above appear to be statistically robust across different methods of estimation that account for the clustered structure of the data (households within neighborhoods).

The second set of supplemental analyses assessed the possibility that more socially privileged neighborhoods are inhabited by more established, long-term residents with a stronger sense of local identity and ties. As a result, homeowners in those areas may elect to purchase homes closer to their bought-out home. By contrast, less socially privileged neighborhoods may attract less established residents with less stake and identity invested in the local community. Thus, for them, the idea of moving farther away may not clash with a sense of community attachment or disrupt social ties in the same way. To test this possibility, we examined the proportion of residents living in the same housing unit five years earlier, using 2000 census data at the tract level. That variable serves as a proxy for average residential stability in the respective neighborhood, which prior research has documented to be a strong predictor of community attachment (Kasarda and Janowitz 1974). Baseline analyses indicate no statistically significant relationship between this variable and distance moved ($r = .01$; $p = .57$), but they do reveal a small *positive* relationship with eventual distance from similarly resettled neighbors ($r = .06$; $p = .01$). Thus, if anything, buyout participants from neighborhoods with more long-term residents end up resettling *farther*, not closer, from similarly resettled neighbors. Next, we re-estimated all models in Tables 2 and 3 with the addition of this new control variable. Overall, the direction and level of statistical significance for respective variables remain substantively similar to those reported, and in none of the re-estimated models does the estimated coefficient for the new control variable reach a p-value below 0.44. Thus, our findings do not appear to stem from covariation of residential stability with the racial and economic status of respective neighborhoods.

Finally, although the question of neighborhood attainment lies beyond the scope of the present study, it is useful to contextualize whether the observed moves are generally leading to neighborhoods of lower or higher socioeconomic status, relative to those departed. If the trend is toward areas of lower status, it would suggest that the findings reported here are more likely to occur under financial duress; however, if it is to areas of higher status, it would suggest more opportunistic resettlement. To assess this trend, we computed change scores for average income per capita, median value of owned housing units, and the proportion of owner-occupied housing between a participant's original and eventual census tract, using 2000 census data. On average, values for all three variables *increased*, ranging from +3 percent for the proportion of owner-occupied housing to +32 percent for income per capita. These results indicate that most homeowners do not voluntarily accept government-funded buyouts unless they can maintain or increase the socioeconomic status of their neighborhood. Yet, at the same time, our findings indicate that buyout participants in more racially and economically privileged neighborhoods are better able to accomplish that outcome while *also* maintaining stronger community attachment, at least socio-spatially.

CONCLUSION

Of all natural hazards, flooding exerts the greatest economic and social impacts on the US population, especially in urban areas where a recent report by the National Academy of Sciences indicates that associated risks are severe and getting worse (NAS 2019). In response, the federal government is funding the managed retreat of people and homes from areas in greatest peril in hopes of creating more resilient cities. That policy is currently grounded in economic theories of rational decision-making and implemented with economic tools. We set out to provide a clear sociological analysis of how that approach plays out among actual participants as it is equally applied across highly unequal urban neighborhoods, paying particular attention to participants' ability to maintain socio-spatial attachments to both place and people.

To do so we developed a new typology to categorize different residential pathways and then applied that typology to Houston, one of the nation's leaders in managed retreat. Results clearly indicate that policy participants in more economically and racially privileged neighborhoods resettle closer to their departed homes *and* to each other. Through this type of spatially gradual "collective retreat," homeowners from more privileged areas are better able to maintain local ties to place, neighbors, and routines. Whether that means still going to the same butcher and meeting at the same seafood restaurants, as in the case of Staten Island, is a matter for further study. But what appears certain is that, without any top-down planning or apparent bottom-up coordination with that intent, this type of resettlement diverges from that of less socially privileged neighborhoods. In those areas, at-risk homeowners end up engaging in longer, more individualistic relocations that end up compromising the social value of home for its economic value in the face of rising flood risks and related policy uncertainties.

What are the implications of these socially divergent residential pathways? One is better contextual understanding of why less privileged communities often fight to adapt collectively (e.g. Bronen 2011; Kozlov 2016; Lynn 2017; Maldanado et al. 2013; Marino 2018). Our results suggest that it is not because they hold the social value of home higher than their more privileged counterparts; instead, it is because managed retreat leaves them less able to protect that social value in the face of not only rising flood risk but also current government interventions intended to reduce that risk. To make up for that lack of *adaptation privilege*, they must organize; otherwise, they will likely sacrifice community attachments that contribute to the social value of home. Conversely and for more privileged counterparts, the economic value of home appears to be less of a substitute for the social value of home than a means of maintaining both values under ascendant climate adaptation policy. We have largely missed that point until now because research on managed retreat has not comparatively investigated resettlement from areas of varying racial and economic status within the same flood-prone city. But, with forecasts of more severe urban flooding ahead, such investigation is increasingly needed, not only because more and more neighborhoods are facing unprecedented flood risk but also because implementation of managed retreat appears to be leading to divergent, not just different, residential pathways from harm's way.

A second and related implication involves climate gentrification. This is the idea that rising flood risk in American cities will suppress property values in more flood-prone neighborhoods while increasing them in less environmentally exposed neighborhoods nearby, driving out residents who can no longer afford to live there. Research from Miami suggests that this process is already underway (Keenan et al. 2018), but thus far the evidence rests primarily on place-based property valuations, or the economic value of home. It does not follow people as they resettle. The present study did just that and shows that urban homeowners from more privileged flood-prone neighborhoods are indeed resettling to nearby homes. In the process, they are also likely to be increasing housing demand and thus prices in those areas in ways that could contribute to gentrification. Homeowners from less privileged flood-prone neighborhoods, by contrast, are moving farther from their communities and from each other, leaving their former flood-prone communities more vulnerable to social disruption, displacement, and physical decay.

Together, these trends suggest that we need to take climate adaptation in general and managed retreat in particular more seriously as a state-led process that is contributing to the inequitable reorganization of social space in US cities, much in the way that past scholarship highlighted the construction of public housing and highways during prior periods of urban redevelopment (Hirsch 1983; Shelton 2017). Like those efforts, current adaptation policies also have historical roots, beginning with the funding of large-scale engineering infrastructures in the 1920s and continuing through the nationalization of flood insurance in the 1960s and mitigation in the 1980s – three processes that continue into the present. As we await further research and action on these successively intertwining processes of adaptation, two limitations of the present study are particularly worth noting and tackling in future research.

First, Houston is clearly just one case. As illustrative as we think that case is, it invites comparative research with other cities, particularly coastal cities, where sea-level rise rather than inland flooding poses the greatest threat to homeowners, many of whom may be wealthier, seasonal residents. Second, our study provides no insight into *why* retreating homeowners from different neighborhoods move when and where they do or if that resettlement leads to environmentally safer residences. Recent research suggests that in some neighborhoods "White flight" may play a strong a role in homeowner decisions to accept government buyouts (Loughran, Elliott and Kennedy 2019; Loughran and Elliott 2019). It also indicates that resettlement, especially from more privileged neighborhoods, does not always lead to neighborhoods with lower flood risk. Both tendencies point to the complexities of residential mobility in general and warn against thinking of flood risks as the only or even most important consideration in homeowners' decisions to resettle. We look forward to future research on these dynamics as well as ongoing efforts to imagine and enact more equitable climate adaptation in the years ahead.

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Figure 1. Types of Resettlement (in CAPS) via Managed Retreat

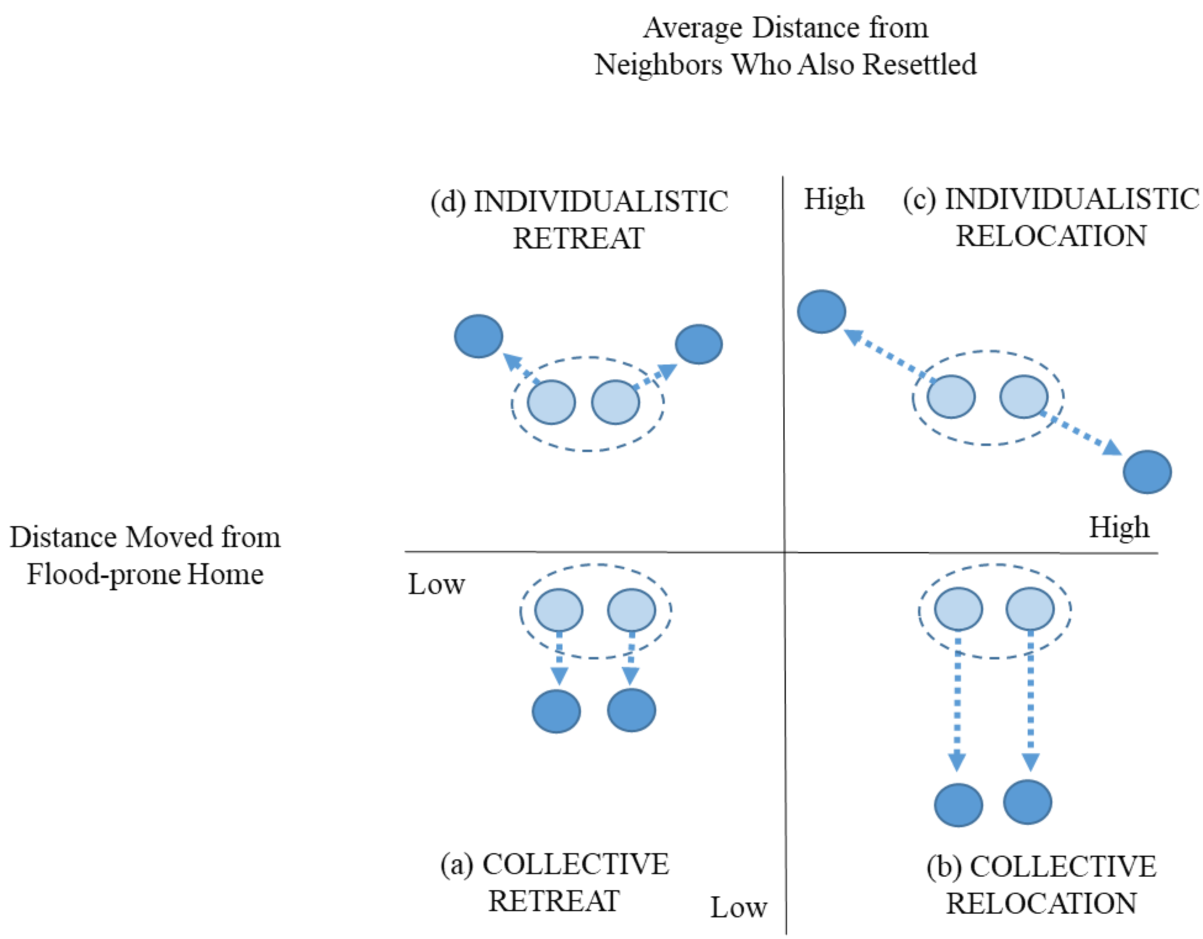
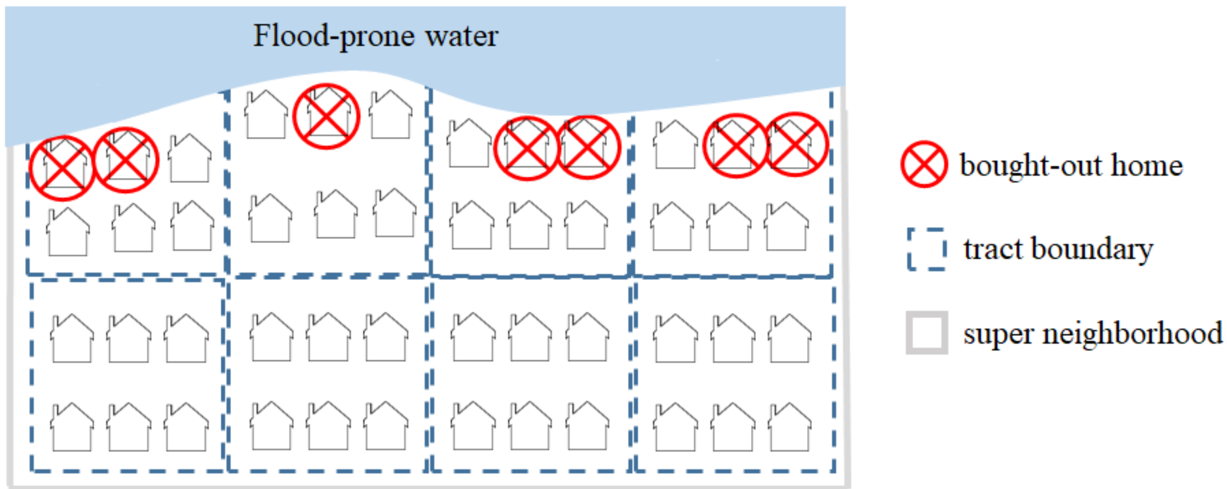


Table 1. Total Counts and Analytic Sample of Federally Funded Buyouts in Harris County, TX.

	Count	% of (Sub)Total
Total Number of Buyout Records[1]	3,076	100.0
Minus undeveloped sites with no housing structures (n= 412)	2,664	86.6
Minus corporate owners (n= 157)	2,507	81.5
Number of Developed, Non-corporate Sites	2,507	100.0
Minus records with clerical errors (n= 141)	2,366	94.4
Number of Developed, Non-Corporate Sites with Valid Data	2,366	100.0
Minus unlocated owners (n= 584)	1,782	75.3
Number of Located Buyout Participants	1,782	100.0
Minus those resettled outside the metro area (n= 175) [2]	1,617	90.7
Number of Located Buyout Participants in Metro Area	1,617	100.00
Minus super neighborhoods with fewer than 5 buyouts (n= 45)	1,572	97.2
Analytic Sample	1,572	100.0
[Number of super neighborhoods of origin]	[39]	
(Number of census tracts of origin)	(92)	

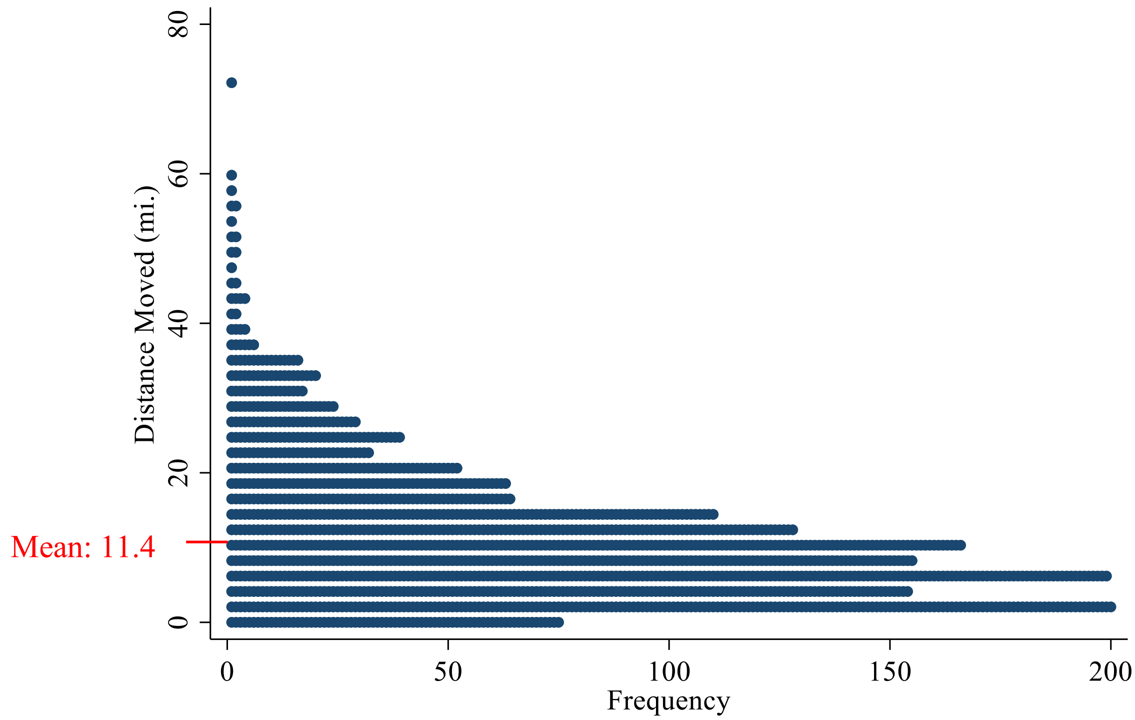
Source: Harris County Flood Control District Records.
[1] Before Hurricane Harvey, August 2017.
[2] Metro counties include: Austin, Brazoria, Chambers, Fort Bend, Galveston, Harris, Liberty, Montgomery, Waller.

Figure 2. Illustrative Sketch of a Flood-prone Area with Buyouts of Residential Properties.[1]



[1] Boundaries for tracts and super neighborhood are presented as rectangular and slightly off-set for illustration purposes only. Actual boundaries would overlap and be much less symmetric, as well as include more housing units.

Figure 3. Frequency Distribution of (Straight-line) Distance Moved for Buyout Participants Who Resettled within the Metropolitan Area



N= 1,572 located buyout participants from super neighborhoods with 5 or more participants; mean= 11.4, s.d.= 9.4.

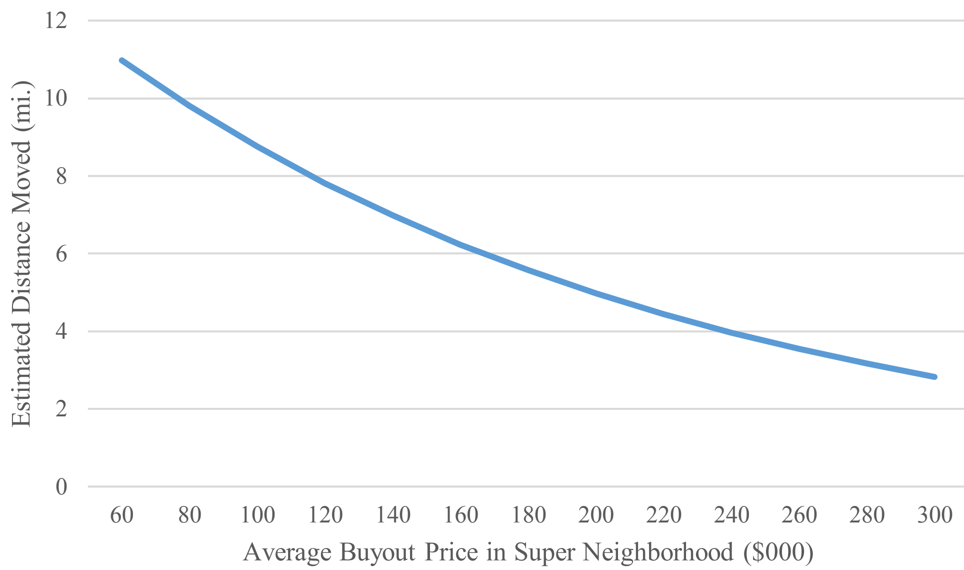
Table 2. Linear Regression Results Predicting Straight-line Distance Moved by FEMA-Buyout Participants Resettling within the Metropolitan Area.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	2.185*	2.370*	2.502*	2.529*	2.240*	2.160*	2.203*	2.521*	2.521*
	(.066)	(.175)	(.179)	(.169)	(.090)	(.083)	(.094)	(.196)	(.114)
Buyout Price (per $10,000)									
Participant	-0.012*			0.002					
	(.004)			(.012)					
Tract Mean		-0.027*		0.018					
		(.013)		(.020)					
Super Neighborhood Mean			-0.038*	-0.057*				-0.028	-0.028*
			(.013)	(.016)				(.016)	(.009)
% White									
In Tract					-0.488*		-0.807*	-0.326	-0.326*
					(.175)		(.339)	(.233)	(.134)
In CTA						-0.352	0.472		
						(.222)	(.369)		
Household N	1,559	1,571	1,571	1,559	1,571	1,571	1,571	1,571	1,571
Cluster Correction Level [1]	none	tract	super n'hood	super n'hood	tract	super n'hood	super n'hood	super n'hood	none
Cluster-Level N	n/a	92	39	39	92	39	39	39	n/a

* p < .05; two-tailed test.

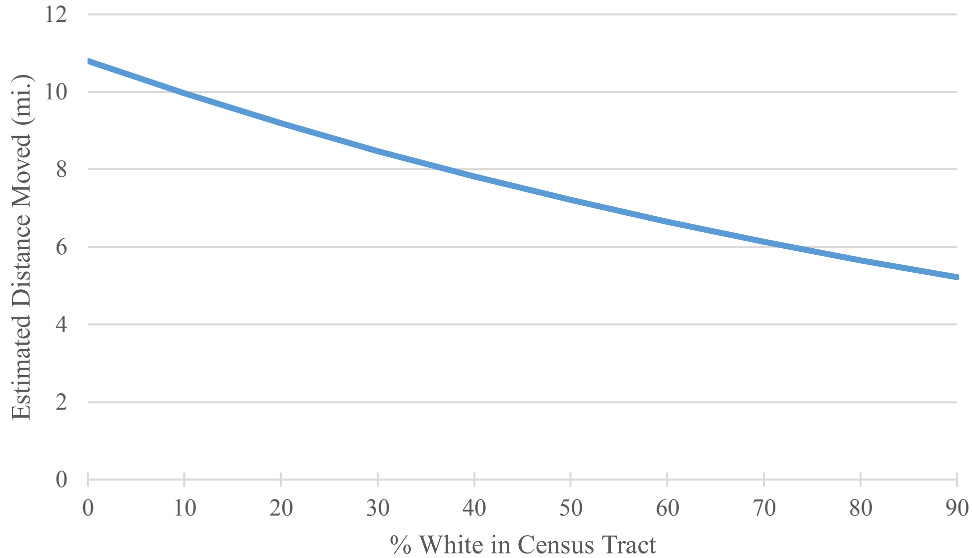
[1] Cluster Correction Level refers to the geographic unit for which respondent clustering is adjusted. Super n'hood refers to super neighborhoods, or community tabulation areas.

Figure 4. Estimated Distance Moved by Average Buyout Price in the Super Neighborhood.



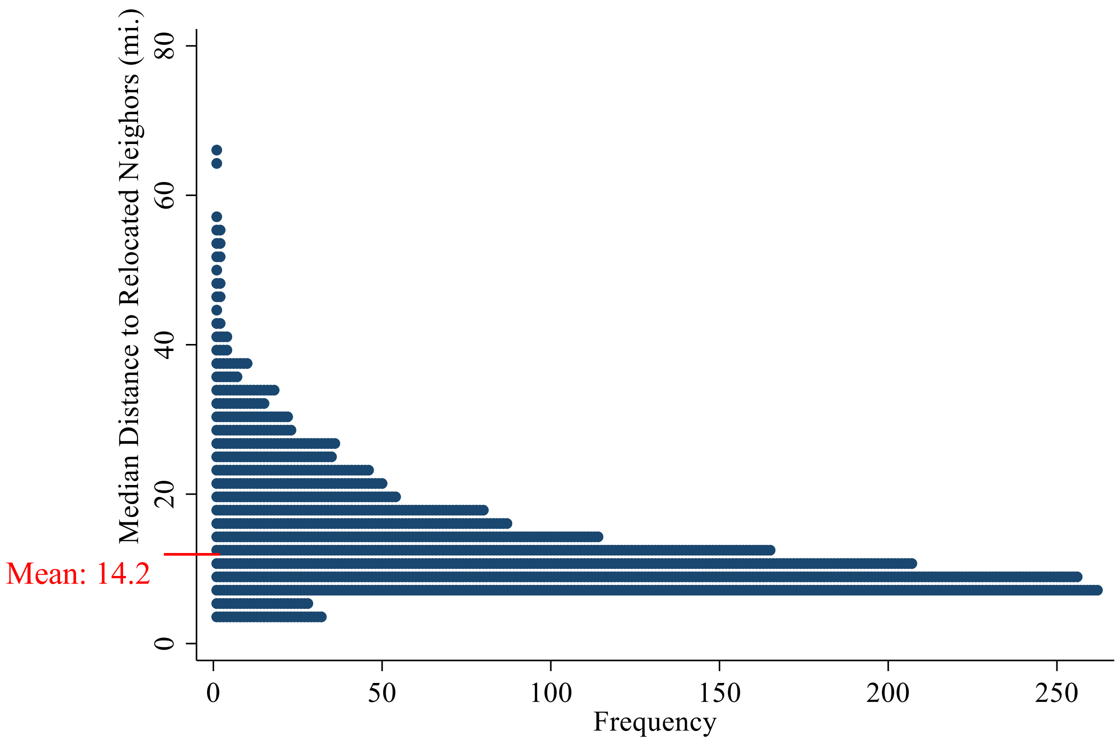
Source: Model 4, Table 2, holding other indicators at their sample means.

Figure 5. Estimated Distance Moved by the Percent White in the Buyout Tract.



Source: Model 7, Table 2, holding other indicators at their sample means.

Figure 6. Frequency Distribution of (Straight-line) Distance from Buyout Participant's Destination to Destinations of Other Participants from Same Super Neighborhood Who Resettled within the Metropolitan Area



N= 1,571 located buyout participants from super neighborhoods with 5 or more participants; mean= 14.2; s.d.= 8.3.

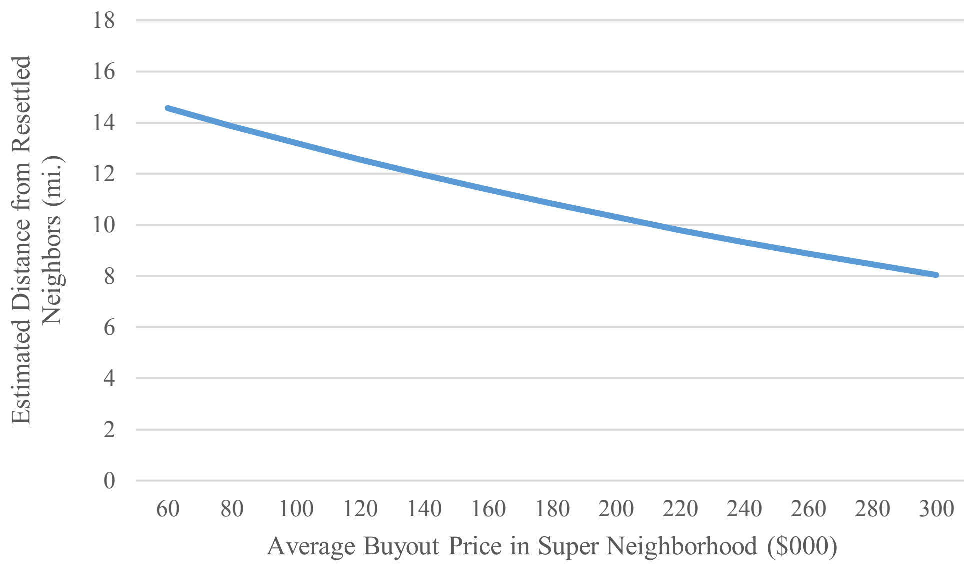
Table 3. Linear Regression Results Predicting Average Straight-line Distance Among Resettled Neighbors from the Same Super Neighborhood Who Resettled within the Same Metropolitan Area.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Constant	2.633*	2.778*	2.827*	2.829*	2.679*	2.616*	2.649*	2.844*	2.844*
	(.032)	(.112)	(.126)	(.111)	(.078)	(.114)	(.114)	(.131)	(.053)
Buyout Price (per $10,000)									
Participant	-0.009*			-0.002					
	(.002)			(.004)					
Tract Mean		-0.021*		-0.002					
		(.009)		(.024)					
Super Neighborhood Mean			-0.025*	-0.021				-0.016	-0.016*
			(.009)	(.026)				(.012)	(.004)
% White									
In Tract					-0.369*		-0.627*	-0.274	-0.274*
					(.166)		(.262)	(.225)	(.063)
In CTA						-0.258	0.382		
						(.257)	(.381)		
Household N	1,560	1,572	1,572	1,560	1,572	1,572	1,572	1,572	1,572
Cluster Correction Level	none	tract	super n'hood	super n'hood	tract	super n'hood	super n'hood	super n'hood	super n'hood
Cluster-Level N	n/a	92	39	39	92	39	39	39	n/a

* p < .05; two-tailed test.

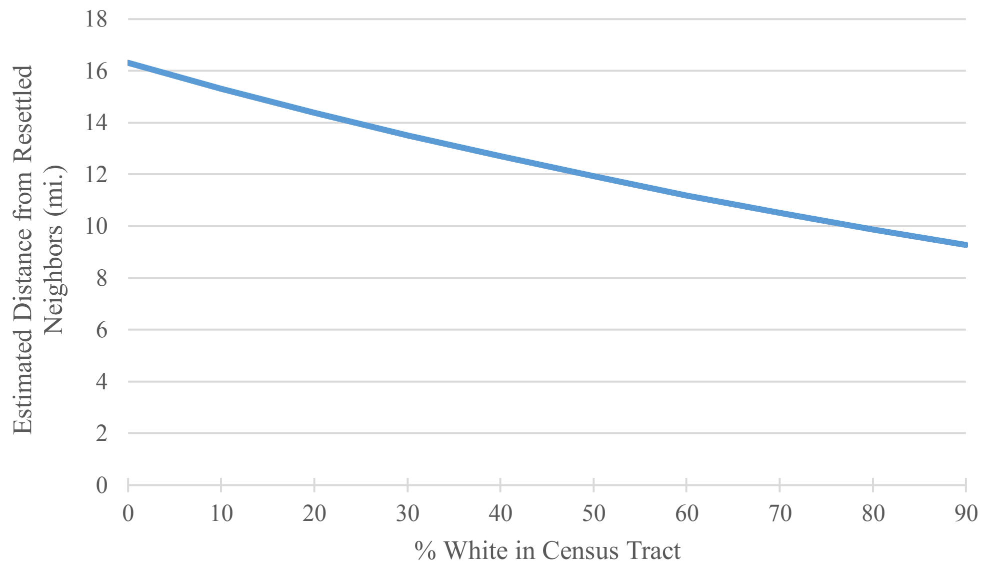
[1] Cluster Correction Level refers to the geographic unit for which respondent clustering is adjusted. Super n'hood refers to super neighborhoods, or community tabulation areas.

Figure 7. Estimated Average Distance from Resettled Neighbors from the Same Super Neighborhood by the Average Buyout Price in the Super Neighborhood.



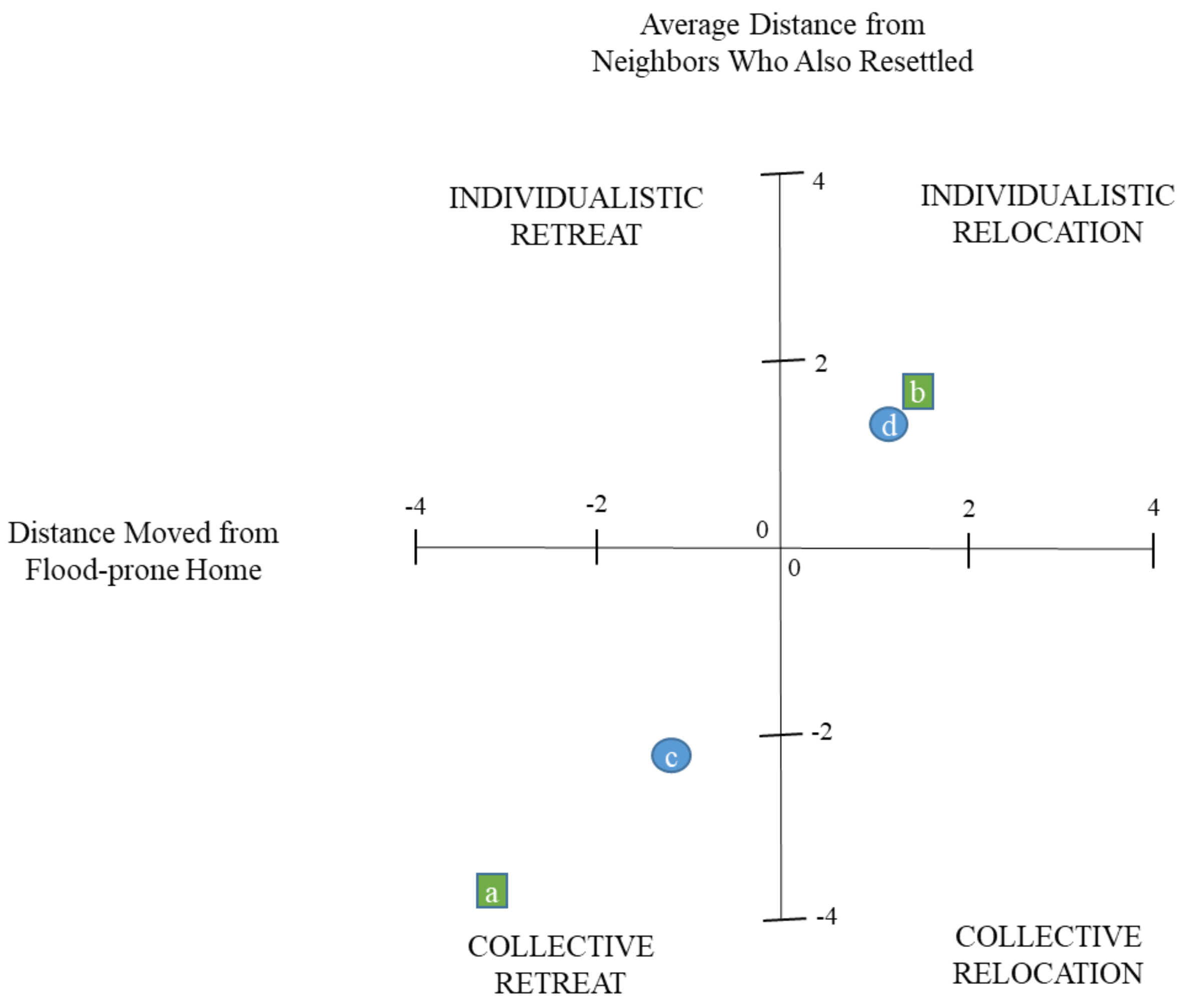
Source: Model 3, Table 3, holding other indicators at their sample means.

Figure 8. Estimated Average Distance from Resettled Neighbors from the Same Super Neighborhood by the Percent White in the Buyout Tract.



Source: Model 7, Table 3, holding other indicators at their sample means.

Figure 9. Cartesian Plot of De-meaned Estimates (in Straight-line Miles) from Tables 2 and 3.



a = $280,000 average buyout price in super neighborhood, net of racial composition
b = $80,000 average buyout price in super neighborhood, net of racial composition

c = 90% White in census tract, net of average buyout price
d = 10% White in census tract, net of average buyout price

Source: For scenarios "a" and "b", simulations come from Model 3 of Tables 2 and 3, all else equal. For scenarios "c" and "d", simulations come Model 7 of Tables 2 and 3, all else equal. The exponents of predicted distances are de-meaned and then plotted. E.g., Scenario "a" indicates that a participant from a super neighborhood where the average buyout price was $280,000 moved 3.39 miles *shorter* than average, and ended up 3.97 miles *closer* than average to similarly resettled neighbors from the same super neighborhood.