Public Attribution of Responsibility for Disaster Preparedness across Three Levels of Government and the Public: Lessons from a Survey of Residents of the U.S. South Atlantic and Gulf Coast

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Using survey data collected from residents of counties along the South Atlantic and Gulf Coasts of the United States, we use innovative compositional data analysis techniques to examine individuals' assignment of responsibility for hurricane preparedness across federal, state, and local officials as well as among household residents and their community. We find that the public assigns limited responsibility for hurricane preparedness to governments. Rather, respondents, especially conservatives and those with low trust in government, view individuals themselves as responsible for preparedness. Our results emphasize the role of ideology and the individualistic culture of American politics. These results also have implications for scholars who study individual attribution responsibility in multi-level systems and who may assume that individuals will assign responsibility to one of the various levels of government; however, focusing on disaster preparation in particular, our study shows that a significant number of individuals may not assign responsibility to government at any level.

Who is responsible for reducing risks to individuals and families from natural hazards? One of the basic responsibilities of government, at all levels, is to ensure the safety and security of the people. However, in the United States the political culture of individualism, a general lack of trust in government, and a federal system with multiple and often overlapping jurisdictions makes addressing this question difficult. Additionally, ideological and partisan beliefs, which can provide heuristic cues for certain levels of government to be responsible, further complicate the process of assigning responsibility and holding officials accountable for policy across all levels of government (Gaines et al. 2007; Gerber and Huber 2010).

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While previous research has examined public venue preferences and policy responsibility across a variety of domains, certain policy areas remain understudied (Choi and Wehde 2019; Leland et al. 2020). Looking specifically at natural hazards, much of the focus of research has been on the retrospective context and what happens after the storm, but less attention has been paid to issues of prospective responsibility and what happens before the storm. That is, who is responsible for preparing for a disaster? Another major limitation of the research on responsibility attribution and intuitive federalism more broadly is the lack of attention to the culture of individualism in the United States and the public's responsibility in policymaking and service provision. We draw on research demonstrating the lack of trust and confidence in government to justify the inclusion of individual responsibility. We overcome the limitations of previous research by examining responsibility attribution—including government, community, and individual (household) responsibility—and by focusing on disaster preparation. Specifically, we examine the assumption that if individuals do not attribute responsibility to the federal government then they simply default to state or local governments. Missing from much of this work is the notion that individuals may decide to assume responsibility themselves.

Disaster preparation is an ideal policy area to examine responsibility attributions because (i) it falls within the realm of basic government functions in terms of public safety and infrastructure provision, (ii) it often requires action across multiple levels of government, and (iii) governmental responses to disasters are relatively clearly delineated across the levels of government and these delineations are reasonably well understood by the public (Schneider 2008). Preparation, though, relative to the other stages of a disaster, also requires greater levels of public action. Governments provide guidelines and create and provide the information and infrastructure necessary to plan, but individuals must act on those guidelines and information. In terms of disasters and natural hazards, hurricanes are especially useful in studying responsibility attribution in federalist systems because they affect and therefore require preparation from multiple jurisdictions, including multiple states. This is in contrast to many other hazards such as earthquakes or tornadoes that primarily affect smaller areas, often within a single state. Hurricanes are also among the most destructive natural hazards and their destructive capacity is expected to increase as a result of climate change (Grinsted, Ditlevsen, and Christense 2019).

In this article, we draw on an original survey of residents of coastal communities in the Southeast and Gulf Coast regions of the United States to examine how the public attributes responsibility for hurricane preparedness across the three levels of government as well as among households and their local community. Overall, we find that, contrary to assumptions, respondents place the largest share of responsibility on individual households, rather than governments at

any level. In other words, in this policy area respondents did not default from the federal government to state and level government, rather they assigned the majority of the responsibility to households. Additionally, using composition analysis—a technique for handling multivariate and dependent data—we find that the attribution of responsibility for hurricane preparedness is associated with several factors including demographics, household preparedness, and, most notably, political beliefs. Specifically, increasing conservatism and decreasing trust in public officials is associated with an increasing proportion of responsibility assigned to households and less to governments at all levels. We also find that younger, non-white respondents and renters assign less responsibility to households. Finally, self-reported level of household preparedness is a significant factor with those that feel their household is more prepared assigning households more responsibility. We conclude by suggesting directions for future research, including a call for scholars of federalism and public opinion to incorporate the key role of individual responsibility into their studies.

Lack of Trust and Individual Responsibility in the United States

One key political variable in examining policy preferences in the United States is trust in government. In general, previous research has demonstrated that many members of the public distrust the federal government and hold low levels of trust and confidence in almost all levels of the government (Choi and Wehde 2020; Hibbing and Theiss-Morse 1995; Uslaner 2001). While confidence in government fluctuates over time, it has remained relatively low across all three levels, though it is slightly higher for state and local governments (Kincaid and Cole 2008; Shaw and Reinhart 2001). Some scholars, such as Schneider, Jacoby, and Lewis (2011), have pushed back against these studies by demonstrating that the public desires more governmental activity at all levels. However, absent from most of this work, excepting Hibbing and Theiss-Morse (2002), is the role of the public in policymaking. While Schneider, Jacoby, and Lewis (2011) found that respondents want more activity at all levels of government, they do not present this as a trade-off with individual versus public responsibility. Following Hibbing and Theiss-Morse (2002), we might expect that even when responsibility is presented as a trade-off the public will prefer government provision, so that they do not have to make decisions or participate. On the other hand, the dislike and lack of trust in government may suggest the public would prefer to be responsible themselves in many policy domains. Given these countervailing pressures, we argue that studies of policy venue preferences and federalism, especially in individualistic cultures with low trust in government such as the United States, ought to consider how individual responsibility is viewed and understood by the public.

In the area of disaster policy, the role of governments in the preparedness phase is to develop infrastructure (e.g., warning systems, shelters) and educate the public on how they can best prepare their households for natural hazards. However, the public is likely to reward or punish elected officials for disaster response but not preparedness (Healy and Malhotra 2009). It is likely that in terms of government actions regarding disaster preparedness the public only sees the education efforts for household preparedness rather than the other government efforts such as infrastructure that are not as visible or obvious to the public. Given the political culture in the United States of individualism and low trust in government, coupled with the largely invisible role for governments in disaster preparedness, we propose:

H1: Individuals will attribute a majority of responsibility for hurricane preparedness to themselves, that is their households.

H2: Individuals with lower (or higher) levels of trust in public officials will attribute more responsibility to themselves (or governments), that is their households.

Intuitive Federalism and Its Limits

Even in the context of low trust in government generally, previous research suggests that the public may possess an "intuitive federalism," where individuals are able to discern and support (or oppose) government actions at the level in which that action is likely to take place (Arceneaux 2005; Schneider and Jacoby 2013). Schneider, Jacoby, and Lewis (2011) found that the public has preferences for one level of government to be responsible in some policy areas over other levels of government and these preferences are largely consistent with the policy areas that each level addresses. For example, the public prefers local government to address urban development and crime reduction, which is usually the purview of local governments. A similar pattern of intuitive federalism also holds for disasters, with the public preferring local governments taking the lead on policy prior to a disaster and the national government taking the lead after a disaster (Schneider 2008).

However, intuitive federalism may be weakened by social identities and political beliefs. It is well known that only a fraction of the politically knowledgeable public hold coherent and consistent ideological positions (Converse 1964; Kalmoe 2020; Kinder and Kalmoe 2017). Therefore, much of the public is not likely to apply "bottom-up" ideological thinking to issues, but rather rely on "top-down" cues from political elites or group identifiers (Barber and Pope 2019; Cohen 2003; Mason 2018). Additionally, ideology and partisanship have become entangled as conservatives and liberals sorted into the Republican and Democratic parties

(Levendusky 2009). However, previous research has found that conservatives and Republicans tend to prefer decentralization more so than liberals and Democrats, therefore they are likely to prefer government decision-making at the state or local level rather than the federal level (Dinan and Heckelman 2020). Indeed, even as public preferences are reasonably aligned with the responsibilities of the various levels of government, ideological and partisan differences remain. On average, Democrats and liberals prefer federal government involvement and Republicans and conservatives prefer state and local government involvement over the federal government in policymaking, both in general as well as when applied to specific policy areas (Schneider, Jacoby, and Lewis 2011). These results are echoed by Konisky (2011) in the domain of environmental issues and Connolly et al. (2020) in the domain of response to the Zika virus.

Political beliefs seem to guide general preferences for which level of government is active in which policy domain; however, general preferences may shift when the opposing party is in power. Between 1987 and 2012, Wolak (2016) finds that people prefer devolution when the president is of the opposing party. Similarly, Dinan and Heckelman (2020) find that Democrats views of decentralization are contingent upon the party in control of the federal government, but Republicans views of decentralization are consistent across party control. Overall, previous research suggests that the public has some intuitive understanding of federalism and the roles of the various levels of government; however, political beliefs influence the level of government the public prefers to be engaged. Consistency among the public in terms of political beliefs and preferred level of government is likely a result of elite cues given that Republicans have for decades been more likely to argue for local control across a host of issues than have the Democrats.

Intuitive Federalism, Political Beliefs, and Disasters

As noted, previous research suggests the public holds an intuitive sense of which level of government is most active across multiple policy areas including disasters. Generally, members of the public view local governments as responsible for preparing for and during the disaster while the national and state governments are responsible for response (Schneider 2008). However, most work in this domain examines blame attributions for responding to disasters, rather than responsibility for preparing for them.

In general, political beliefs play a role in the public's views of federalism, yet research on disaster response and political beliefs has found mixed effects regarding partisanship and ideology on blame attribution or government evaluation. Darr, Cate, and Moak (2019) find a very limited role of partisanship in approval ratings for the state government and FEMA in the aftermath of multiple disasters in Louisiana. However, others, such as Malhotra and Kuo (2008), emphasize the role

of political beliefs. They find that party cues increase respondents' blame attributions for officials of the opposite party in the context of response to Hurricane Katrina. This increase can be moderated when respondents are presented with information about those officials' specific duties, however. Also, Malhotra and Kuo's (2008) descriptive findings suggest that respondents attribute the most blame to federal level actors such as Bush and the FEMA director followed by local actors such as the mayor, and then other actors at the state and federal level. Others find a similarly central role of political beliefs, including both ideology and partisanship (Gomez and Wilson 2008; Maestas et al. 2008). These studies find that partisanship and ideology are associated with decreased blame for co-partisans, with conservatives and Republicans being more likely to blame the Democratic state government than the Republican federal government for the failed response to Hurricane Katrina.

One major limitation of most of the previous studies is that they focus on blame, not responsibility, and were mostly conducted in the aftermath of Hurricane Katrina, a particularly politicized disaster. Most hurricanes and other natural hazard induced disasters do not achieve the same level of political attention as Katrina did. This may have been because, as these studies note, the governmental response and intergovernmental coordination was ultimately considered a failure. More broadly, this work is limited by being retrospective and considering disaster response. Much less work has examined blame or responsibility attribution for pre-disaster stages such as preparation.

Examining responsibility for disaster preparedness is especially important as preparation and mitigation policy can be highly effective at reducing future costs and damages relative to response (Bechtel and Mannino 2019; Healy and Malhotra 2009). One of the few studies to examine preparation responsibility under federalism is that of Arceneaux and Stein (2006), and their findings generally support the idea of intuitive federalism. They do not, however, report the effects of ideology or partisanship on responsibility attribution for flood preparation. More recent work has examined perceptions of the government's responsibility for preparation and, in line with work on response, finds that increasing knowledge about the high levels of benefits and low costs of preparedness increased respondents' willingness to support government funding for preparation (Bechtel and Mannino 2019). However, these effects are largely consistent across partisanship.

Other research has found that conservative ideology is positively associated with a preference for state level, as opposed to federal level, policy in earthquake risk management (Choi and Wehde 2019). This research confirms in a hazard-specific context (earthquake risk management policy) the more general research on the ideological limits of intuitive federalism (Connolly et al. 2020; Konisky 2011;

Schneider, Jacoby and Lewis 2011). Based on this research and the numerous studies on disaster response, we propose the following hypotheses:

*H3: Conservatives (Republicans) will attribute more responsibility for hurricane preparation to individuals/households **and** local/state government than liberals (Democrats).*

H4: Conservatives (Republicans) will attribute less responsibility for hurricane preparation to the federal government than liberals (Democrats).

Past Experience and Attribution

Research on previous experience with disaster or with the government in response stages suggests mixed results. Darr, Cate, and Moak (2019) find that respondents with previous experience with FEMA in disaster response had higher expectations, more positive evaluations of the federal government, and more negative evaluations of the state government. Additional studies find that property damage or harm is associated with less blame for state and local governments (Gomez and Wilson 2008; Maestas et al. 2008). On the other hand, Forgette, King, and Dettrey (2008) find that self-reported property damage is associated with lower levels of satisfaction with the president and local governments, but not other government actors. They also find job loss after Hurricane Katrina is associated with dissatisfaction with almost all government actors. Arceneaux and Stein's (2005) study on preparation finds that those with higher levels of damage were more likely to blame nonlocal governments and the city for their responsibility in flood preparation than credit them for increasing preparation. However, Bechtel and Mannino (2019) find that support for preparedness is largely unrelated to how affected respondents are by disasters (their experiences). In general, this research suggests previous experiences with hazards and with the government shape blame attributions and satisfaction levels, yet the nature of this relationship is uncertain. Thus, we think work such as ours, which occurs absent a specific and politicized disaster event, is important in establishing more general patterns. Because of prior mixed results, we propose the simple expectation:

H5: Past experience with hurricanes will shape responsibility attributions for preparedness.

Data and Methods

The data for this project come from a survey of about 1520 respondents in coastal counties from eight states (North Carolina, South Carolina, Georgia, Florida,

Alabama, Mississippi, Louisiana, and Texas) along the Southeast and Gulf Coast of the United States. Respondents were recruited from an internet survey panel maintained by Qualtrics with quotas for gender, age, and race/ethnicity. The survey contained a variety of questions related to hurricane experience and evacuation, ideology, partisan affiliation, as well as common demographic data such as age and race. For our analysis, we rely on a compositional dependent variable regarding respondents' preferences for responsibility for hurricane resilience. Specifically, we asked,

> "Being resilient and prepared for severe weather events requires having homes that are resistant to high winds and water; access to a sheltered location; and access to an effective warning system. Different types of people and organizations all have a part in assuring that households are prepared for a severe weather event: homeowners, residents of the local neighborhood, local officials, state officials, and federal officials. In your view, who should be responsible for assuring that households are resilient and prepared for **hurricanes**? Assign responsibility across the following people and groups. The total should add up to 100%."

Respondents were asked to assign responsibility across five categories:

1. Household residents (homeowners or renters)
2. Residents in the local area (neighbors)
3. Local officials (emergency managers, mayors, etc.)
4. State officials (state legislators, governors, etc.)
5. Federal officials (members of congress, the president, etc.)

The categories capture the three levels of government as well as individual households and residents in the proximate community. This variable allows us to move beyond government, at all levels, when considering how the public views who is responsible for preparedness for natural hazards. Given the individualistic culture of the United States, individual preparedness is important. Additionally, those in the local community are important as well since some may take cues from the neighbors about the need to prepare and a lack of preparedness by neighbors could have a negative impact on other households.

A composition variable like what we are using as our dependent variable is, by definition, multivariate, and its components are dependent on each other and therefore cannot be modeled appropriately by commonly used linear regression techniques. As such, techniques have been developed to address these violations of the assumptions of linear regression, primarily in the field of geosciences (Aitchison 1983, 1986, 1999; for an application in political science see Katz and King 1999). For the purposes of our data, responsibility attributions (R_{ij} denoting

responsibility attributed to each actor, *j*, for each respondent, *i)* must meet two criteria:

$$R_{ij} \in [0, 1] \ for \ all \ i \ and \ j \tag{1}$$

And

$$\Sigma_{j=1}^{J} R_{ij} = 1 \ for \ all \ i. \tag{2}$$

That is, each responsibility attribution R_{ij} must fall within the unit interval and the sum of all responsibility attributions must equal one. Attributions which meet these requirements are referred to as being in the *simplex* and are call "closed" compositions. These data can be modeled using either the Dirichlet distribution or the additive logistic normal distribution as proposed by Aitchison (1986). While Aitchison argued using the Dirichlet distribution faced many shortcomings, some research suggests these approaches results in similar conclusions, across a variety of situations (Brehm, Gates, and Gomez 1998). One potential problem with compositional data analysis techniques is they are not well equipped to deal with zeroes in the composition. For our data, however, these zeroes are common as respondents often assigned zero responsibility for hurricane preparedness and resilience to any one or more of the five actors. In order to address this in our data, we follow the technique of Fry, Fry, and McLaren (2000). This technique preserves the share ratios of the components as opposed to the simpler technique proposed by Aitchison (1986) which does not preserve these share ratios. This method is thus preferable when we not only care about the absolute proportions in the composition but also the relative proportions as we do here. Standard summary statistics for all independent variables are presented in Table 1.[1]

Table 1 displays a few key characteristics of the data. First, respondents' responsibility attributions are distributed across the entire range, from 0 percent to 100 percent, for all five actors. Before controlling for other factors, respondents view preparation for hurricanes, on average, as primarily their own responsibility (over 52 percent), or at least of the responsibility of households. All four other potentially responsible actors receive much lower apportionments of responsibility with the lowest belonging to residents in the local community with approximately 8.6 percent of responsibility. The second most responsible actor is local governments with 15.6 percent of responsibility. These patterns are important to note, as the question asked not only about the resilience of homes but also about access to public services such as a shelter or effective warning system. Question wording and measurements for key variables are in Table 2.

For compositional variables, summary statistics are calculated differently than for other types of variables. For example, instead of calculating the mean of each

Table 1 Summary statistics

Statistic	*N*	Mean	St. Dev.	Min	Max
Dependent variables					
Federal Govt. Responsibility	1,520	11.0	13.6	0	100
Community Responsibility	1,520	8.6	11.3	0	100
Local Govt. Responsibility	1,520	15.6	14.8	0	100
Household Responsibility	1,520	52.8	32.1	0	100
State Govt. Responsibility	1,520	12.0	12.2	0	100
Political beliefs					
Ideology	1,520	4.4	1.7	1	7
Partisanship	1,493	0.19	2.0	−3	3
Demographics					
Age	1,520	48.5	17.5	18	90
Male	1,520	0.49	0.50	0	1
White	1,520	0.72	0.45	0	1
Education	1,520	4.7	1.8	1	7
Income	1,520	3.6	1.8	1	7
Hurricane specific variables					
Renter	1,520	0.30	0.46	0	1
Damage from Past Hurricane	1,519	0.44	0.50	0	1
Community Preparation	1,520	3.4	0.98	1	5
Household Preparation	1,520	3.6	0.97	1	5

compositional component individually, the average composition over all is calculated. Table 3 shows the average composition has 74 percent of responsibility attributed to households. The next largest attribution of responsibility is to local governments at 10 percent, with just over 3 percent responsibility attributed to community members.

The compositional mean somewhat deviates from the means of each individual variable as it represents the average composition, suggesting that at the composition level responsibility is even more highly attributed to households/homeowners. Additionally, we find that the federal government is viewed as the least responsible for hurricane preparedness, with only 4.9 percent of responsibility in the average composition. These findings suggest the public does not think of hurricane preparedness as a responsibility of any government. Rather, it is the responsibility of individual households (that is, members of the public) who are responsible. In fact, the pairwise ratios demonstrate that respondents attribute, on average, between 7 and 15 times the responsibility for hurricane prepared to the public than to any government. Additionally, the compositional metric standard deviation is 1.75. These descriptive results provide evidence for H1 that the public

Table 2 Measurement of key variables

Variable	Question wording	Measurement
Ideology	On a scale of political ideology, individuals can be arranged from strongly liberal to strongly conservative. Which of the following best describes your views? Would you say that you are:	1 — Strongly Liberal 2 — Liberal 3 — Slightly Liberal 4 — Middle of the Road 5 — Slightly Conservative 6 — Conservative 7 — Strongly Conservative
Partisanship	With which political party do you most identify? Do you completely, somewhat, or slightly identify with that party?	−3 — Completely Democrat −2 — Somewhat Democrat −1 — Slightly Democrat 0 — Neither Democrat nor Republican 1 — Slightly Republican 2 — Somewhat Republican 3 — Completely Republican
Public Trust	People in this community trust public officials.	1 — Strongly Disagree To 7 — Strongly Agree
Education	What is the highest level of education that you have ***completed?***	1 — Less than high school 2 — High school graduate / GED 3 — Vocational or technical training 4 — Some college 5 — 2-year / Associate's degree 6 — 4-year / Bachelor's degree 7 — Graduate or professional degree
Income	Last year, that is in 2017, what was your total family income from all sources, before taxes?	1 — $0-$19,999 2 — $20,000-$39,999 3 — $40,000-$59,999 4 — $60,000-$79,999 5 — $80,000-$99,999 6 — $100,000-$149,999 7 — $150,000 or more.
Renter	Do you own your home or are you renting?	0 — Own and Other 1 — Renting
Damage from Past Hurricane	Has your home ever been damaged by a hurricane? Either wind or water damage.	0 — No 1 — Yes

(continued)

Table 2 Continued

Variable	Question wording	Measurement
Community Preparation	How prepared do you feel your *community* is to cope with future severe weather events?	1 — Not at all prepared 2 — Somewhat prepared 3 — Unsure 4 — Well prepared 5 — Very well prepared
Household Preparation	How prepared do you feel your *household* is to cope with future severe weather events?	1 — Not at all prepared 2 — Somewhat prepared 3 — Unsure 4— Well prepared 5 — Very well prepared

Table 3 Compositional mean and geometric means of pairwise ratios

	Households	Federal Govt.	State Govt.	Local Govt.	Community
Compositional mean	0.74	0.049	0.068	0.10	0.033
Geometric pairwise mean ratios					
Households	1.0	15.1	10.9	7.2	22.3
Federal Govt.	0.066	1.0	0.72	0.48	1.5
State Govt.	0.092	1.4	1.0	0.66	2.0
Local Govt.	0.14	2.1	1.5	1.0	3.1
Community	0.045	0.68	0.49	0.32	1.0

attributes the majority of responsibility to themselves, as opposed to any level of government. Finally, while the standard deviation of the composition does not have the typical interpretation of a standard deviation, it does still provide an averaged measure of the distance from the center of the composition. However, as Figure 1 demonstrates that radius is not always equal in all directions.

The ternary plots in Figure 1 plot the compositional data on a two-dimensional plane which visualizes the components. At the top of each ternary plot is the geometric mean of all compositional variables, excluding the two remaining components which are represented by the other two points. These points are then centered around the compositional mean which allows for better comparison across the panels of the plots that do not contain specific components in common. Thus, these figures demonstrate the pairwise balance between compositional components relative to the average of all other compositional components. Plotted over the data are 95 percent probability ellipses around the mean. These regions

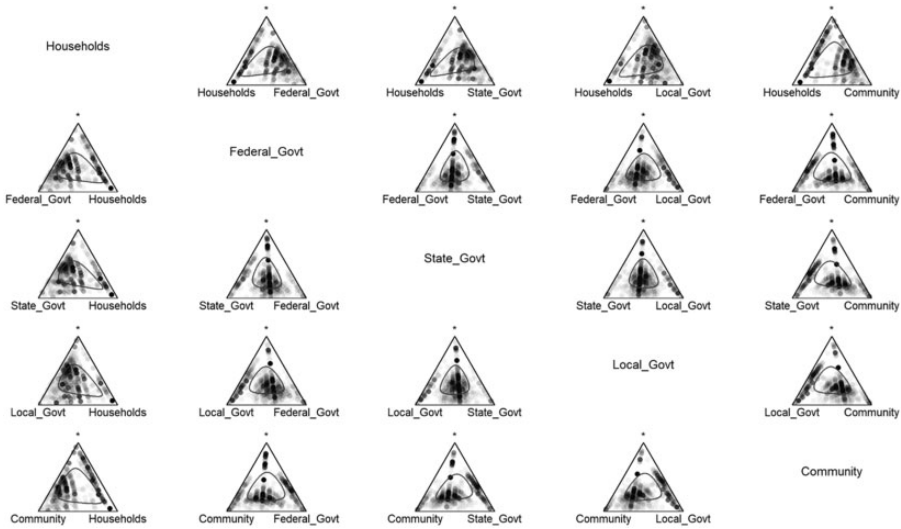

Figure 1 Centered ternary plots of responsibility attribution.

help examine the variance structure in the data and assess proportionality. Specifically, Figure 1 demonstrates that the primary variance in proportionality is between the household responsibility component of the compositions and all other components. This is evidenced by the fact that when household responsibility is plotted as an individual component, thus looking at either the top row or first column, the ellipse is elongated in that direction. In all other plots, such as that between state and local government responsibilities, the composition is more proportional and therefore evenly balanced in the figures. This panel (third column, fourth row, or vice versa) is especially proportional as the third element averages out the effect of the largest (households) and two smallest (federal government and community) components.

Having examined our data descriptively, we then want to model the compositions as a dependent variable. In order to do so, we have to consider our data in a coordinate system. But before that, we first apply an isometric log ratio (ilr) transformation to our data. This regression can be represented, generically, in predicting our composition of five variables as linear functions of n explanatory variables:

$$\begin{aligned} R_i &= \left[R_{i,\ 1}, R_{i,\ 2}, R_{i,3}, R_{i4}, R_{i,5}\right] \\ &= \left[a_1, a_2, a_3, a_4, a_5\right] + X_{i,n} \times \begin{bmatrix} b_{11} b_{12} b_{13} b_{14} b_{15} \\ \cdots b_{n5} \end{bmatrix} + \left[\varepsilon_{i,1}, \varepsilon_{i,2}, \varepsilon_{i,3}, \varepsilon_{i,4}, \varepsilon_{i,5}\right] \end{aligned} \quad (3)$$

In compositional notation, this is represented as such:

$$R_i = a \oplus X_i \odot b + \varepsilon_i \quad (4)$$

Where a and b are unknown compositional constraints, $\oplus$ is the symbol for a perturbation or summing of the compositions and $\odot$ is the symbol for powering or the power transformation which is equivalent to compositional scalar multiplication and ε_i is a compositional random variable with a neutral compositional expected value and constant variance which follows a normal distribution on the simplex. In order to estimate this, we apply the isometric log ratio transformation to R_i, a, b, and ε_i to model the multivariate regression problem using a coordinates system.[2] In order to interpret our results, we apply the inverse isometric log ratio transformation to represent our findings in terms of the original scale measurement of responsibility attributions (Van den Boogaart and Tolosana-Delgado 2013). The results of these analyses are presented in the following section as well as a comparison to more commonly used regression techniques.

Findings

In this section, we present the findings from our model which includes demographics, political beliefs, and hurricane specific variables. We first present the results from multivariate analysis of variance tests on the isometric log-ratio transformed composition regression model, as opposed to the regression coefficient outputs (see endnote two). These tests allow us to examine the influence of each variable on the compositional response.[3] Given that the purpose of this analysis is to test theory, as opposed to maximize the predictive potential of our models, we simply present the results from the test on our full model and retain each variable, even if it does not have a significant relationship with the compositional dependent variable. The results from this test is presented below in Table 4.

Table 4 demonstrates the statistically significant relationship between ideology—increasing conservativeness—and the hurricane preparedness responsibility attribution composition.[4] Our model suggests partisanship, as another form of political belief, does not have a significant relationship with attribution of responsibility for hurricane preparedness. Public trust, however, does. Our model suggests that age, race (White) and income have significant relationships with the hurricane preparedness responsibility attribution composition. We also find that being a renter and self-reported perceptions of household preparedness have significant effects on responsibility attribution compositions. To better understand the relationship between these variables and our hurricane preparedness responsibility attribution composition, we present figures of compositional predictions, in original proportional units, for all significant variables and partisanship below.

Table 4 Results from multivariate analysis of variance on isometric log-ratio transformed compositional regression model

	Model 1		
	Df	Pillai	Approx. F
Intercept	1	0.59	524.0***
Ideology	1	0.036	13.7***
Party Strength	1	0.005	1.8
Public Trust	1	0.023	8.8***
Age	1	0.058	22.7***
Male	1	0.004	1.5
White	1	0.017	6.3***
Education	1	0.006	2.3
Income	1	0.007	2.6*
Renter	1	0.009	3.5**
Exp. Past Damage	1	0.003	1.2
Comm. Preparedness	1	0.001	0.5
HH Preparedness	1	0.007	2.7*
N		1,492	
Adj. R^2		0.054	

*p < 0.05, **p < 0.01, ***p < 0.001.

Figure 2 depicts the relationship between political beliefs and the predicted attributional composition of responsibility for hurricane preparedness, with all other variables held at their means or modes. In the top facet, ideology, measured by a seven-point self-reported scale, is plotted against the composition while the middle panel plots the effect of party strength on the compositional dependent variable. The bottom panel of Figure 2 demonstrates strong evidence in support of H2. When all else is held at its mean or mode, respondents with the lowest trust in public officials attribute almost 95 percent or responsibility to households themselves. However, as trust in public officials increases, so does the responsibility attributed to government actors. The top and middle panels suggest that as respondents become more conservative, they attribute less responsibility to the federal and other governments and more responsibility to households themselves. This plot also suggests that the relationship with responsibility attribution is much stronger for ideology than party strength. Across the range of ideology, responsibility attributed to households changes by 17 percent; however, across the range of party strength, this change is only 2.4 percent. We thus find mixed results for H3 and H4. Conservative ideology is associated with increased responsibility for households, not lower levels of government, yet partisanship has

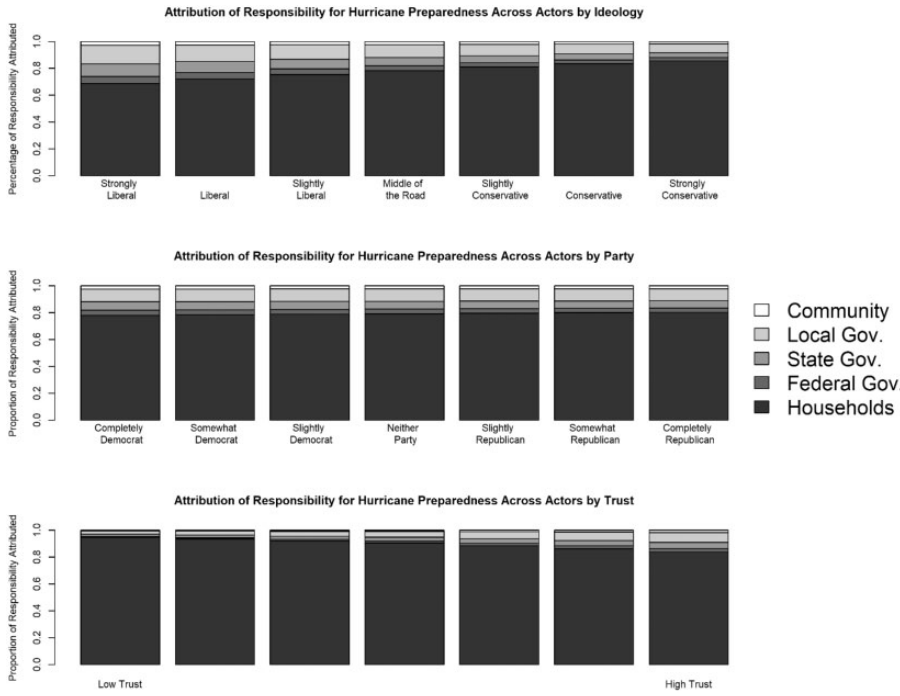

Figure 2 Effect of political beliefs on preparedness responsibility attribution.

no relationship with responsibility attributions. Next, we examine the role of demographics in explaining responsibility attribution for hurricane preparedness.

Figure 3 displays the relationship between age and income and the predicted responsibility attribution, all other variables held at their means or modes. The lines in Figure 3 clearly demonstrate that older respondents attribute more responsibility to households than other actors. Similarly, income is positively associated with responsibility attributed to households and negatively associated with responsibility to the federal and other governments. We find no significant effect of education on responsibility attributions, however.

Figure 4 depicts the relationship between race, White and Non-White, and the predicted responsibility attribution composition. This figure suggests White respondents allocate a larger portion of the responsibility for hurricane preparedness to households themselves. Specifically, White respondents attribute, on average, approximately 79 percent of responsibility to households while Non-White respondents attribute, on average, approximately 70 percent of responsibility to households. Non-White respondents attribute, on average, more responsibility to the federal government and their community as their Non-White correspondents (5.9 percent vs. 3.5 percent and 4.0 percent vs. 2.2 percent,

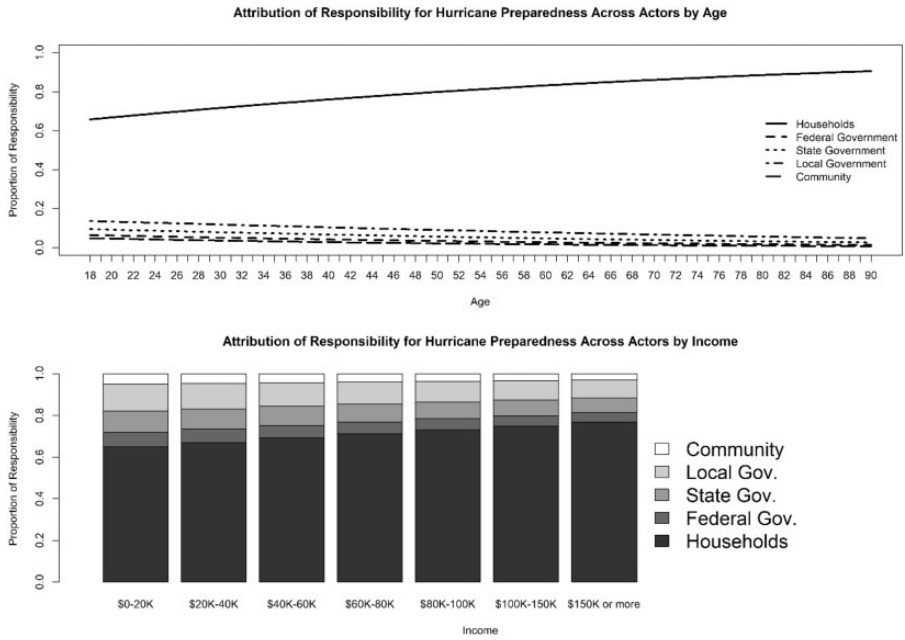

Figure 3 Effect of age and income on preparedness responsibility attribution composition.

respectively). Finally, we examine the effects of hurricane specific characteristics on responsibility attribution.

Figure 5 depicts the relationship between rental status and self-reported preparedness with responsibility attribution compositions in the bottom panel. The top panel suggests renters attribute less responsibility to households for hurricane preparedness and more to other actors, primarily local governments. Specifically, renters attribute approximately 5 percent less responsibility to households, attributing on average 74.1 percent of responsibility to households compared to 79.3 percent of responsibility attributed by nonrenters. Regarding local government, renters assign 13.2 percent of responsibility while nonrenters only assign 9.2 percent of responsibility (an increase of approximately 43 percent). Having examined the dependent variable as a composition, which is appropriate for the type of data analyzed, we also present the results from more traditional linear (OLS) regressions for comparison. Finally, households which believe they are more prepared assign more responsibility for preparedness to themselves. We do not, however, find evidence in support of H5; previous experience with hurricanes does not shape our respondents' responsibility attributions.

Table 5 presents the results of linear regressions where the dependent variable is the percentage of responsibility assigned to each actor, individually. While these models violate the assumptions of linear regression, they provide a useful

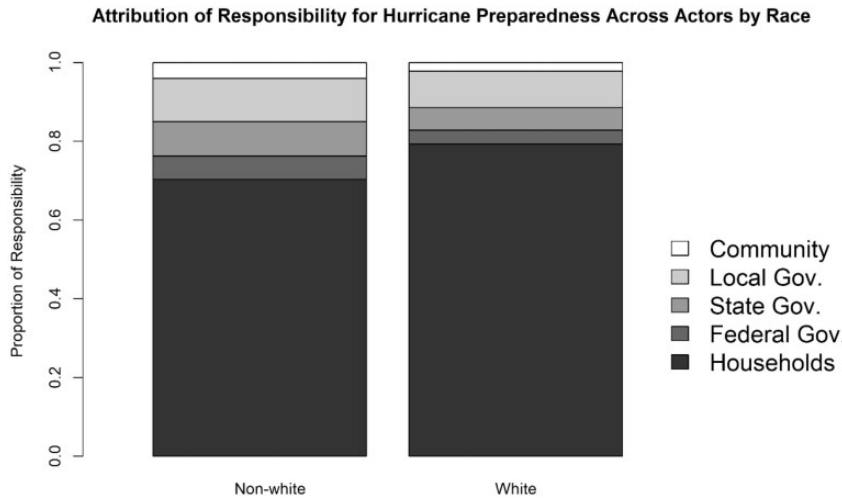

Figure 4 Effect of race on responsibility attribution composition.

comparison to the more appropriate compositional models. Specifically, these models confirm that the explanatory variables in the compositional regression are also significant in the linear regression on household responsibility. This logic is also confirmed by the adjusted R-squared statistics which suggest our independent variables best explain variance in responsibility assigned to households. Confirming the findings of the compositional regression, age and public trust are the only independent variables significantly associated with responsibility for all five actors. These results also confirm the compositional finding that rental status is associated with responsibility attributions for households and local governments, primarily. In general, our compositional regression models are more conservative in finding significance for independent variables because the model considers perturbations on the overall composition. However, the linear regression models confirm the findings of the compositional regressions, suggesting our findings are robust to model estimation technique.

Discussion

In our analysis, we find that respondents attribute the majority of the responsibility for hurricane preparation to homeowners or households themselves, as opposed to government entities. Local, state, and federal governments are, in that order, assigned the next levels of responsibility for preparedness for hurricanes. Our results generally suggest that the culture of individualism and lack of trust in government dominates in attributions of responsibility for hurricane preparedness. In fact, trust in public officials is one of the most consistent explanatory variables

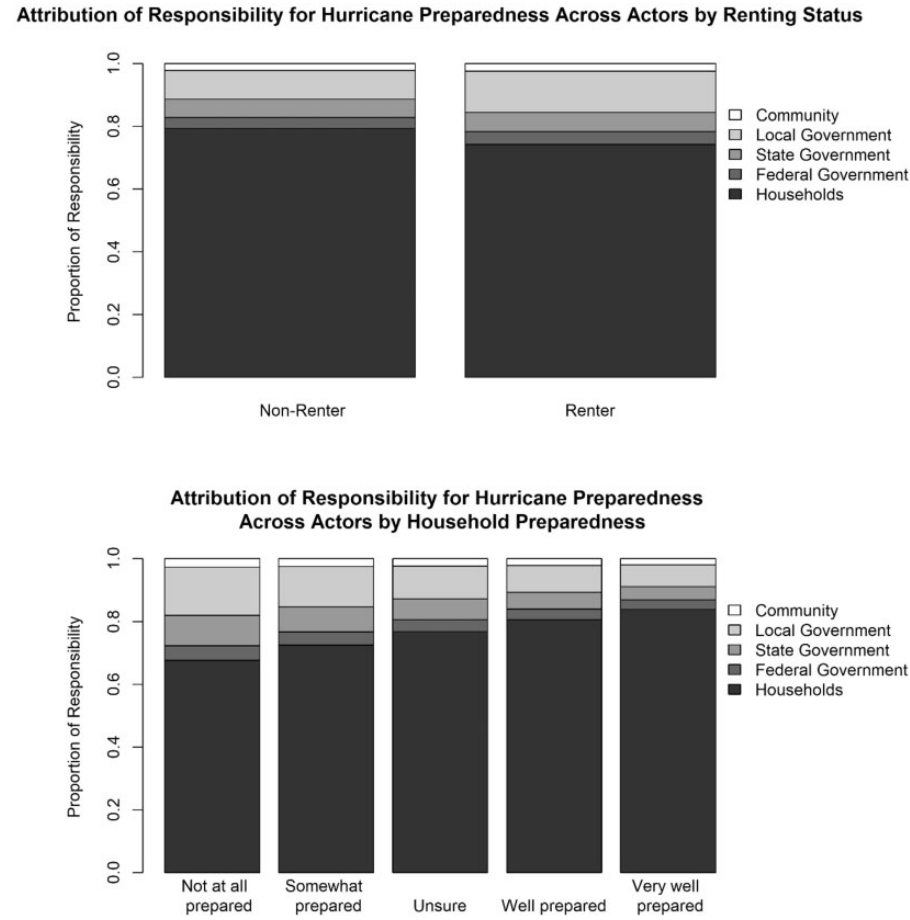

Figure 5 Effect of disaster specific contexts on responsibility attribution composition.

for our responsibility attributions. Higher levels of trust are associated with placing more responsibility for disaster preparedness on governments and less on individuals. Our results also generally echo the results of others who examine government responsibility exclusively, finding that respondents see hurricane preparedness as a bottom-up, and therefore more local, area of government (Choi and Wehde 2019; Schneider 2008). Additionally, we find a distinct role of political beliefs in explaining responsibility attributions for hurricane preparation.

Conservatism is strongly related to increased responsibility for households and decreased responsibility for the federal government. However, contrary to our expectations, we did not find evidence that conservatism is associated with increased responsibility for lower levels of government. Party strength, however,

Table 5 OLS regression estimates for percentage responsibility for each actor

	Federal Govt. (1)	Households (2)	Community (3)	Local Govt. (4)	State Govt. (5)
Political beliefs					
Ideology	−0.653**	1.369**	0.057	−0.288	−0.485*
	(0.299)	(0.617)	(0.248)	(0.294)	(0.263)
Party strength	−0.025	0.724	−0.355	−0.074	−0.269
	(0.258)	(0.527)	(0.225)	(0.250)	(0.220)
Public trust	0.704***	−2.844***	0.815***	0.714***	0.612***
	(0.228)	(0.510)	(0.181)	(0.239)	(0.203)
Demographics					
Age	−0.107***	0.317***	−0.094***	−0.050**	−0.066***
	(0.022)	(0.051)	(0.018)	(0.024)	(0.021)
Male	0.022	−1.376	2.440***	−0.731	−0.354
	(0.769)	(1.727)	(0.669)	(0.794)	(0.687)
White	−2.714***	6.385***	−3.000***	0.612	−1.283
	(1.001)	(2.021)	(0.784)	(1.006)	(0.835)
Education	−0.358	−0.067	−0.229	0.339	0.315
	(0.226)	(0.507)	(0.176)	(0.243)	(0.197)
Income	−0.228	1.334**	−0.407**	−0.417*	−0.283
Hurricane characteristics					
Renter	1.018	−4.090**	−0.182	2.997***	0.258
	(0.857)	(1.972)	(0.769)	(0.969)	(0.767)
Past damage	1.380**	−1.995	−0.259	0.168	0.705
	(0.684)	(1.572)	(0.571)	(0.743)	(0.617)
Community preparedness	−0.508	−0.075	0.549	−0.038	0.071
	(0.466)	(0.929)	(0.361)	(0.428)	(0.384)
Household preparedness	−0.190	2.262**	−0.051	−1.051**	−0.971**
	(0.436)	(0.968)	(0.366)	(0.440)	(0.409)
Constant	21.739***	29.959***	11.381***	18.863***	18.058***
	(2.656)	(5.412)	(1.879)	(2.584)	(2.123)
N	1,492	1,492	1,492	1,492	1,492
Adjusted R^2	0.076	0.126	0.074	0.031	0.047
F Statistic (df = 11; 1487)	11.276***	18.962***	10.973***	4.990***	7.067***

*p < 0.1; **p < 0.05; ***p < 0.01.

has a very limited role in explaining responsibility attributions. These findings are in line with previous work that finds a limited role for partisanship with regard to disaster preparedness and actors (Bechtel and Mannino 2019; Darr, Cate, and Moak 2019; in contrast to Malhotra and Kuo 2008) as well as in line with those that find that ideology is related to preferences for disaster mitigation policies

(Choi and Wehde 2019). Our findings are also in contrast to scholars who argue that partisanship and other group identifications, not ideology, structure policy preferences in the United States (Kinder and Kalmoe 2017). More broadly, these results confirm prior research that suggests conservatives prefer a limited role for the federal government (Connolly et al. 2020; Konisky 2011; Schneider, Jacoby, and Lewis 2011). However, unlike previous studies, we do not find a corresponding increased preference for the intervention of state or other local governments; instead, we find that conservatives prefer households be responsible for hurricane preparation. These findings emphasize the need to consider personal responsibility in future studies of government responsibility and policy preferences. We also find that income, but not education, is associated with decreased responsibility attributed to the federal government and more to individuals. Finally, while others find disaster experience matters (Arceneaux and Stein 2006; Darr et al. 2019; Forgette, King, and Dettrey 2008) we find a limited role for disaster experience.

Our findings may be useful for emergency managers and other government officials concerned with preparedness for hurricanes or other natural hazards. As our results show, the majority of respondents think that households bare the most responsibility with regard to hurricane preparedness. Therefore, government officials may want to focus efforts on ensuring that individuals know the most effective ways of preparing their households. Our results suggest that communication efforts by emergency managers might be improved if they approach preparedness as a partnership between their agencies and the public. Additionally, government officials may want to focus education efforts on communities with a greater proportion of households that are younger, non-white, and renting to ensure that they are adequately prepared. Finally, officials may want to work with all communities to ensure residents are fully aware of preparedness efforts that are occurring within the local community and across levels of government. These efforts might emphasize preparedness as a partnership between government and individuals, especially in conservative localities and states.

Our results may also suggest implications for representation and responsiveness to the public. Given that respondents assigned most of the responsibility for hurricane preparedness to households, it follows that responsive local governments in charge of preparedness ought to shift their resources to other stages of the disaster cycle. However, the cost-benefit ratio of preparedness over response suggests that preparedness is much more cost-effective than response. In addition, research has found that informing the public of the cost-benefit ratio improves willingness to support government invest in preparedness (Bechtel and Mannino 2019). Given that we find that the public largely considers themselves responsible for disaster preparedness, future research should examine whether responsibility attributions, which include the role of households, shift when respondents are given information about the benefits and/or the nature of government

preparedness efforts. Do individuals still see themselves as responsible for hurricane or disaster preparedness when they are confronted with this sort of information?

Apart from information specific to disaster preparedness, previous research suggests knowledge, attention, and political sophistication are important in explaining blame attribution. Maestas et al. (2008) find that attention to news media about Hurricane Katrina was associated with attributing blame to the state government because national political elites pushed this narrative in national news. Gomez and Wilson (2008), also examining Hurricane Katrina, find that less politically sophisticated respondents disproportionately blamed the president for failed response, whereas, more politically sophisticated respondents had more nuanced blame attributions. Examining preparation, Arceneaux and Stein (2006) find that those with higher levels of local knowledge were more likely to credit the county for their responsibility in flood preparation than blame them for reducing preparation. Future research should examine how knowledge and political sophistication might shift how the public attributes responsibility for disaster preparedness.

Additionally, our findings suggest a potential disconnect between responsibility attribution and accountability. Respondents in this study view themselves as responsible for hurricane preparedness, yet it seems to be something in which their elected officials continue to invest. How should elected officials respond to public preferences when those preferences seem to be to do nothing? Scholars of public opinion and responsibility attribution are encouraged to design studies which incorporate personal responsibility. While we find that personal responsibility dominates for our sample along the Gulf and Atlantic Coasts for hurricane preparedness, we do not know to what other samples and policy domains this may generalize. Another avenue for future exploration is to examine if our results from individuals hold at the local and state level. Do state and local governments that are more conservative or have more conservative constituents allocate less money to disaster preparedness than their more liberal counterparts? Do panel analyses suggest that as jurisdictions political alignments or demographics change—i.e. become more conservative, whiter, wealthier, older or otherwise—do their allocations to disaster preparedness change correspondingly?

Finally, while our results provide nuance into discussions of federalism and individual preferences for disaster policy in the United States, they are also subject to a few limitations. First, as with most studies of natural hazards, the relationships we find may be specific to preparation for hurricanes. Hurricanes are, by far, the most studied hazard in this domain and therefore we know the most about policy preferences regarding them. Future work ought to consider how these relationships may be present in other natural hazard domains. Other hazards that span multi-state areas such as large floods and blizzards may reflect similar patterns while more (usually) localized hazards such as tornadoes or earthquakes may not. Another potential limitation of the current study is the survey question examined.

The specific wording may pre-dispose respondents to thinking of preparation actions that are more easily assigned to individuals for responsibility. Given this, future work might consider a more neutral survey question. Another avenue for future work in this area would be to experimentally assess this proposition by randomizing the order and amplitude of the preparation actions described. This would allow researchers to assess the potential priming effect of the survey frame on responsibility attributions.

Conclusion

Accountability for the actions of all levels of government is necessary for a democracy with a federal system to function. However, properly attributing responsibility to the relevant level of government is demanding of voters and is likely influenced by political beliefs. Additionally, it is assumed that the public will default to assigning responsibility to some level of government and not themselves. Extending this logic and examining the assumption of government responsibility, we explored how political beliefs, namely ideology, partisanship, and trust in public officials influenced how respondents attributed responsibility for hurricane preparedness and resilience across individuals (households), communities, and levels of government.

Using compositional analysis, we found that, on average, respondents assigned the largest proportion of responsibility to households, followed by local government, state government, federal government, and finally the least amount of responsibility was assigned to the local community. Our findings suggest that the assumption of government, and not personal, responsibility is a false assumption for hurricane preparedness and may be false for other policy domains as well. Yet, there were differences in how responsibility was assigned across political beliefs, some demographics, renter status, and self-reported level of household preparedness. For political beliefs, increasing conservatism was associated with an increasing share of responsibility assigned to households and a decreasing share assigned to government at all levels. Additionally, increasing trust in public officials was associated with a decrease in household responsibility and an increase in responsibility for all levels of government as well as the local community. Demographics including age and race were significant factors, with older and white respondents more likely to assign a larger amount of responsibility on households, and less responsibility on all other actors, than their younger and non-white counterparts. Renters assigned less responsibility to households than nonrenters. Finally, as self-reported preparedness increased so did the proportion of responsibility that was assigned to households. By assessing individual and governmental responsibility in conjunction, our findings emphasize the role of individual characteristics, in particular ideology and trust, in explaining the diversity of attitudes toward responsibility and accountability in preparation for

natural hazards. Additionally, we find that, in some policy areas, the public may assign responsibility to themselves rather than to any level of government.

Notes

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1. Compositional data analyses were conducted in R 3.6.1 using the compositions package (Van den Boogaart and Tolosana-Delgado 2008), following the guidelines of van den Boogart and Tolosana-Delgado (2013).
2. Coefficients from regressions on isometric log-ratio transformed compositional dependent variables are in the transformed coordinate space and therefore not possible to interpret directly.
3. Specifically, we test the null hypothesis that the i^{th} covariable has no influence on the composition, given the preceding $(i - 1)$ variables. As opposed to conducting a separate test for each variable in the last spot, individually, we present the tests from our fully specified model for theory testing not model specification.
4. Note that in this analysis the direction of the relationships is not specified, only the statistical significance.

References

Aitchison, John. 1986. *The statistical analysis of compositional data. Monographs on statistics and applied probability*. London: Chapman & Hall (Reprinted in 2003 with additional material by The Blackburn Press).

———. 1983. Principal component analysis of compositional data. *Biometrika* 70 (1): 57–65.

———. 1999. Logratios and natural laws in compositional data analysis. *Mathematical Geology* 31 (5): 563–580.

Arceneaux, Kevin. 2005. Does federalism weaken democratic representation in the United States?. *Publius: The Journal of Federalism* 35 (2): 297–311.

Arceneaux, Kevin, and Robert M. Stein. 2006. Who is held responsible when disaster strikes? The attribution of responsibility for a natural disaster in an urban election. *Journal of Urban Affairs* 28 (1): 43–53.

Barber, Michael, and Jeremy C. Pope. 2019. Does party Trump ideology?. *Disentangling Party and Ideology in America. American Political Science Review* 113 (1): 38–54.

Bechtel, Michael M., and Massimo, Mannino. 2019. Overcoming Policy Myopia: Personal Exposure, Voter Ignorance, and Disaster Policy Preferences. Available at SSRN: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3494976. Accessed August 20, 2020.

Brehm, John, Scott Gates, and Brad Gomez. 1998, July. *A Monte Carlo comparison of methods for compositional data analysis. In 1998 Annual Meeting of the Society for Political Methodology*.

Choi, Junghwa, and Wesley Wehde. 2019. Venue preference and earthquake mitigation policy: Expanding the micro-model of policy choice. *Review of Policy Research* 36 (5): 683–701.

Choi, Junghwa and Wesley Wehde. 2020. Trust in emergency management authorities and individual emergency preparedness for tornadoes. *Risk, Hazards & Crisis in Public Policy* 11 (1): 12–34.

Cohen, Geoffrey L. 2003. Party over policy: the dominating impact of group influence on political beliefs. *Journal of Personality and Social Psychology* 85 (5): 808–822.

Connolly, Jennifer M., Casey Klofstad, Joseph Uscinski, and Jonathan West. 2020. Public preferences for Zika Policy and responsibility in the absence of Partisan cues. *Journal of Public Policy* 4 (3): 402–427.

Converse, Philip E. 1964. The nature of belief systems in mass publics. In *Ideology and discontent*, ed. Apter. David New York: Free Press.

Darr, Joshua P., Sarah D. Cate, and Daniel S. Moak. 2019. Who'll stop the rain? Repeated disasters and attitudes toward government. *Social Science Quarterly* 100: 2581–2593. doi : 10.1111/ssqu.12633

Dinan, John, and Jac C. Heckelman. 2020. Stability and contingency in federalism preferences. *Public Administration Review* 80 (2): 234–243.

Forgette, Richard, Marvin King, and Bryan Dettrey. 2008. Race, Hurricane Katrina, and government satisfaction: Examining the role of race in assessing blame. *Publius: The Journal of Federalism* 38 (4): 671–691.

Fry, Jane M., and Tim R. Fry, and Keith R. McLaren. 2000. Compositional data analysis and zeros in micro data. *Applied Economics* 32 (8): 953–959.

Gaines, Brian J., James H. Kuklinski, Paul J. Quirk, Buddy Peyton, and Jay Verkuilen. 2007. Same facts, different interpretations: partisan motivation and opinion on Iraq. *Journal of Politics* 69 (4): 957–974.

Gerber, Alan S. and Gregory A. Huber. 2010. Partisanship, political control, and economic assessments. *American Journal of Political Science* 54 (1): 153–173.

Gomez, Brad T., and J. Matthew Wilson. 2008. Political sophistication and attributions of blame in the wake of Hurricane Katrina. *Publius: The Journal of Federalism* 38 (4): 633–650.

Grinsted, Aslak, Peter Ditlevsen, and Jens H. Christense. 2019. Normalized US hurricane damage estimates using area of total destruction, 1900-2018. *Proceedings of the National Academy of Sciences* 116 (48): 23942–23946.

Healy, Andrew, and Neal Malhotra. 2009. Myopic voters and natural disaster policy. *American Political Science Review* 103 (3): 387–406.

Hibbing, John R., and Elizabeth Theiss-Morse. 2002. *Stealth democracy: Americans' beliefs about how government should work*. New York: Cambridge University Press.

———. 1995. *Congress as public enemy*. New York: Cambridge University Press.

Kalmoe, Nathan P. 2020. Uses and abuses of ideology in political psychology. *Political Psychology* 41 (4): 771–793.

Katz, Jonathan N. and Gary King. 1999. A statistical model for multiparty electoral data. *American Political Science Review* 93 (1): 15–32.

Konisky, David M. 2011. Public preferences for environmental policy responsibility. *Publius: The Journal of Federalism* 41 (1): 76–100.

Kincaid, John, and Richard L. Cole. 2008. Public opinion on issues of federalism in 2007: A Bush plus?. *Publius: The Journal of Federalism* 38 (3): 469–487.

Kinder, Donald R., and Nathan P. Kalmoe. 2017. *Neither Liberal nor Conservative: Ideological Innocence in the American Public*. Chicago, IL: University of Chicago Press.

Leland, Suzanne, Jaqueline Chattopadhyay, Cherie Maestas, and Jaclyn Piatak. 2020. Policy venue preference and relative trust in government in federal systems. *Governance*, 1–21. https://doi-org.ezproxy.lib.ou.edu/10.1111/gove.12501

Levendusky, Matthew. 2009. *The Partisan sort: How liberals became democrats and conservatives became republicans*. Chicago, IL: University of Chicago Press.

Maestas, Cherie D., Lonna Rae Atkeson, Thomas Croom, and Lisa A. Bryant. 2008. Shifting the blame: Federalism, media, and public assignment of blame following Hurricane Katrina. *Publius: The Journal of Federalism* 38 (4): 609–632.

Malhotra, Neal, and Alexander G. Kuo. 2008. Attributing blame: The public's response to Hurricane Katrina. *The Journal of Politics* 70 (1): 120–135.

Mason, Lilliana. 2018. *Uncivil agreement: How politics became our identity*. Chicago, IL: University of Chicago Press.

Schneider, Saundra K. 2008. Who's to Blame? (Mis) Perceptions of the intergovernmental response to disasters. *Publius: The Journal of Federalism* 38 (4): 715–738.

Schneider, Saundra K., and William G. Jacoby. 2013. '*Intuitive Federalism' and Public Opinion Toward Government. Presented at the annual meeting of the Annual Meeting of the American Political Science Association.* Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2300590. Accessed August 20, 2020.

Schneider, Saundra K., William G. Jacoby, and Daniel C. Lewis. 2011. Public opinion toward intergovernmental policy responsibilities. *Publius: The Journal of Federalism* 41 (1): 1–30.

Shaw, Greg M., and Stephanie L. Reinhart. 2001. Trends: Devolution and confidence in government. *The Public Opinion Quarterly* 65 (3): 369–388.

Uslaner, Eric M. 2001. *Is Washington really the problem? in what is it about government that Americans dislike?* eds. John R. Hibbing and Elizabeth Theiss-Morse. Cambridge, UK: Cambridge University Press.

Van den Boogaart, Karl G., and Raimon Tolosana-Delgado. 2008. "Compositions": a unified R package to analyze compositional data. *Computers & Geosciences* 34 (4): 320–338.

———. 2013. *Analyzing compositional data with R* (Vol. 122). Heidelberg: Springer.

Wolak, Jennifer. 2016. Core values and partisan thinking about devolution. *Publius: The Journal of Federalism* 46 (4): 463–485.