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American adaptation: Social factors affecting new developments to address climate change

Kathleen Carlson*, Sabrina McCormick

George Washington University, Milken Institute School of Public Health, 950 New Hampshire Ave, Suite 400, Washington, DC 20052, United States

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ABSTRACT

Climate change and extreme weather events are expected to increase in frequency and intensity in the United States. The social factors that drive cities to adapt to and/or prepare for these impacts are largely unknown. Sixty-five qualitative interviews were conducted with multi-sectoral decision-makers to assess factors driving adaptation in six cities across the United States: Tucson, Arizona; Tampa, Florida; Raleigh, North Carolina; Boston, Massachusetts; Portland, Oregon; and Los Angeles, California. We find that there are three type of factors that affect adaptation: (1) swing—characteristics of or events within localities that can lead toward or away from action; (2) inhibitors—ways of thinking and framing climate change available to decision-makers that slow, but do not necessarily stop change; and (3) resource catalysts—types of information and moral grounding that provide a rationale for change. These factors often intersect such that swing factors are only influential in cities with some political acceptance of climate change. In cities where public acceptance of climate change is slowly shifting, resource catalysts are more influential. This is the first qualitative study of climate change adaptation in American cities.

1. Introduction

Increases in the global surface temperature are expected to continue for decades, regardless of mitigation strategies currently being implemented (Patz et al., 2000; Bernardi 2008; Ebi and Semenza, 2008; Kjellstrom and McMichael, 2013). These changes will affect the United States in dramatic ways (Melillo and Richmond, 2014). As a result, climate change adaptation and preparedness for extreme weather events is necessary at all scales. Yet, creating such action is a distinctly challenging social problem. Climate change is often perceived as spatially and temporally distant (Moser and Dilling 2007; Norgaard, 2011), is characterized by uncertain outcomes, and has been highly politicized in the United States (McCright and Dunlap, 2000). Additionally, it is very difficult to say that any particular event can be directly attributed to climate change in order to generate concern. There are also entrenched social institutions, processes, and economic interests that work against its address (McCright and Dunlap, 2000). These challenges are a part of what hinders action at the federal, state and local levels.

Cities are often the unit of greatest risk since they contain areas of concentrated development and are populated by vulnerable groups (Dodman and Satterthwaite, 2008). In some parts of the world, the majority of the population is already urbanized. In other parts, urbanization is rapidly expanding such that the majority population will soon live there. In the United States, an estimated 249 million, or over 80% of the population, live in urban areas. The urban climate is particularly important for health (Reid et al., 2009) with a wide variety of infrastructural and environmental factors influencing outcomes (Rainham and Smoyer-Tomic, 2002).

It is particularly important to investigate the actions of cities to address climate change since city-scale planning may also be more amenable to adaptation than actions at the federal level (Cutter et al., 2012), and policy instruments used there are critical to protection of these populations from climate impacts (Zahran et al., 2008). The city is one scale at which climate action has been the most facile (Betsill and Bulkeley, 2007), and at which emissions are the greatest (Betsill, 2001). Cities in the United States and many other countries have adopted climate mitigation actions – the reduction of greenhouse gases (GHGs) – for some time (Fussel, 2007). Adaptation has become more important relative to mitigation in some areas, often when weather-related extreme event damages are catastrophic and planning horizon increases (McMichael and Kovats, 2000; Burton et al., 2006). Cities have joined international networks geared toward motivating both

* Corresponding author.
E-mail addresses: kathleencarl@gwmail.gwu.edu (K. Carlson), sabrina.mccormick@gmail.com (S. McCormick).

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mitigation and adaptation, making them some of the most progressive units of change (Kern and Alber, 2008).

However, while cities around the world have been experiencing the impacts of climate-related events and taking some action, few have begun institutionalizing adaptation measures (Carmin and Zhang, 2009). This lack of preparedness appears to be the case for American cities, although reports have documented sporadic implementation of particular measures with little explanation for their motivators (Poyar and Beller-Simms, 2010). Chicago, which is well-known for being advanced in climate awareness, has a pilot adaptation program that uses porous surfacing to improve flood risk management and better protection of groundwater while also benefiting biodiversity and increasing urban amenities. Early assessments of potential climate impacts in Boston have led to awareness about climate change, but apparently been institutionalization only to a limited degree (Kirshen et al., 2008a,b). New York City began addressing infrastructure risks from climate change in 2008 (The City of New York, 2008), and has implemented a variety of programs addressing the urban heat island effect and other climate risks. A wide range of cities has developed climate adaptation plans, often which overlap with disaster preparedness plans, but to date, there appears to be limited implementation of plans.

In other developed nations, such as Australia, the European Union, and the United Kingdom, adaptation plans have been moving forward rapidly in recent years, but still remain largely underdeveloped (Preston et al., 2011; Baker et al., 2012). Research into climate risks has often been the largest form of investment (Tompkins et al., 2010). Gaps in planning include limited consideration for non-climatic factors and neglect of issues pertaining to adaptive capacity, such as forms of capital needed for effective adaptation (Preston et al., 2011). Overall, action on climate change varies widely across cities and localities, and there is little explanation of why it occurs in some places and not others (Brooks, 2003; O'Neill et al., 2010).

Adaptation measures are often focused around land use planning and emergency management, although they are also frequently multi-sectoral and multi-dimensional, crossing multiple systems and institutional boundaries (Kirshen et al., 2008a,b). The maintenance and protection of infrastructure to sustain impacts of climate change is one piece of this planning (Revi, 2008). In addition, other sectors such as transportation and energy are engaged in adaptation planning in many cities, resulting in ripple effects across a variety of policy domains (Viguié and Hallegatte, 2012). Cities make decisions about adaptation within the context of these and other disaster-specific needs. For instance, Los Angeles has a long history of planning for and risk of earthquake events. Decision-making regarding the investment of funds in preparedness for these events may be weighed with climate-related events that are more or less likely. This is true of all the cities in this study. However, while emergency planning and land use experts were interviewed for this research, they are part of the overall picture of climate adaptation that includes multiple other sectors (Lemmen and Warren, 2004). This approach is based on the argument that diverse sectors must be integrated for the most effective adaptation measures (Fussel, 2007).

This research takes a multi-sectoral approach to investigating the factors affecting climate adaptation in six cities across the United States with the aim of beginning to explain why there are varying levels of action. We interview decision-makers who are often the social actors assessing risk and making decisions about preparedness. We maintain a greater focus on public sector stakeholders since policy instruments are often critical to climate mitigation and resilience (Zahran et al., 2008). By conducting in-depth interviews in multiple study sites, this research identifies factors driving change within a particular locale and also validates the importance of these factors across urban locale. We find that there are three type of factors that we label in the following ways: (1) swing—characteristics of or events within localities that can lead toward or away from action; (2) inhibitors—ways of thinking and framing climate change available to decision-makers that slow, but do not necessarily stop change; and (3) resource catalysts—types of information and moral grounding that provide a rationale for change.

This article seeks to advance adaptation knowledge and practice by articulating the social, political, and economic problems that stand in its way while also offering insight into related factors that can help move adaptation forward. It is one of the first studies to analyze climate adaptation actions in American cities and to provide evidence for what factors influence implementation.

2. Material and methods

This study was based on sixty-five in-depth, semi-structured qualitative interviews of local decision-makers working in the cities of Tucson, Arizona; Tampa, Florida; Raleigh, North Carolina; Boston, Massachusetts; Portland, Oregon; and Los Angeles, California. Interviews were conducted during the winter of 2011–2012. Cities were selected based on their diversity of size, geographic region, stage of planning for climate change (see Table 1).

Interviewees were identified through a purposive sample where specific individuals are asked for an interview (Oliver, 2006), beginning with key local government officials and non-governmental representatives involved in climate change or environmental planning. These interviewees were supplemented by a snowball sample to identify individuals across sectors who participate in climate adaptation activities in each city. A snowball sample allows the first set of interviewees to identify subsequent research subjects with relevant knowledge and experience. As

Table 1
City characteristics.

City	Population	Major disaster declarations through 2013	Reported level of public concern	Reported level of academic resources	Reported political leaning	Planning stage[a]
Portland	603,000	29	Very high	Medium	Democrat	Advanced
Boston	630,000	29	Medium	High	Democrat	Mid–Adv
Lost Angeles	3.8 mill	79	High	Medium	Democrat	Mid
Raleigh	423,000	43	Medium	High	Conservative democrat	Early–Mid
Tucson	524,000	23	Low–Med	High	Conservative democrat	Early–Mid
Tampa	347,000	67	Low	Low	Republican	Early

[a] Stage of planning was qualitatively determined based on how much planning and implementation had been executed. Early = little to no planning; mid = some planning, but no implementation; advanced = planning and some implementation, at minimum. Planning includes adaptive plans only. Mitigation measures were not considered.

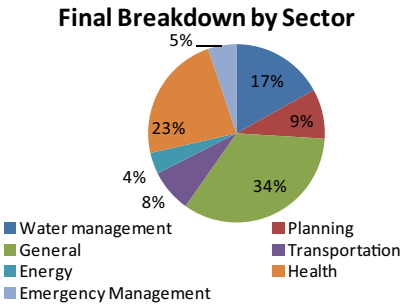

Fig. 1. Interviewee characteristics.

Atkinson and Flint (2001) describe, this method allows a researcher to access a particular social network, especially in a situation where the potential interviewee group is small or difficult to access. This approach may also result in more honest answers to research questions since interviewees are more likely to trust a researcher referred to them by a friend or colleague (NSF, 2005). There were a total of 65 interviewees who crossed sectors and affiliation. (see Fig. 1 for areas of work.) Interviewees were fairly evenly situated in five sectors – non-governmental organizations (25%), city government (23%), county or regional governments (18%), academia (18%), state government (13%) – with an additional 3% in the private sector. This limited number of interviewees in the private sector is one of the central limitations of this research, which may mean some types of adaptive measures have not been fully explored. Overall, the limited number of interviewees in each city means that the range of the adaptation experience within each city may not be fully represented.

Interviews were conducted in person and over the phone when necessary. Each interview was recorded and subsequently transcribed. All 65 transcripts were then imported into the qualitative software program QSR NVivo Version 10. Transcripts were simultaneously coded and cross-checked by three analysts from May to July 2014. Transcripts were coded using nodes, which organize selected information into categories. In total (across all three researchers and projects), there were 45 nodes. This analysis utilized 20 of the 45 codes (numbered below) (see Table 2 for a list of interview codes).

Analysis was conducted using NVivo 10. Transcripts were coded then common themes and interesting findings were identified based on the frequency or relevance with which similar phrases/concepts were mentioned across sectors working in the same cities. All uncited quotes in the results section are drawn from these interviews.

3. Theory

Assessments of how adaptation occurs in industrialized nations only preliminarily account for the social processes that might drive such measures. Factors functioning on the scale of the locality and on the scale of the individual are both potentially influential factors shaping adaptation outcomes. Social factors have been broadly acknowledge as equally important to ecological factors in shaping adaptation outcomes (Moser, 2010). For example, researchers have claimed that demographic, cultural, and economic exchange affect adaptation (Adger, 2000). Additionally, internal resources, incentives, ideas and knowledge motivate adaptation (Carmin et al., 2009). Fussel, (2007) and others have demonstrated that awareness of the problem, availability of effective adaptation measures, information about these measures, availability of resources for implementing measures, cultural acceptability of adaptation, and incentives for implementing measures all affect how adaptation takes place (Fankhauser et al., 1999). Values also influence which adaptation options are considered desirable and prioritized (O'Brien, 2009), and so policy-makers face challenges in their need to account for multiple value systems within their constituency (O'Brien et al., 2009). Broader responses to climate change may also affect the capacity of adaptation programs. For example, in developing countries, international policies and pressures have long been seen as the primary drivers of local climate measures (Anguelovski and Carmin, 2011).

Public awareness of and perception of climate risks has also represented an important dimension of influence. Research in Mozambique demonstrated that the level of information received, the number of sources from which information is received, and whether people have access to a reputable daily newspaper influenced the likelihood of implementing adaptive measures (Patt and Schröter, 2008). In addition, psychological factors such as feelings of control, optimism, and fatalism appeared to have an effect on likelihood of implementation (Patt and Schröter, 2008). More generally, perceptions of climate change and its associated risks affect willingness to accept adaptation and mitigation strategies (Semenza et al., 2008). This may mean that popular opinion on climate or political affiliation could be potentially important factors in adaptation measures.

Extreme weather events have often been cited as a motivator for political action, yet little research has yet to investigate how these events might drive adaptation actions (Linnenluecke et al., 2011). Some research has shown that an increased risk of experiencing extreme weather events may encourage the implementation of adaptive measures (Berkhout, 2005; Næss, et al., 2005). For example, research from Norway based on responses to a series of severe floods that took place in 1995 found that extreme events inspired the implementation of over $73 million worth of adaptive measures (Næss et al., 2005; Amundsen et al., 2010). Other findings demonstrate that such events actually decrease the likelihood of adaptation (Patt and Schröter, 2008).

Moser and Ekstrom (2010) have offered a theoretical model that outlines the appearance and address of climate adaptation obstacles. Their complex, multi-phased process focuses on five factors that are critical throughout the process: the role of leadership, access to both financial and technical resources, the need for effective communication, and the role of values and beliefs that can shape cognition and actions. We see these factors being important in both the lay public that attempts to influence decision-makers through advocacy and in scientists or experts

Table 2
Interview codes.

Major code	Sub-code
Interviewee background	(1) Area of expertise/work
	(2) Sector
Limitations and obstacles	(3) Knowledge
	(4) Competing agendas
	(49) Communication
	(6) Other
Collaboration	(7) Scientists and/or experts
	(8) Cross-institutional
	(9) Stakeholder engagement
Leadership	
Awareness of and/or advocacy for climate change	
Extreme events	(12) Perception
	(13) Impacts and/or perception of impacts
Motivation for change	(14) Severity of events
	(15) Frequency of events
	(16) Economic resources
	(17) Other
Planning	(18) Current
	(50) Future
	(20) Implementation of plans

who might advise decision-makers. The lay public perceptions of climate are influenced by a variety of psychological and social factors including personal experience and emotion as well as moral, economic, institutional, and cultural processes (Leiserowitz, 2005). Policymakers are influenced by these social factors characterizing the lay public. Local decision-makers also receive advice from scientists or experts who could be classified as "boundary actors" and the institutions in which they work, "boundary organizations," a set of institutions otherwise suggested as playing an important role in the iterative process of designing and implementing adaptation efforts in cities (Corfee-Morlot et al., 2011). It is important to note, however, that scientific presentations of climate change may be quite different from that of the lay public (Leiserowitz, 2005). They may influence stakeholder and policy-maker perceptions of danger by identifying quantifiable, measurable goals for estimating risk and risk reduction associated with mitigation and adaptation (Leiserowitz, 2005). In this research, we investigate how these factors of perception, politics, scientific resources and other factors may drive adaptation.

4. Results

4.1. Climate planning status in the case study cities

Our study sites, like most cities across the United States, have varying levels and types of climate planning. Based on what interviews revealed about the past and current climate planning, these cities can currently be categorized as most advanced to least in the following order: Portland, Boston, Los Angeles, Tucson, Raleigh and Tampa. This ranking is based on a qualitative assessment of climate mitigation and adaptation planning, as well as implementation of these plans. Portland and Boston have been conducting work on climate change since the early 1990s, first focusing on climate mitigation. Both cities have conducted greenhouse gas (GHG) inventories and implemented policies to reduce GHG emissions. Both cities began adaptation planning in the early 2000s. Los Angeles began mitigation planning and implementation about a decade after Boston and Portland, and followed up more rapidly with investigating how adaptation might be added on. None of these cities have implemented their adaptation plans, although all of them have begun specific measures that fall inside the realm of adaptation.

The other three cities lag in their adaptation efforts. Tucson has invested in some climate mitigation work and has begun the initial stages of adaptation planning, while Raleigh and Tampa have executed very little in climate mitigation or adaptation planning. Yet, the formal representation of each city belies a more nuanced set of social processes. In Tucson, interviewees expressed great concern about the impacts of climate change, and local NGO leaders are particularly exploring how to address risks such as species migration and food scarcity. For Raleigh, innovations in mitigation and adaption have taken place in the state of North Carolina more broadly, especially regarding sea level rise and water scarcity. For Tampa, some adaptation has occurred without official approval of the city, particularly around water and health affects of climate change.

In these cities, action on climate change generally began with mitigation activities then developed into adaptation. However, even in places where public officials were generally concerned about climate change, most effort has gone into mitigation. We begin to explain why this might be in the sections below.

4.2. Swing factors

4.2.1. Extreme weather events

Previous research has shown extreme weather to both encourage and inhibit adaptation responses. This research helps explain why such events can lead in both directions. Comparing the cases of Tampa and Los Angeles demonstrates that extreme weather events alone do not drive climate adaptation. Although Tampa has not experienced a hurricane in 93 years, it is the most vulnerable city to hurricanes in the United States (Freedman 2012). Over 125,000 Tampa area residents live below the 100-year flood height of approximately 6.5 feet (Freedman 2012), placing every person and building in the area at a severe risk of flooding in the case of a hurricane. The odds that Tampa will experience a hurricane that exceeds the flood height are estimated at over 20%, and likely within the next five years (Freedman 2012). Tampa's last hurricane, which occurred in 1921, reached a maximum storm surge of over 10.5 feet (Freedman 2012). Despite this evidence suggesting impending hurricanes in the Tampa area, residents and local decision-makers remain largely unalarmed. One interviewee explained that the threat is normalized:

> People just don't believe. They just flat outright don not believe it. [. . .] Here you have whole government systems in denial because it's insidious; it's so slow that it becomes normal over the course of time. I think that we tend to be reactive in what we do, that we have some sort of adverse outcomes. But I think it is going to take large events of certain magnitude in order to hit a trip wire.

Interviewees claimed that hurricanes are viewed as normal aspect of life in Florida, and, as a whole, citizens of the Tampa area are still largely undecided about whether climate change even exists. One interviewee expressed this perspective:

> Almost three or four years ago, we had four hurricanes that hit Florida. I think we had three weeks when we had no power in our house. But when you live here, you get used to that. People are in just massive denial.

Because hurricanes have historically always been an issue in Florida, decision-makers deny that climate change exacerbates the effects of these storms and, for the most part, deny that climate change exists entirely.

> The public does't pay attention to it because of the controversy of whether it's real or not. The fact that they called it global warming for so long was a complete misnomer, and that detracted from what was really happening.

Los Angeles, California is also similarly disaster-prone to droughts and subsequent wildfires simply due to its semi-arid climate and natural vegetation coverage. Historically, the Los Angeles region has experienced some of the most costly and deadly wildfires ever recorded in the U.S., and recent modeling predicts that the Los Angeles area will continue to experience regular wildfires (CALFIRE, 2013). In 2009 alone, the state of California experienced over 8200 wildfires that burned a total of over 93,000 acres, and estimates through the year 2020 suggest that wildfire incidence will increase significantly as the average global surface temperature continues to rise (CALFIRE, 2013). Unlike Tampa, however, Los Angeles's predisposition for natural disasters like drought, wildfires, and even earthquakes has not desensitized decision-makers but rather has inspired them to make adaptive changes via the creation of numerous climate action plans and policies.

> Within Los Angeles County, we're developing three separate climate action plans [. . .] We included in that plan emergency preparedness—and a part of emergency preparedness was climate adaptation and climate change. [. . .] In addition to climate action plans for the entire region, cities and counties have now taken the attorney general's actions and everybody is accounting for greenhouse gas mitigation in their local jurisdictional general plan.

Interviewees claimed that at least partially because of the regularity with which Los Angeles experiences disasters, the city is well prepared to react, and many sectors (such as the fire department, public health departments, and hospitals) are highly integrated and informed of their specific roles in disasters.

> We have a really, really well developed emergency management system because [we] know we're going to have a huge earthquake that is probably going to demolish downtown . . . A lot of this work has been going on for years and years, but now we're trying to build adaptation and mitigation considerations into the emergency planning as well.

The dichotomy of Tampa and Los Angeles – two disaster-prone cities – and their adaptive plans poses a key question in regards to what motivates decision makers to implement adaptive disaster strategies. These findings suggest that geographic predisposition/increased risk of climate-related disasters is not the sole determinant of adaptive capacity or even the main factor influencing a city's likelihood to adapt. It also suggests that risk is perceived differently depending on the climate change culture of the individual city (among other factors). In the following sections, we explore some of these factors.

4.2.2. Political Culture

Research suggests that political culture has a strong influence on a community's likelihood of implementing adaptive measures (Dunlap 2008). Interviewees in all cities often mentioned political will and local political culture as an important motivating factor to consider. These interviews offer the beginnings of an assessment of how politics and political culture affect adaptation; however much more data would be required to capture the full breadth of how this works in any one city. Therefore, two of our cases – Tampa and Portland – offer a basic understanding of how some multi-sectoral stakeholders see political culture affecting their work.

As previously discussed, the city of Tampa is vulnerable to climate change and associated extreme weather events. Despite this risk, Florida's political representatives are largely unconcerned about climate change. As a historically republican state, politicians in Florida often create campaign platforms based on conservative values. Interviewees in political positions suggested that politicians and leaders rarely discuss the existence of climate change or make environmental issues central to their platforms. One said:

> Local governments do not acknowledge that climate change is going to cause problems. I think that the way we start to transform it, you have to have a change in political will. [. . .] With election season, people who are a certain type of Republican are going to hold to the party line, especially on something like that [(climate change)]. It is too controversial.

Non-governmental decision-makers often felt that without some level of political openness, their capabilities were limited. Interviewees in Tampa stated that political leadership there had a significant influence on the media, and citizens are exposed to large-scale denial campaigns that are politically supported and corporate-funded.

> I think when it's climate change and you are trying to advocate, you've got a whole group of people who are very vocal and are very articulate about [how] it's a huge myth. And my sense is they are a lot better organized, because they are funded by various groups to get out there and make those cases. [. . .] If you can't counter the message of the conservative media and the corporate control of it, then there's nothing you can do.

Interviewees in Tampa overwhelmingly claimed that, mainly due to the lack of political buy-in regarding climate change, their city remains one of the most vulnerable and least prepared cities in the country.

Portland offers an alternative example to Tampa in terms of public support, advocacy and action on climate. Interviewees described its political culture as the opposite of Tampa. It is a historically democratic region with environmentalism and climate change adaptation being openly discussed by Portland political leaders and citizens.

> There's a high expectation on the part of the public that their elected officials take these issues seriously, and there's just a very strong environmental ethic. There's an expectation on the part of the public that our elected officials are adopting policies and moving programs forward that are progressive. And [if] no one has ever done this before, [it] is usually seen as a sign that we're on the right track.

Politicians bring climate change mitigation and adaptation to the forefront of policy because Portland citizens view them as important topics despite their low risk of experiencing extreme weather events. The city has been steadily implementing climate change mitigation measures for almost twenty years. They have engaged in the following activities: setting aside farm/forestland, implementing green spaces and community gardens in the city, ensuring walkable neighborhoods, providing public transportation choices, all in an effort to "go green".

> There's sort of a natural thing in Portland that we try and do a lot of this stuff anyway. [. . .] It started 20 years ago. They [(decision-makers)] try to set it up so that the city emerges and grows in a way that is what is envisioned to be a good city.

Portland's geographic location in the Pacific Northwest is protective against climate-related extreme weather events, and local decision makers acknowledge there they are at very low risk for disaster. Despite this, interviewees argued that Portland's political leaders aim to be the nation's leader in climate change preparedness and adaptation, partly for the benefits that "going green" can have on their property values and their job market.

Other case study cities reflected that, like in these two cities, political culture is an important social factor that affects climate adaptation. Simply put, while the largely politically conservative cities of Tucson and Raleigh have a low level of climate activity and high risks of climate-related water risks, the more liberal cities of Boston and Los Angeles have a much larger climate adaptation portfolio. Other factors intervene in climate adaptation as well. The following sections investigate some of these factors.

4.3. Inhibitors

Our interviewees highlighted two interrelated inhibitors to climate adaptation: scientific uncertainty and politicization of climate change. This supports previous research showing that scientific uncertainty a common challenge in addressing climate change (Dessai and Hulme, 2004). Interviewee data demonstrated more specificity to this overall challenge. Interviewees focused specifically on the need for particular kinds of science like localized data, case studies that reflected success stories they could follow, and concrete cost-benefit assessments that would allow them to justify adaptation-related expenditures. Politicization of climate change was also often raised. This finding adds a new dimension to adaptation research. Politicization was generally related to lack of broad public understanding of the issue and lack of political support within government institutions.

4.3.1. Scientific uncertainty

Adaptation programs and policies generally stem from scientific assessments that outline adaptation needs (Carmin

et al., 2011). Yet, these types of assessments are often unavailable to those who need them. In addition, when scientific assessments are available, scientific uncertainty is often a problem. Such uncertainty was mentioned in every city as a challenge to implementing adaptation. Uncertainty was often raised first when interviewees were asked why adaptation programs were not moving forward. For example, when asked about why his local government had not implemented adaptation programs, one interviewee said: "It was hard to get people past that 'Well, we do not know what the impacts are going to be, so why are we talking about this right now? We should wait.'" Another interviewee in Boston said: "adaptation is trickier [than mitigation], and there's not a clear science of adaptation yet."

Even in cities where interviewees were cognizant of and acknowledged the pending impacts of climate change, they felt unable to identify what, exactly, would happen in their locale. As one interviewee said in an attempt to explain his city's inaction:

> We don't have a vast amount of data and information available to us that is at a regional or local level so we still have a lot of fairly big generalities and pretty wide ranges and a lot of uncertainty about what exactly we think is going to happen.

Alternative approaches to adaptation, such as vulnerability assessments, developing flexible response systems, and engaging with experts who can advise officials even before scientific assessments, are available and have been attempted in many locations (Dodman and Carmin, 2011). In this research, of the above options, interviewees only mentioned the role of scientists as advisors on adaptation as a viable option for planning adaptation.

4.3.2. Politicization

Denial and politicization has been cited as a critical problem inhibiting the formation of action on climate change (Norgaard, 2011). In every of the case study cities, interviewees talked about the influence of climate change politicization both within government agencies and amongst the general public. They identified both types as inhibitors to adaptation. Politicization was defined as decision-makers who either questioned the existence of climate change or who did not know much about it. The factors of ignorance and disbelief often appeared to be interrelated. As one official in Tampa said:

> We don't know enough about it. There's just not enough information and it's become so politicized, that it's difficult to—in this environment, with the political landscape the way it is, it's difficult to know who's telling the truth, or who's using propaganda and this is just their method of a scare tactic.

She continued to say that these factors affected her ability or interest in incorporating climate change into city planning.

In other instances, interviewees were skeptical of adaptation programs because they felt that climate change was too contentious an issue for the broader public to believe much of the existing evidence. Interviewees felt that the politically-debated nature of climate change made it difficult for them to advance new programs or policies in their cities. Even in Portland where there was wide-scale support for climate, one interviewee said it was difficult to develop climate adaptation:

> ...especially with the climate that we have here in America about the, you know, the paid disinformation campaigns that are going on. So I think that's one of the challenges, and we try to respond to it, and I guess the saving grace is, as I said at the beginning, is that the actions we've taken to improve our quality of life . . . have a huge support from the public...

4.4. Resource catalysts

4.4.1. Advocacy and political engagement

A common theme across interviews was the importance of public values in environmentalism and beliefs regarding climate change. Often, public buy-in was encouraged by historical public awareness of environmental issues. This was most clearly the case in Portland and Los Angeles, and was cited as playing an important role in both cities becoming leaders in climate change adaptation and mitigation. As one interviewee in Los Angeles said:

> In terms of political influence, environmentalism is a close second to labor in terms of its relevance to the region . . . The politics aren't as big a deal and environmentalism is a very strong value.

Similarly, a Portland interviewee said: "I think a community that understands this issue and demands action from leadership is really a huge part of it. [. . .] We have a very engaged public."

Interviewees from Los Angeles and Portland discussed climate change action being a moral imperative, rather than simply a protective measure. They often stated that that adopting policies and taking part in activities that reduce risks for current and future generations was simply the right thing to do. As one Los Angeles interviewee described: "There seems to also be a moral imperative of what are we doing for the future: 'What is the legacy we're passing on to our children and their children?'" Very similarly, an interviewee from Portland described how this moral imperative is a constant motivation for action:

> People do want to do the right thing. People here recycle at huge rates; we have pretty high bicycling ridership for America. We have a good transit system that the public supports over and over again, and the question is, you know, how do we take the next step?

Portland has been taking steps to mitigate climate change for roughly 20 years, and the state of California enforces some of the strictest emission rules in the country. Both Portland and Los Angeles have implemented plans for adaptation and are continuing to plan for future events.

Interviewees stated that the high level of interest and involvement in climate change issues stems from public acceptance of climate change as an important issue and subsequent pressure on decision-makers. This was true across other cities as well. Yet, there were obstacles to the role of advocacy in other cities. In some cases, interviewees stated that citizens tended to accept and understand climate change, but that they perceived it as a global issue with few consequences that would affect them personally. For example, one interviewee in Boston said in regards to the assessment he had done of local perceptions:

> People were fairly well aware of climate change and the global issues, although there were the standard misconceptions. We found that they seemed to understand its impact and [that] it also has impacts on society, but there was really not much of an understanding of what it meant locally to them individually and what they should do about it.

4.4.2. Academic resources as a motivating factor for change

Researchers have called for increased linkage between decision-makers and scientific information in order to facilitate adaptation (Moser et al., 2008). The development of relationships between local experts with government agencies involved in adaptation has been suggested as an intermediary approach to adaptation before solid scientific evidence is available to pinpoint specific climate outcomes (Dodman and Carmin, 2011). This research attests to the importance of these kinds of resources. Local experts who could advise government institutions were referred to as critical in facilitating adaptation efforts in several ways. Local

universities where researchers specialize in climate change and local non-governmental organizations that conduct research were the most common points of reference by government officials working on adaptation planning. For example, in Boston the work done by Massachusetts Institute of Technology and the Union of Concerned Scientists played important catalyzing roles in helping local officials understand what might happen in their city.

Academic resources such as nearby universities and research centers influenced the development of adaptive measures. This was particularly evident in Boston, Raleigh, and Tucson. Research produced by institutions in our case study cities, such as Harvard University, the University of North Carolina, and the University of Arizona, for example, was often mentioned as invaluable to surrounding communities in assessment of risk, vulnerability, and adaptive capacities. Many interviewees cited specific institutions as contributing factors to implementation of adaptation measures occurring within their cities. For example, in Boston, one interviewee said:

> I think having the Union of Concerned Scientists and several major universities in the area is also a really big driver. You know the fact that there are studies that specifically looked at the city, that really sort of provides detailed information is a helpful driver as well.

Despite the generally low level of preparedness in Raleigh, interviewees pointed to local academic resources as one of the most important factors in moving them closer to addressing climate change. Participants also often made a link between the presence of academic institutions and a consequently more educated general population. In several cities, interviewees cited academic resources as a reason climate change is now becoming an issue of interest among their citizens. For example, one interviewee in Raleigh said:

> There's a high level of education and so I think that creates a higher awareness level, if you will. I could honestly say that you would probably be able to find a higher percentage of people in this region who would be willing to agree [that climate change poses an immediate threat] just because of the education.

However, academic resources can also fall on deaf ears. When there was a general disregard for climate change by political leaders, experts felt as though their work was disregarded. As one expert interviewee said:

> Unless you have a champion of a certain level, all professors are viewed by the legislature as being in ivory towers . . . we 'aren't in touch with policy issues' . . . we 'don't understand the implications [of] how it affects populations'. It's easy, in some ways, to discredit what we put out there.

5. Discussion

We find that there are three types of factors that play a role in urban climate adaptation in the United States: swing factors, inhibitors, and resource catalysts. First, swing factors, including extreme weather events and political culture, can play a role in motivating or inhibiting action. We name these factors swing factors because their role in supporting or inhibiting change depends on their context. This finding supports both sides of past research that demonstrate extreme weather events motivating or inhibiting climate change. These events drive change when they interpreted as threats. This was the case in areas with more liberal climate attitudes. These events inhibit change when they are normalized and not interpreted as climate-related, as took place in Tampa. Extreme events were therefore a swing factor that interacted with the second swing factor we identified—political culture. Political culture also acted both as an inhibitor or catalyst for climate adaptation with conservative areas being less likely to adapt and liberal areas being more likely to undertake such activities. While this is possibly unsurprising, it is important to note that this may mean that conservative areas will be less prepared for the impacts of climate, and therefore sustain more costs from these events.

Second, inhibitors, or scientific uncertainty and politicization that affect the thinking of decision-makers and framing of climate change, may slow, but do not necessarily stop change. Politicization was often cited in Tucson, Tampa, and Raleigh, in particular. Interviewees often referred to this as climate change becoming a political, rather than a scientific issue, and then referred to as a possible, but not definitive problem. Scientific uncertainty and politicization often overlapped as interviewees claimed that one might lead to the other, and that both resulted in the slowing of action on climate adaptation. A central concern was a lack of trusted information regarding clear outcomes of climate change for which decision-makers could plan.

Third, resource catalysts were public interest or advocacy and academic resources that provided a scientific rationale or moral grounding for change. The results of this study suggest the critical importance of resource catalysts such as public engagement. Our interview data demonstrates that a city's stage of climate change adaptation may correspond to the public's engagement in the issue. For example, in Los Angeles and Portland, decision-makers generally felt that a majority of the citizens accepted the existence of climate change, often pressuring politicians and decision-makers to address, which gave them the support to plan for adaptation. Boston, Raleigh, and Tucson, in contrast, were in the early to mid stages of public acceptance of climate change, and decision-makers in these three cities stated that public perceptions vary greatly throughout their populations. Our findings regarding resource catalysts also suggest that academic buy-in may precede public buy-in in places that are historically less environmentally-friendly/more politically conservative.

Overall, swing factors, inhibitors, and resource catalysts often interact, although the specific pattern of interaction varies.

6. Conclusions

This research demonstrates several important social factors that affect adaptation planning and implementation. They include the interpretation of extreme weather events, the role of political context, public awareness, politicization of climate change, and scientific uncertainty. As such, it offers a broadened conceptualization of what drives or inhibits cities to adapt. It also represents the first extensive qualitative investigation of American urban adaptation. While its scope is limited both in case study numbers and depth of investigation per city, it offers several findings useful to practitioners in advancing climate adaptation. First, since politicization of climate change can be directly related to scientific uncertainty, advisory scientists who can work across the boundaries of science and policy-making may play a critical to adaptation programming. In the case study cities, these kinds of experts were more useful than alternative vulnerability assessments or other experimental approaches to identifying climate impacts. On a related note, public education that leads to awareness and understanding of climate change may play a critical role in supporting adaptation measures at the city level. Second, interviewees demonstrated that extreme events can be moments in which there is motivation to address potential climate impacts, if they are interpreted as representing future risks by policy-makers. This interpretation may depend, however, on the aforementioned understanding of climate change by policy-makers and the public. Third, these findings indicate that conservative cities may be slower to adapt, resulting in higher risks of climate impacts.

This research is only an initial investigation of the social factors relevant to climate adaptation. There are many others to which future researchers might draw attention. Overall, the results of this study suggest that a city's likelihood for implementing adaptive measures is influenced by several previously unexplored social factors. This study also begins to indicate which cities in the U.S. are likely to adapt, and which are likely to be worst off, simply because of the social factors that affect the likelihood that they will adopt adaptation measures. Considering findings in this research may help guide where and how resources should be directed when attempting to prepare for climate impacts.

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