PSJ
POLICY STUDIES JOURNAL

Policy Studies Journal, Vol. 49, No. 1, 2021

Capacity Building toward Resilience: How Communities Recover, Learn, and Change in the Aftermath of Extreme Events

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When faced with natural disasters, communities respond in diverse ways, with processes that reflect the extent of damage experienced by the community, their resource availability, and stakeholder needs. Local-level processes drive decisions about mitigating future flood risks, such as if, how, and where to rebuild, as well as changes in zoning practices and public outreach programs. Because of their potentially recurring nature, floods offer an opportunity for communities to learn from and adapt to these experiences with the goal of increasing resiliency through deliberation, modification of former policies, and adoption of new policies. By following the response to the September 2013 floods in seven Colorado communities, this study investigates if, how, and why communities successfully learn from extreme events and change their local government policies to increase resilience and decrease vulnerability to future floods. We find that greater openness of post-flood decision process is associated with more in-depth deliberation, learning, and more substantive and frequent policy change.

KEY WORDS: policy change, policy learning, resilience, disasters, resources, capacity

面临自然灾害，社区以多样化的方式进行响应，响应过程反映了社区损坏程度、社区资源可用性、利益攸关方需求。地方响应过程推动了有关减少未来洪灾风险的决策，例如是否应重建区划实践和公共外展服务项目，应如何进行，在何处进行，区划实践和外展服务会发生何种变化。由于洪灾具有潜在重现的性质，它给社区提供了从受灾经历中学习和适应的机会，目的在于通过商讨和修改以往政策、采用新政策，进而增强社区弹性。通过追踪*2013*年*9*月科罗拉多州七个社区对洪灾的响应，本文研究了社区是否成功从极端事件中获取经验，改变地方政府政策，以增强社区弹性、减少面临未来洪灾时的脆弱性，以及社区如何开展这一过程，开展原因是什么。作者发现，灾后决策过程的公开程度越大，则与更深度的商讨、学习，更实质性和频繁的政策变化有关。

关键词: 政策变化, 政策学习, 弹性, 灾害, 资源, 能力

Cuando se enfrentan a desastres naturales, las comunidades responden de diversas maneras, con procesos que reflejan la magnitud del daño experimentado por la comunidad, la disponibilidad de sus recursos y las necesidades de los interesados. Los procesos a nivel local guían las decisiones sobre cómo mitigar los futuros riesgos de inundación, como por ejemplo, cómo y dónde reconstruir, así como los cambios en las prácticas de zonificación y los programas de divulgación pública. Debido a su naturaleza potencialmente recurrente,

doi: 10.1111/psj.12364
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las inundaciones ofrecen una oportunidad para que las comunidades aprendan y se adapten a estas experiencias con el objetivo de aumentar la resiliencia mediante la deliberación, la modificación de políticas anteriores y la adopción de nuevas políticas. Al seguir la respuesta a las inundaciones de septiembre de 2013 en siete comunidades de Colorado, este estudio investiga si, cómo y por qué las comunidades aprenden con éxito de los eventos extremos y cambian sus políticas gubernamentales locales para aumentar la resiliencia y disminuir la vulnerabilidad a futuras inundaciones. Encontramos que una mayor apertura en el proceso de decisión posterior a la inundación está asociada con una mayor deliberación, aprendizaje y un cambio de política más sustancial y frecuente.

PALABRAS CLAVE: cambio de políticas, aprendizaje de políticas, resiliencia, desastres, recursos, capacidad

Introduction

Disasters can provide opportunities for governments to learn from, and reduce vulnerability to, risks that they face (Birkland, 2006). Flooding is one such hazard that communities and local governments confront, annually causing billions of dollars in damage losses, and response and recovery expenses in the United States alone, with costs escalating. From 1980 to 2018, flood damages across the United States totaled roughly $125 billion in CPI-adjusted dollars and tropical cyclone damage summed to approximately $928 billion (NOAA, 2019). Human decisions to build in risk-prone areas, combined with population growth and predicted increases in precipitation due to climate change, may exacerbate flood damages and put more communities and people at flood risk. Simultaneously, disasters are viewed as local problems, both supported and constrained by federal and state actions or policies (Havidan, Enrico & Russell, 2006; Smith, 2012). As a result of this increased risk and increased policy responsibility, local-level political and policy processes drive decisions about mitigating hazards such as flood risk.

In the aftermath of a disaster, decisions such as if, how, and where to rebuild, as well as other policy changes such as zoning, public risk education, and stakeholder engagement processes are all areas of potential policy action for local governments. Floods provide an excellent lens through which to study learning and policy change after disasters because of their potentially recurring nature (Brody, Zahran, Highfield, Bernhardt, & Vedlitz, 2009). Floods offer an opportunity for communities to learn from and adapt to these experiences with the goal of increasing resilience. This study analyzes decisions made by local governments after extreme floods in Colorado, United States during 2013, to investigate local policy change and understand whether learning from past disasters helps communities increase resilience and decrease vulnerability to future floods.

As local governments begin recovery from disaster, they must navigate myriad policy challenges including recovery planning, budgetary changes, and considerations of future risk reduction. Through the integrated lens of policy learning and change during disaster recovery we are able to analyze the degree to which local governments make longer-term changes that can reduce their future risk to natural hazards by building community resilience. While the policy process literature points

to key variables that encourage or limit policy change and learning, the causal pathways and processes that lead to these outcomes are not fully understood (Kingdon, 2003; Sabatier & Weible, 2007; Weible & Sabatier, 2017). This study seeks to wed the literatures of policy change and learning to understand when resilience building is more likely. Additionally, it integrates ideas from organizational capacity and planning literatures to identify what resources (or capacities) encourage or impede learning and policy change in the aftermath of a disaster. In doing so, we aim to identify drivers that may lead to the strengthening community-level resilience. This paper focuses on two sets of variables—capacity building strategies and resource shifts—that might drive policy learning and changes in policies stemming from an extreme event. In doing so, this paper seeks to clarify the drivers that may motivate policy change and learning which may lead to increased community resilience.

Disaster Recovery toward Resilience

Smith and Wenger (2007, p. 237) define disaster recovery as "the differential process of restoring, rebuilding, and reshaping the physical, social, economic, and natural environment through pre-event planning and post-event actions," which is part of the disaster cycle that includes disaster preparedness, emergency response, disaster recovery, and eventually hazard mitigation. In the wake of extreme flooding, communities will face numerous decisions throughout the recovery period, including decisions about emergency management and if, where, and how to rebuild. The literature on policy change after a crisis or disaster provides one lens through which to examine community-level disaster recovery. In the public policy literature, a disaster is often described as an external shock or perturbation (e.g., Advocacy Coalition Framework; Sabatier & Jenkins-Smith, 1999; Sabatier & Weible, 2007), a potential focusing event (Birkland, 1997, 2006), or a crisis (Nohrstedt & Weible, 2010). These events have the potential to increase the likelihood of policy changes within disaster-affected governments.

The recovery phase of the disaster cycle presents an opportunity to improve conditions to prevent or reduce the impacts of similar disaster events in the future (Kates & Pijawka, 1977; Smith & Wenger, 2007). Planning scholars have posed the question of how communities can best plan for increased resilience to future disaster in communities (e.g., Berke & Campanella, 2006; Brody, Kang, & Bernhardt, 2010; Smith, 2012). By analyzing policy change and learning in disaster-affected communities, this study aims to enhance our understanding of community-level disaster recovery decisions that promote resilience in the face of vulnerability to various risks. It is therefore important to understand the links between resources, capacity building, policy change, and learning and whether they lead to resilience.

Resilience, broadly cast, entails "the ability of a system to withstand perturbations and shocks" (Gunderson & Light, 2006, p. 324). Folke (2006, Table 1), in his discussion of resilience, distinguishes between engineering, ecological/social, and socio-ecological resilience. In his terms, engineering resilience focuses on the time it takes to recover to a previous state, whereas ecological resilience emphasizes the maintenance of function and ability to absorb shocks. Socio-ecological resilience,

in this framework, centers on learning, reorganization, innovation, and adaptive capacity. Adger (2000, p. 347) views social and ecological resilience as linked concepts, where social resilience is "the ability of groups or communities to cope with external stresses and disturbances as a result of social, political, and environmental change." Community resilience, as defined by Magis (2010), centers on community members' engagement in decisions about resource use, with the goal of thriving in an uncertain environment. Cutter et al. (2008) conceptualizes community resilience as composed of a number of factors including: ecological, social, economic, institutional (plans and standards), infrastructure, and community competence (health, understanding of risk, quality of life, etc.). Planning scholars have described resilience to disasters to include minimizing the loss of life and damages; integrating and diversifying economies and communities, while strengthening sense of place and public and stakeholder voice in recovery planning (Berke & Campanella, 2006; Smith, 2012; Vale & Campanella, 2005). While each of these conceptualizations informs what we mean by "community resilience," each falls short because they do not holistically describe what is required for a community to develop the capacities needed to minimize the likelihood of future shocks and rebound afterwards.

In the conceptualization that guides this study, community resilience entails the ability to anticipate, learn from, and cope with past perturbations, while integrating this knowledge to reduce vulnerability to future risks and lessen the likelihood of disaster. This requires a community to draw upon social connections, capacity, resources, and natural or built capital to rebound from and reduce future risks. More resilient communities take a more system-wide view of risks and vulnerabilities, viewing risks comprehensively by thinking about a variety of vulnerabilities rather than singular risks (Johansen, Horney, & Tien, 2016). Further, resilient communities often demonstrate a greater reliance on their own resources to recover from a disaster, instead of relying on external sources of funds (Federal Emergency Management Agency [FEMA], 2011).

As definitions and the operationalization of community resilience often encompass the construct of social learning, the literature says less about other types of learning that may be critical to resilience. Most conceptualizations of resilience ignore or underemphasize the role of policy learning and change as a part of their resilience measures. The ability of a community to learn from past failures and institutionalize this new knowledge in changes to policy is critical for increasing a community's ability to cope with future disasters. Even though Cutter et al. (2008) include measures of institutions (policies, plans, and standards) and community (community health and risk awareness), the role that community members play in the local-level policy process is largely excluded from their model of resilience. Theories of policy change examine the drivers of changes in policy, but often do not explain differences in the content of these changes, leading to a gap in the disaster and policy change literature. Depending on their content, policy changes may or may not lead to increased resilience to future disasters. Furthermore, our operationalization of community resilience includes an assertion that more in-depth learning is essential for a community to move toward resilience. Without institutionalizing changes in goals and

priorities based on analysis of new information and engagement with community members, learning will not lead to changes in development, social connectedness, or disaster planning that move closer toward resilience. As such, this study assesses the variables that may lead to more in-depth learning and policy change, specifically through the lens of disaster recovery and resilience-building.

Policy Learning and Policy Change after Disaster

Policy subsystems are the constellation of individuals and organizations that work on a specific policy problem or issues, in this case disaster recovery. The study of policy subsystems has frequently focused on the national or regional level, but local policy issues may also be viewed through this conceptual structure (Goetz & Sidney, 1997). Multiple, overlapping and interdependent local policy subsystems interact and are often constrained by higher-level jurisdictions and their rules. Local policy subsystems include government officials at multiple levels of governance, as well as nongovernmental actors, such as interested nongovernmental, advocacy, and business organizations. Actors within a subsystem have "privileged access" to the policy and decision-making processes (Goetz & Sidney, 1997). Similarly, Smith (2012), in the disaster recovery assistance framework, describes the interconnected networks of actors and organizations involved in disaster recovery, including governmental, quasi-governmental, nongovernmental organizations, and private sector organizations along with community members and other engaged stakeholders.

As an external shock to a policy subsystem, disasters may lead to policy change and learning through a variety of pathways. Policy change may stem from postdisaster learning, or may occur through "mimicking" the actions or policies of others, without demonstrable learning (Birkland, 2006). The adoption of new policies or alterations of former policies may depend on the extent and type of learning that occurs within a community during the recovery process. Based on Busenberg's (2001) conceptualization, Birkland (2006) defines learning broadly as "… a process in which individuals apply new information and ideas or information and ideas elevated on the agenda by a recent event, to policy decisions" (p. 22). Policy learning may occur at three different levels as delineated by Moyson, Scholten, and Weible (2017); the micro (individual), meso (organization), and macro (system) levels. The focus of this study centers on meso-level learning and change that occurs at the level of community, recognizing that individual and system dynamics are also at play.

Several overlapping concepts of learning permeate the policy literature (Goyal & Howlett, 2018), but definitions typically consider the collection and processing of information, and transforming it into knowledge, which may eventually lead to a learning product such as a report or new or modified policy (Gerlak & Heikkila, 2011; Heikkila & Gerlak, 2013). Moyson et al. (2017) define policy learning as "adjusting understandings and beliefs related to public policy (Dunlop & Radaelli, 2013)," and emphasize the role of circulation of ideas among stakeholders and the public as central to policy learning.

Table 1 lists a continuum of types of learning, based on the depth and type of learning and each of these types of learning is linked with products of learning.

Table 1. A Continuum of Learning Concepts, Processes, and Products

Relevant Learning Framework	Type of Learning Observed	Products of Learning
Lesson drawing (Rose, 1991)	• Learning from other's experiences	• Adoption of a policy developed by another community • Evidence of dialogue between communities
Political learning (Birkland, 2006; May, 1992)	• Learning about strategies and tactics	• Adoption of new financing mechanisms to meet funding goals
Instrumental learning (Birkland, 2006; May, 1992; Rose, 1991)	• Changes in policy instruments	• Alterations in penalties/financial incentives for flood protection • Changes in land use policies/regulations
Government learning (Bennett & Howlett, 1992; Etheredge, 1981)	• Learning about governmental organizations	• Formation of new departments or divisions with a local government • Development of new venue to discuss flood and flood responses
Policy-oriented learning (Sabatier & Jenkins-Smith, 1999)	• Enduring alterations of beliefs about and severity and causes of a policy problem	• Discussion of causes and severity of flood
Social learning (Birkland, 2006; Hall, 1993; May, 1992; Sabatier & Jenkins-Smith, 1999)	• Goal redefinition • Reflection on past experiences • Collection of new information	• Discussion of failed policies • Statement of new goals • Changes in defined scope of problem

The types of learning listed in Table 1 (in italics) vary based on the content and purpose of what is learned, as well as the depth of learning process. Depth of learning has been described along a continuum where simple lessons can be extracted from an experience to improve future decisions or processes in single-loop learning, or more in-depth assessments of an organization's information uptake and learning processes themselves can be conducted along with the learning of information (double-loop learning) (Argyris, 1977, 1998). This more in-depth double-loop learning is thought to increase reflection and adaptability of organizations. At the thinnest level of learning, new policies or actions may occur through copying or mimicking, mechanisms that do not require in-depth reflection of past policies or failures, but where policy changes still take place (Birkland, 2006; Heikkila & Gerlak, 2013). Such mimicking may represent learning from others, akin to *lesson drawing* as described by Rose (1991).

Instrumental learning can occur when an organization, such as a local government, learns about specific policy tools or instruments (e.g., learning about fees to pay for damaged parks) to achieve discrete goals (Crow, Albright, Ely, Koebele, & Lawhon, 2018). *Political learning*, the next step of learning in the continuum, occurs when an

organization learns about strategies and tactics to reach a goal (May, 1992), such as learning about how to effectively engage stakeholders in new venues. Strategies used to increase human resource capacity, such as adding new staff or reconfiguring organizational structures, may suggest learning about governmental organizations, also called *government learning* (Bennett & Howlett, 1992; Etheredge, 1981). *Policy-oriented learning* encompasses the alterations of beliefs about a policy problem or its causes (Sabatier & Jenkins-Smith, 1999). *Social learning* (Hall, 1993), the highest level of learning in our continuum, requires more in-depth analysis and discussion of previous policies and policy failures, including changes in goal definition and priorities.

Building on our prior analysis of learning within the more narrow bounds of local government finance policy (Crow et al., 2018), the current study expands this to a broader assessment of learning, policy change, and resilience across the disaster policy subsystem of local governments. Measuring learning presents several challenges, including questions surrounding who learns (e.g., collective vs. individual learning), and the difficulty in identifying what is learned (Birkland, 2006).

The policy literature is currently vague or ambiguous on the relationship between policy change and learning (Moyson et al., 2017). Policy change may occur without learning, through mimicking processes, and policy learning may or may not lead to policy change due to barriers such as political will, limited resources, and others. One of the potential outcomes of learning is policy change, but policy change, when it occurs, can vary depending on what type of learning motivates it (Birkland, 2006; Crow et al., 2018), which in disaster recovery can range from discrete instrumental changes focused on navigating complex intergovernmental relationships to in-depth planning changes that reduce community risk. Multiple organizational, resource, and capacity constraints may block or limit learning from disaster. At the federal level, learning and change after a focusing event, such as a disaster, is rare (Birkland, 2006). In the aftermath of a disaster, pressure from the public to build back quickly may limit opportunities to learn from failures of previous policies, constraining learning. In our examination of learning and policy change, we will seek to identify both the process of learning (i.e., acquisition and analysis of new information, discussion of policy failures and goals) and the products of learning (i.e., changes in policies, programs, and plans) to identify different learning types. In cases of lesson drawing, we will look for direct mentions of policy actions within other communities and organizations.

The Role of Resources in Learning and Policy Change

The policy process literature, including the Advocacy Coalition Framework and to a lesser extent models of agenda setting such as Multiple Streams and Punctuated Equilibrium Theory, posits that existing resources and shock-driven shifts in resources are important in promoting policy change and learning. The disaster recovery literature also suggests that resources are critical in recovery, although less is known about (i) to what extent local governments actively seek resources to build capacity for recovery, and (ii) what type of resources or local government capacity encourage or limit policy change and learning. Birkland's model of event-related policy learning (2006,

Figure 1.2) provides a schema of postdisaster policy processes and mechanisms that may lead to learning and policy change. This model, developed for disasters at the national level, however, does not assert a specific role that resources and mobilization of resources play in encouraging or impeding policy change and learning. Integrating resources into our understanding of policy learning and change to better refine these concepts in the policy process literature can help scholars examine processes (learning and change) with more clarity, especially at the local level.

Capacity and Capacity Building: Shifts in Resources during Recovery

A disaster may differentially impact policy subsystems within a single community. A flood may have direct impact on the emergency response subsystem, while having less of an impact on the parks or education subsystem within a community. Nohrstedt and Weible (2010) hypothesize that with closer geographic and policy proximity, greater mobilization of resources will occur, which may lead to policy change. It may be that the closer in proximity the disaster, the more likely that policy actors and perhaps the public writ large will perceive former policies as failures, motivating resource mobilization (Nohrstedt & Weible, 2010). In a community-level disaster context, scale of the disaster effects may be as important as proximity. For example, because a community may be small in geographical size, all residents may be roughly proximate to the damage. However, some may have directly experienced the damage while others experience it simply due to the community-wide aspect of the disaster.

Although Nohrstedt and Weible (2010) hypothesize that a disaster's geographic and policy proximity may drive mobilization of and shifts in available resources, little is offered to explain what type of resources are mobilized in what contexts. A local government's capacity encompasses the interdependent fiscal, technical, and human resource dimensions that enable or inhibit its ability to carry out governmental functions (Leavitt, 1965). Prior disaster recovery studies indicate that the availability of resources, expertise, leadership, and organizational capacity frequently drives or limits recovery processes (Brody et al., 2010; Handmer, 1996; Smith & Wenger, 2007). In the aftermath of an extreme event, we may see a redistribution in types of resources, including changes in the flow of financial and technical resources, alterations in sources and amount of information produced and consumed, and mobilization of the public around recovery-related concerns (Albright, 2011; Albright & Crow, 2015; Sabatier & Weible, 2007). These shifts in resources may enhance the ability of local governments to alter or adopt policies, potentially affecting recovery from and building resilience to future extreme events. Alternatively, in the wake of disaster, capacity to learn, and change policies may become extremely limited. For example, the immediate needs of emergency response may limit a local government's ability to reflect on past policies and develop new policies, constraining its capability to recover and become more resilient after a disaster (e.g., staff may focus on relocating and offering assistance to community residents vs. focusing long-term planning). Further, community members and the private sector may

press for a quick return to pre-event state (Berke & Campanella, 2006). This suggests that the time horizon of disasters must be accounted for in understanding policy learning since in the immediate aftermath we would expect less learning to occur, as scholars have documented in other crisis scenarios such as pandemic response (DeLeo, 2018). However, waiting too long to engage the public in deliberative policy processes might also inhibit learning since motivations and lessons from an extreme event presumably cannot last indefinitely.

Despite our goal of understanding whether and how local governments learn from disaster, the literature suggests that policy learning after a crisis is rare and that novel ideas infrequently emerge in the wake of extreme events (Birkland, 2006). However, it may be that through the mobilization of resources, new problem definitions, causal stories, and solutions surface. Research suggests that postdisaster resources are critical in a community's ability to adopt new flood recovery policies (Burch, Sheppard, Shaw, & Flanders, 2010). Yet, the policy change literature often views shifts or mobilizations in resources after a disaster happens with no clear drivers or motivators. It is not clear the extent to which communities purposefully and successfully pursue strategies to mobilize resources after a disaster, and how this strategic capacity building may in turn motivate changes in policy. We examine four types of capacity building strategies and shifts that may alter fiscal, technical/informational, human, and civic resources.

Fiscal Capacity. In the aftermath of a disaster, local governments may attempt to increase fiscal capacity through such mechanisms as applying for reimbursements for damages from government agencies, seeking grants from government and nongovernmental organizations, levying municipal taxes or fees, and seeking loans (Albright & Crow, 2015; Crow et al., 2018; Muñoz & Tate, 2016; Spader & Turnham, 2014; Tate, Strong, Krause, & Xiong, 2016). While potentially increasing fiscal resources, these strategies may also constrain policy change by mandating adherence to requirements of the funding agency (e.g., FEMA requirements). An inability to acquire financial resources may limit the type and extent of policy change that can occur. Further, these efforts are often time and staff intensive, potentially taking up significant local human resources that cannot then be dedicated elsewhere.

Information and Technical Capacity. Local governments often produce and/or use a number of technical tools, such as hydrologic modeling or floodplain mapping to inform flood mitigation activities. In the aftermath of, or in response to a flood, local governments may seek out these resources to effectively guide and inform their recovery-related decision-making processes. This information may be acquired through strategic discussions among individuals or organizations, internally or externally (Heikkila & Gerlak, 2013; Huber, 1991), or they may be more formalized through the contracting or conducing of flood-related studies. Communities may increase their postflood technical capacity, such as building networks with research and academic institutions, or hiring external organizations to conduct mapping, or other technical or engineering exercises. A reliance on technical expertise may, however, limit the level of openness of policy discussions (Crow, 2010; Schneider & Teske, 1992), potentially constraining the generation of new ideas (Birkland, 2006),

potentially dampening opportunities for collective learning and policy change (Albright & Crow, 2015). Further, a heavy reliance on technical expertise may lead to a lack of local knowledge leading to plans, policies, and actions that may not mesh with local values and culture (Berke & Campanella, 2006; Burby, 2003).

Human Resource Capacity. Organizational human resource capacity (e.g., leadership and staffing) plays a critical role in effective local-level governance and influences delivery of government services at the local level (Andrews & Boyne, 2010; Brody et al., 2010; Ingraham, Joyce, & Donahue, 2013). Brody et al. (2010) argue that capacity of expert local staff who are collaborative, flexible, and adaptive are critical for flood-risk mitigation. Organizational leadership (or lack thereof) may influence local-level performance and outcomes (Andrews, Boyne, & Enticott, 2006). Local officials and professional staff may serve as policy entrepreneurs by building coalitions, increasing media attention to mitigation issues, and elevating mitigation on the political agenda (Prater & Lindell, 2000). Human resources, such as local government staff, may also help motivate policy change in the realm of disaster. The presence of trained planning staff, along with increased financial resources, may lead to more effective disaster mitigation programs (Berke, Cooper, Aminto, Grabich, & Horney, 2014; Prater & Lindell, 2000; Smith, 2012). Local government leadership and staff may encourage learning through their interpretation of the disaster, its cause, and future risk of similar disasters (Beck & Plowman, 2009). Both of these categories of personnel may be limited in number and disaster expertise, potentially motivating a community to hire additional staff or shift existing staff into new disaster recovery roles to deal with new issues that arose as a result of the disaster. New staff members may bring novel ideas and approaches to recovery, or alternatively, may hinder or slow policy change because of time required to learn a new organization and their job duties. Training of local staff to handle the diverse responsibilities of recovery may be inadequate (Smith, 2012). Research also suggests that there may be confusion among staff due to shifts between pre- and post-disaster work responsibilities, potentially slowing, or interfering with the recovery process (Smith, 2012; Wolensky & Miller, 1981).

Civic Capacity. Successful recovery is seen in communities where local empowerment is a key component of the recovery process (Berke & Campanella, 2006; Burby, 2003; Smith, 2012). In the aftermath of a flood, communities may seek to build civic capacity by creating venues in which the public can engage in discussions of disaster recovery. Building civic capacity entails encouraging citizen engagement in solving complex policy problems by building relationships through sharing of goals, interests, and developing a common understanding of a problem (Page, 2016; Saegert, 2006). Increasing the diversity of participants in recovery processes may elevate legitimacy of the process, strengthen relationships, and diversify ideas discussed in the process (Ansell & Gash, 2008; Fung, 2006; Page, 2016). That said, engaging the public in issues focused on hazard mitigation may be challenging due to disinterest (Godschalk, Brody, & Burby, 2003). Increasing strength of relationships and trust between community members and local officials may help garner support for and reduce conflict over proposed policies and recovery projects (Aldrich, 2012; Berke & Beatley, 1997; Chaskin, 2001; Kweit & Kweit, 2004). But building civic capacity

remains difficult and often time- and resource consuming, and may be ephemeral (Page, 2016). Further, participatory processes that engage the public may serve to further disenfranchise groups that had limited access to authority prior to the disaster due to the greater likelihood of higher resourced individuals participating in the processes, potentially increasing vulnerability of individuals with limited access and resources in the face of disaster (Cote & Nightengale, 2012; Cretney, 2014).

These four types of resources are potentially key to understanding the likelihood of learning and policy change within local governments after a disaster. When we observe learning and policy change, we also may observe communities move closer to resilience, the context within which we analyze these processes.

Hypotheses

Linking our understanding of capacity and capacity building approaches with the outcome variables of policy change, learning, and community resilience, we hypothesize several relationships that connect resource mobilization, type of policy change observed, types of learning, and resilience outcomes. First, we draw on the literature to focus on the factors associated with capacity building (i.e., increasing resources available for recovery) in communities after disaster since governmental capacity is expected to be tied to successful learning and policy change, and active capacity building is likely to occur in communities that face the most daunting disaster recovery (Albright & Crow, 2015; Crow et al., 2018).

> *Hypothesis 1: The use of capacity-building strategies will be greater in communities that experienced more extensive disaster damage*.

As discussed above, in a postdisaster context, communities may engage in learning processes in which new goals and objectives may be formed and former policies may be examined (Hall, 1993; Sabatier & Jenkins-Smith, 1999), potentially identifying failures in past policies (Birkland, 2006). Deeper learning processes such as goal formation and identification of policy failures often require human and civic capacity, and therefore, we posit:

> *Hypothesis 2: Communities that demonstrate a greater use of capacity-building strategies to increase postdisaster resource availability in human and civic sectors are more likely to engage in deeper deliberative processes, as compared to communities that focus more singularly on fiscal or technical capacity building*.

We next propose the following hypothesis to examine the connection between human and civic capacity building and in-depth policy learning such as social or governmental learning:

> *Hypothesis 3: Communities that adopted more extensive human resource- and civic capacity-building strategies are more likely to demonstrate deeper learning, as compared to communities that did not use these strategies*.

Next, we turn to the relationship between learning processes and policy change, by hypothesizing about the types of policy change we will see, including the depth and the breadth or diversity of changes. Depth of policy changes is a measure of the extent of which the policy has been altered at its core, representing a shift in the underlying understanding of causes or severity of the policy problem versus instrumental or implementation-focused policy change (Sabatier & Jenkins-Smith, 1999).

Hypothesis 4: Communities that demonstrate deeper learning are more likely to demonstrate greater breadth and depth of policy change than communities that engage in thinner learning.

And finally, we integrate the capacity measures of policy change and learning to understand whether they lead to greater levels of postdisaster community resilience to posit:

Hypothesis 5: Communities that adopt more extensive postdisaster financial, human, and civic capacity-building strategies are more likely to demonstrate community resilience after disaster than communities that adopted fewer capacity-building strategies.

Community resilience after a disaster will be measured by presence of fiscal, physical, ecological, and social resilience as discussed in the literature, along with community-member engagement, deeper processes of learning, and policy changes.

Research Design and Methods

In our examination of learning and policy change, we seek to identify both the process of learning (i.e., acquisition and analysis of new information, discussion of policy failures and goals) and the products of learning (i.e., changes in policies, programs, and plans) to identify different learning types.

We study postdisaster learning and policy change through the lens of catastrophic floods. The research questions and hypotheses presented above were studied in a longitudinal comparative in-depth case study (Yin, 2003) of seven Colorado communities, located in the three Colorado counties most severely impacted by flooding during September 2013, as measured by FEMA assistance estimates in the month after the disaster (Table 2) (FEMA, 2013). Case study communities vary based on county, population size, demographics, extent, and type of flood damage. The seven communities are located in three adjacent counties, which are situated north of the Denver metropolitan region in Colorado. They include small mountain communities (Estes Park), those located just at the base of the Rocky Mountains (Boulder, Longmont, Lyons, Loveland), and plains communities (Greeley and Evans), which represents common community locations in Colorado. The communities are closely situated and could have been expected to communicate, share information, or learn from one another due to proximity and prior relationships.

Table 2. Case Study Communities

County (Population)	Community	Approx. Size (2010 Census)	Median Household Income (2008–10 Census)	Extent and Type of Flood Damage
Boulder (295,169)	Boulder	101,800	$56,206	Moderate to infrastructure and residential, in specific zones
	Longmont	88,600	$57,142	Significant to city infrastructure with moderate residential damage, in specific zones
	Lyons	2,000	$73,918[a]	Significant throughout town to both infrastructure and residential
Larimer (299,630)	Loveland	67,039	$55,838	Moderate to mostly infrastructure and commercial, in specific zones
	Estes Park	6,000	$57,789	Minor to moderate to residential, infrastructure, and commercial, in specific zones
Weld (254,241)	Greeley	95,300	$44,226	No lasting damage, only moderate debris removal
	Evans	19,500	$46,180	Significant to both infrastructure and residential, in specific zones

[a]Median household income data for Lyons, CO was obtained from City-Data.com.

Data Collection and Analysis

Four data sources from each of the case communities were gathered over a 3-year period of disaster recovery beginning in September 2013. First, all documents related to flood management planning, emergency response, evaluation of policies, and community responses to the floods were gathered and analyzed from the date of flood occurrence (September 11–13, 2013) through September 15, 2016. This includes all web content, outreach communications, city council minutes and memos, planning session documents, and other documents as appropriate for each community. All documents were coded[1] for policy changes by indicating the presence or absence of: (i) changes in policies, programs, and plans, including changes in resources (e.g., taxes, fees, and grant acquisition); (ii) changes in organizations/institutions (e.g., establishment of flood working groups); (iii) changes in relationships (e.g., intergovernmental agreements and resource sharing); and (iv) postflood resources (i.e., government budgets), state and federal financial support, and postflood nonfinancial resources such as coordination with neighboring communities or volunteer organizations. Stevens, Lyles, and Berke (2014) and Lyles and Stevens (2014) underscore the importance of completing content analysis by a minimum of two coders and offer a method of measure of intercoder reliability. Two researchers coded these policy changes after pre-coding sessions to create a common understanding of categories of codes, subjectivity, and other potential problems. A quantitative calculation of intercoder reliability, such as Krippendorff's alpha, was not calculated, a potential limitation to our study. However, because the coding scheme focused on aspects of government documents that are clearly presented due, most importantly, to recording requirements for government meetings, this limitation is minimized. These aspects of the documents included authors, dates, whether meetings were public, whether votes were taken to change rules/laws/etc., and similar document content.

Policy learning, a more subjective concept, was defined according to the concepts presented in Table 1. When policy changes (or failures of change) were coded above, those incidents were further coded for the following content: (i) any mention of policy or community goals and potential revision of those goals, (ii) former policies that existed at the time of the disaster that failed to prevent or mitigate flood risk, and (iii) clear statements of lessons learned during flood recovery. The coding protocol required clear statements of these links so that coders were not expected to intuit these connections. For example, a document produced by Estes Park states the following, illustrating a clear example of discussion of a policy failure in risk identification and lessons learned:

> The 2013 flood taught us that the 30-plus year-old flood data significantly underestimated flood risk, highlighting the need for new floodplain mapping. (Estes Park, Document-181)

Quotations from documents are marked with the community name and document number when included in the findings section.

Second, stakeholders with formal responsibilities related to flood disaster recovery were surveyed annually for 3 years following the flood. The population included staff and board members from municipal administration (e.g., city manager), emergency management, public works, planning, transportation and other relevant departments, boards, and commissions. In communities with flood recovery task force(s), task force members were included as well. The survey[2] included questions regarding flood damage severity, resource availability and changes in resources after the flood, flood risk perceptions, their involvement in discussion of preflood policies, alterations of policies, or adoption of new policies after the flood. The design and implementation of the survey followed recommendations by Dillman, Smyth, and Christian (2014), in which a pilot survey was developed to detect any issues with survey design and implementation. The population of experts was contacted three times via email and once via telephone. Across the 3 years of the survey, 248 responses were collected, with a total of 189 unique individuals responding. Some individuals filled out the survey across all 3 years, while most answered the survey once or twice, so we do not treat the data as panel data in the analysis. Across the 3 years, averaged across all communities, response rates varied from roughly 35.6% (2015) to 21.5% (2016), typical of response rates in other local-level expert studies in policy fields (Brody et al., 2010; Robinson & Eller, 2010). Additionally, given the state of flux of the seven case communities after the floods, residents, and government personnel were less likely to respond to surveys than during nondisaster times.

Third, interviews with flood recovery personnel in each community were conducted, with the first round beginning near the time disaster recovery began in late 2013, and following up in early 2016 and 2017. The number of interviews totaled 70 after the 3 years postflood. Each round of interviews included an overlapping but not identical group of subjects due to personnel changes in municipal governments. Interviews were digitally recorded and transcribed and transcripts were coded for themes relevant to the hypotheses posited in the introduction. A codebook (see footnote 2) was developed based on the policy change and learning literatures and coding was conducted according to accepted open-coding procedures for qualitative analysis (Rubin & Rubin, 2005). For example, the literature on resilience suggests four broad categories that constitute community resilience, and therefore the following group of codes was developed:

RESILIENCE—Mentions of resilience

- PHYSICAL—Mentions of physical/engineering resilience (i.e., rebuilding physical structures to withstand future risks)
- ECOLOGICAL—Mentions of ecological resilience (i.e., ecological health of stream and river corridors)
- SOCIAL—Mentions of social resilience (i.e., health and well-being of neighborhoods and community members)
- FISCAL—Mentions of fiscal resilience (i.e., ability to recover financially from a disaster)

Coding was conducted using NVivo 11 software. Analysis of coded interview data was conducted according to the processes outlined by Miles, Huberman, and

Saldana (2013) wherein patterns within the data are identified based on the coded data, specifically looking for patterns within and across communities so as to map those onto findings that emerge from other data analysis in this study to understand the overall picture related to the links among resources, policy changes, learning, and resilience.

Fourth, surveys of residents in six of the flood-affected communities (Greeley was not included since most residents were presumed not to be aware of flood damage enough to answer the questions due to the limited nature of the event in Greeley) were also conducted in 2016 and again in 2017 (distinct samples in each year). The design and implementation of the survey followed recommendations by Dillman et al. (2014), in which a pilot survey was conducted first to troubleshoot any issues with question design and implementation and multiple contacts were used to increase response rates. The surveys were conducted online in 2016 using multiple mailed letters asking residents to take an online survey, and via mail in 2017, which was adjusted to increase response rates from 2016. Response rates varied across communities and years, with responses totaling 903, with an overall rate of approximately 17% (Table S1, Supplementary Material). The survey sample was drawn from both nonflooded and flooded households to elicit responses from both categories of residents. Flood maps accessed through local government websites were used to identify and sample from both flooded and nonflooded neighborhoods.

Research Findings

Extent of Flood Damages and Capacity-Building Strategies (Hypothesis 1)

We posited above that existing capacity and capacity building strategies will vary based on extent of flood damage incurred. Before, during, and after the floods each of the seven study communities demonstrated a unique array of resources—fiscal, human, civic, and technical. In the flood stakeholder survey, local officials and flood task force members were asked about the adequacy of their local government financial, technical, and human resources during recovery. Respondents were instructed not to consider any external sources of recovery resources (e.g., FEMA, State of Colorado) in their response. Over the three phases of the survey, flood personnel rated, on a scale of one to five, adequacy of human resources (overall mean 2.8), and technical resources (overall mean 2.9) statistically significantly greater than perceived levels of financial resources (overall mean 2.2, $p < 0.05$, $p < 0.05$, respectively, Wilcoxon sign paired test, Bonferonni adjusted), Table S2, Supplementary Material.

Fiscal Capacity. While all communities sought reimbursement for some recovery costs from FEMA, the capacity to handle the community cost share varied significantly across communities (in this disaster, local governments were expected to pay 12.5% of damage costs, with FEMA covering 75%, and the State of Colorado covering 12.5%[3]). Further, FEMA reimbursements often do not cover all costs of recovery. For example restoration of river corridors and parks may not be included in reimbursement unless the restoration costs can be directly linked to flood-risk

mitigation. In the stakeholder survey, local officials in Longmont, Lyons, and Estes Park indicated that they depended on funds from FEMA more so than the other communities (Table S3, Supplementary Material). Each community sought additional fiscal resources through a mix of internal budget re-appropriations, levying fees, external grant applications, and formal partnerships (e.g., intergovernmental agreements [IGA] or memoranda of understanding [MOU]) (Table S4, Supplementary Material). Even though the majority of communities used diverse fiscal capacity building strategies, the relative mix of these strategies varied across communities. Boulder relied most on internal capacity, such as bonds and new fees, and less on external grants or intergovernmental agreements. Lyons, the most devastated community from the 2013 flood, used all tools listed in Table S4, and still struggled to meet recovery needs, as indicated by perceptions of adequacy of resources (Table S2).

Human Resource and Civic Capacity. Along with flood damage and fiscal resource capacity, strategies to increase human resource (i.e., staff) and civic capacity varied (Albright & Crow, 2015). With the exception of Loveland and Greeley, all communities increased flood-related internal human resource capacity by adding additional staff members. In Boulder, new staff members were hired to support flood recovery and develop projects to increase long-term resilience. In Longmont and Lyons, new positions were funded, in part, by external grants. In Lyons, the influx of new staff necessitated additional office space, a rare commodity in a highly damaged community, but also led to issues related to training many new employees who were new to the town and unfamiliar with its history.

The communities also took different approaches to engage the public and build civic capacity around flood recovery issues (Table S5, Supplementary Material). In the wake of the floods, each community, to varying degrees, assessed and discussed flood damages and recovery with residents through a number of venues—city council and sector-specific commission (e.g., open space, parks, and utility), stakeholder venues, and broad public meetings (Albright & Crow, 2015). Postflood civic capacity building was measured along three key dimensions: role of the public, depth of participation, and dimensionality of process (i.e., one sector vs. multiple, integrated sectors), as shown in Table S5. In addition, to better understand public involvement in flood recovery, the public survey included questions of frequency in participation in flood-related meetings (5-point scale), and perceptions about the openness and transparency of the recovery process in their community. Table S6 (Supplementary Material) shows a summary of the means of these measures.

Based on the analysis of documents and survey responses, Lyons demonstrated the broadest, most integrative, and most frequently attended participatory process, which may have enabled the most robust opportunity for residents to provide input into postflood recovery. Residents also rated the Estes Park flood recovery process as relatively open and transparent, with a high degree of participation. Greeley sits at the opposite end of the three dimensions with minimal public and stakeholder engagement in participatory processes.[4] The other four communities are located between these two points along the continuum.

Technical Capacity. Each community in our study engaged either directly or indirectly in developing and implementing postflood studies (Table S7, Supplementary Material). Boulder, the home of the University of Colorado Boulder, appeared most actively engaged in carrying out postflood studies. This relatively high level of technical capacity was also demonstrated in the breadth of type of studies conducted—from floodplain modeling to social science surveys. Evans and Greeley conducted fewer and a less diverse array of studies than the other communities. Greeley's lack of post-flood studies may be linked to the relatively minor impact the flood had on the community, whereas in Evans, the lack of demonstrated postflood technical capacity may be due to the amount of damage and the relative paucity of community resources after the flood event.

The analysis of documents and responses to the expert survey provides evidence in support of hypothesis 1 (Table 3), although the hypothesis does not hold across all cases. Each community, to varying degrees, pursued strategies to increase its capacity to recover from the flood. Lyons, a community that suffered the most

Table 3. Overall Capacity Building and Resource Shifts[a]

	Fiscal Capacity	Technical Capacity	Human/Civic Capacity
Boulder	• Damages within capacity • Compared to other communities, self-reliant	High pre- and post-flood	New staff resources Limited development of civic capacity
Longmont	• Within capacity • Compared to other communities, self-reliant	Moderate	Limited development of civic capacity—circumscribed to park sector
Lyons	• Costs far exceed capacity • Influx of federal and state funds	Low but increased technical capacity by resources from external sources	Influx of new staff members/human resources and high level of civic capacity development
Estes Park	• Moderate influx of federal and state funds	Moderate	Moderate/high development of civic capacity in long-term corridor planning process
Loveland	• Moderate influx of federal and state funds	High (but somewhat narrow focus) level of engineering/technical capacity/focus	Limited development of civic or human capacity
Evans	• Costs far exceed capacity • Influx of federal and state funds	Limited pre- and post-flood	Limited development of civic capacity through selected members of task force Increase and reorganization of staff members
Greeley	• Minimal damage • Little change in capacity	Little if any change in capacity	Little if any change in human or civic capacity

[a]Findings reported in this table are drawn from coding of interviews and municipal documents between 2013 and 2016.

extensive damage across a greater number of sectors of the community engaged in capacity-building strategies to increase fiscal, technical, human, and civic capacities. However, Evans, which also experienced severe flood damage, was not as successful at building capacity across any of these dimensions. The flood damage in Lyons was much more widespread than Evans, affecting a greater percentage of the small community, which may be driving some of the difference in use of capacity-building strategies and shifts in resources that occurred after the flood.

Deliberative Processes and In-Depth Learning in the Aftermath of the Floods (Hypotheses 2 and 3)

Experiencing sudden shocks or extreme events may motivate reflection of past experiences and discussion of goals, objectives, and priorities; however, the depth of these reflections may depend on human and civic capacity to maintain these discussions. We examined deliberative processes by analyzing documents for evidence of: (i) formation of new community-level goals and objectives and (ii) reflection on past experiences. We measured these concepts by coding flood-related documents produced by each community for presence of discussions of new goals/objectives and presence of discussion of past experiences as measured by mentions of failures and lessons learned.

The analysis of documents suggests that Lyons, Evans, and Boulder had the most frequent discussion of goals for their flood recovery processes, as measured by counts of mentions of goals in the coded documents, while Greeley and Loveland demonstrated less frequent explicit discussion of community-level goals and objectives (Table 4). In Lyons, community members, government staff (local and external), and involved stakeholders in recovery working groups spent numerous meetings over an extended period of time developing goals and objectives for their specific recovery working group. Lyons's goals and objectives are sector-specific and encompass all sectors of the community. The Evans City Council developed a list of recovery goals when they established their flood task and appointed members to the group. Evans's objectives focus more specifically on the historic old town, but did not include strategies beyond communicating with businesses and residents to achieve these goals. As compared to Lyons and Evans, Boulder's recovery goals focus more directly on recovery of flood impacts and increasing flood resilience, a much narrower definition of the problem to be addressed than put forth by Lyons, which incorporated concerns regarding housing, recreation, youth and elder care, and transportation. Estes Park asserted an overall goal of flood-risk reduction in their downtown area while maintaining community and economic health and aesthetics of the river corridor, but were less specific about objectives or strategies in how to reach these goals. Loveland, in their master plan for physical development focused on increasing resilience to floods and natural disasters through "development patterns, hazard identification and mitigation, and communication."

Each document was coded for policy failures and lessons learned through the recovery process to measure reflections on past experience. A summary of the findings is listed in Table 4. The types of failures are categorized based on the content of

Table 4. Evidence of Discussion of Goals, Policy Failures, and Lessons Learned of Preflood Policies, Planning, and Infrastructure Across Seven Case Communities, Made Evident by 2013 Flood, and Total Stated Goals of Flood Recovery[a]

Community		Total (% of Total Docs)	Resource Needs	Risk Identification	Emergency Response	Physical Infrastructure	Comprehensive Planning	Community Needs
Boulder	Goals	268 (49.7%)						
	Policy failures	138 (25.6%)	18	56	5	31	19	11
	Lessons learned	192 (36.3%)	42	62		38	45	2
Longmont	Goals	148 (50.1%)						
	Policy failures	28 (9.7%)	10	8		1	3	6
	Lessons learned	73 (25.2%)	15	14	3	16	21	4
Lyons	Goals	363 (89.0%)						
	Policy failures	76 (18.6%)	13	3	5	9	16	30
	Lessons learned	87 (21.3%)	18	5	6	12	33	13
Estes Park	Goals	83 (52.2%)						
	Policy failures	32 (20.1%)	15	9		8		
	Lessons learned	29 (18.2%)	12	7		6	4	
Loveland	Goals	117 (45.3%)						
	Policy failures	31 (12.0%)	15	4		5	5	2
	Lessons learned	51 (19.8%)	6	7		22	15	
Evans	Goals	86 (64.2%)						
	Policy failures	18 (13.4%)	7	4	1	3	3	
	Lessons learned	22 (16.4%)	3	8		3	8	
Greeley	Goals	17 (44.7%)						
	Policy failures	7 (18.4%)	3		1	2	1	
	Lessons learned	7 (18.4%)	1	3		1	2	

[a]Findings reported in this table are drawn from coding of municipal documents between 2013 and 2016. Goals were not coded into subcategories as they often cut across multiple categories.

the prior policy that was deemed inadequate or flawed. In the classification of policy failures, the categories include recovery processes (e.g., grants management and reimbursement processes), immediate emergency response, risk identification, community member needs, and failures in planning processes. Based on the analysis of documents, flood-related documents produced by Boulder and Lyons contained the greatest number of mentions of failures from previous policies. Mentions of failures in risk identification predominated the policy failure mentions in Boulder, while failures in meeting community member needs were most frequent in Lyons.

Evidence from the analysis of capacity building (Table S5) and deliberative processes (Table S6) at least partially support hypothesis 2. In comparing Lyons (high levels of civic capacity-building strategies) with Evans (moderate level of human/civic capacity building), Lyons focused more intensely on goal formation and failure identification across a broad diversity of sectors, while new goals in Evans were less substantive and more instrumental in nature, in support of hypothesis 2. Analysis of the coded documents from Greeley and Loveland, neither of which employed significant human and civic capacity-building strategies, displayed lower levels of engagement in deliberative processes, as evidenced in the fewer mentions of discussion of goals or policy failures in the coded documents, further supporting hypothesis 2.

In the introduction, we described a continuum of learning types (Table 1) based on the depth of deliberation and content of what is learned. An analysis of the documents suggests that many of the communities demonstrated some level of instrumental and/or governmental learning during the flood recovery process (Table 5). Instrumental learning signifies learning about recovery processes, such as learning about financial and grant management processes and protocols to more efficiently recover from the flood. Governmental learning captures local government's reflection of and enduring alterations to their organizational structure and function for improved ability to attain the organization's goals. While temporarily shifting staff to fill recovery needs, as seen in many of the communities, is more representative of instrumental learning, changes such as adding new boards and commissions, such as in Lyons, signify more in-depth governmental learning.

Policy changes indicative of policy-oriented learning demonstrate a novel understanding of the cause and/or severity of a problem. Addressing floods through new approaches, such as incorporating flood risk-reduction strategies in master planning documents, such as in Lyons, is one example of demonstrated policy-oriented learning. Lyons also tackled issues such as public transportation needs and affordable housing. This consideration of low-income populations and their needs within a more resilient (specifically social resilience) community framework suggests that policy-oriented learning may have occurred in the expansion of understanding of the policy problem beyond direct recovery and flood-risk mitigation. Loveland, with its move toward more redundant and resilient infrastructure, also suggests a new understanding of future risks.

Social learning (Hall, 1993), the most in-depth type of learning in the continuum, mandates in-depth analysis and discussion of previous policies and policy failures, as well as goal redefinition. Based on this definition, Lyons exemplified the

Table 5. Evidence of Types of Learning Across the Seven Case Communities[a]

Community	Government/Organizational Learning	Instrumental Learning	Policy Learning	Social Learning
Boulder	• Recognized staff needs and added long-term capacity	• Budgeting/finance instruments • Prioritization of projects to optimize FEMA reimbursement • Communication with public about recovery	• Focused on risk reduction • Increased resilience of trails and open space	Moderate
Longmont	• Recognized staff needs and added capacity		• Sector-specific learning in park redesign for risk reduction	Moderate
Lyons	• Recognized staff needs, new organizational structure for recovery • New commission	• Development of grant management guidelines	• Recognition of lack of affordable housing/need for social services • Recognition of need for updated WWTF • Risk reduction, particularly in floodplain	High
Estes Park		• Recognized staff needs and added capacity	• Focused on increasing ecological resilience of river corridor	Moderate
Loveland		• Reorganized staff based on EOC structure	• Risk reduction in infrastructure	Minimal
Evans		• Adoption of new structure for recovery, but less robust and more top-down than Lyons	• Risk reduction in floodplain	Minimal
Greeley	• None	• None	• None	Minimal

[a]Findings reported in this table are drawn from coding of municipal documents between 2013 and 2016.

greatest extent of social learning, with in-depth deliberation of goals, objectives, and previous policies, supporting hypothesis 3. Findings support hypothesis 3, where communities that focused on human resource (Boulder) and civic capacity-building strategies (Lyons) demonstrated greater depth of learning, as illustrated by the extent of discussion of goals, policy failures, and lessons learned from the disaster (Table 4). Boulder did not engage the public at great depth compared to Lyons; however, it maintained relatively high levels of local government human resources and demonstrated a high level of learning, as illustrated by mentions of policy failures and lessons learned. Communities that demonstrated less robust use of human and civic capacity-building strategies (Greeley, Loveland) did not show the depth of learning as the other communities.

Policy Change in Response to the Flood (Hypothesis 4)

Beyond the capacity building for recovery that was discussed above, all of the case communities adopted or revised policies to a greater or lesser extent (Table 6). Based on hypothesis 4, we would expect communities demonstrating deeper learning to have changed a wider array of policies, programs, and projects and altered those policies at a greater depth (e.g., substantive changes vs. changes in instruments). An examination of Tables 4–6 suggests a positive relationship between depth of engagement in deliberative processes, depth of learning, and development of new and/or revised projects, programs, and policies, wherein communities that engaged in deeper learning also saw a greater number of policy changes across a wider array of sectors.

If hypothesis 4 holds, we would expect Lyons, a small community with in-depth and lengthy community engagement in deliberative processes and evidence of learning, to have adopted the more significant and more substantial changes in policies. The analysis of the documents suggests that Lyons developed and adopted the only flood recovery plan out of the seven communities. A large number and diversity of new projects and programs stemmed from this recovery plan (Table 6). Similar to Lyons in its limited fiscal resource capacity, Evans differed in civic capacity development (low), engagement in learning processes (moderate), and policy changes (limited). Evans's process for involving community members in goal formation falls short of the social learning process experienced in Lyons due to the breadth and nature of engagement with the public. When comparing Loveland and Longmont—both communities that experienced similar levels of damage and had similar post-flood capacity—Longmont engaged community members in deliberations over park redesign and demonstrated more in-depth learning, while Loveland had minimal public engagement and less evidence of in-depth learning, measured by mentions of policy failures and lessons learned. Longmont revised and adopted new policies across a number of sectors, while Loveland focused primarily on altering its physical infrastructure (e.g., water and power systems). The comparison of Lyons and Evans and Loveland and Longmont support hypothesis 4.

Table 6. Summary of New Flood-Related Policies Adopted and Changes in Policies Across Case Communities[a]

Community	Disaster Recovery Process	Mitigation of Risks and Hazards	Social, Economic, and Community Member Needs	Comprehensive Planning
Boulder	• Fee waivers • Flood information dissemination plan	• Revised floodplain maps • Infrastructure improvements • Remove structures in high hazards zones	• New grant/loan program for flooded businesses	• Master plan for creeks • Revisions to trail and park plans • Revised transportation, wastewater, and stormwater plans • Streamlining resilience to disasters in planning processes
Longmont	• Revise monitoring, warning, and information system	• Redesign of transportation infrastructure • Changes in building code ordinances • Buy out mobile home park damaged by flood	• Micro-lending program for flood-affected residents	• Revisions of park master, greenway, and river corridor plans • Water supply and drought management plan
Lyons	• Revisions to emergency warning systems, emergency master plan, municipal codes	• Annexation and buy-out of properties	• Developed policies to address transportation needs of special or high needs groups • Developed policies to address affordable housing	• New flood recovery plan • New master plan • Updated/new stormwater master plan • New creek restoration project
Estes Park	• Modification of temporary building requirements	• Redesign of roadways and highways • Revision of floodplain regulations		• New river corridor plan and redesign of trails • Property rezoning

(Continues)

Table 6. (Continued)

Community	Disaster Recovery Process	Mitigation of Risks and Hazards	Social, Economic, and Community Member Needs	Comprehensive Planning
Loveland	• Ordinance temporarily waiving building permit fees • Utility fee relief for flooded residents	• Redesign of park infrastructure • Expansion of WWTP, new pipes, increase redundancy • Building of solar facility to replace capacity of hydroelectric dam		
Evans	• Revisions to variance process for floodplain permits • Modifications to municipal code concerning flood damage	• Establishment of special flood hazard area		• Created long-term vision for sustainable old historic downtown area
Greeley	• Emergency operation plan approved	• Adopted FEMA's digital floodplain maps and new hazard mitigation plan • Property buyout		

[a]Findings reported in this table are drawn from coding of municipal documents between 2013 and 2016.

Resilience in the Aftermath of Disaster (Hypothesis 5)

Finally, community resilience was measured by presence of fiscal, physical, ecological, and social resilience, as well as depth of community member engagement, presence of deeper learning, and policy changes that address a broad range of risks. These measures are summarized in Table 7. We also analyzed interview data to understand how resilience is considered within the study communities. Four resilience-related themes emerged from the coded interview data: fiscal resilience, resilience of physical infrastructure systems, ecological resilience, and social resilience.

The focus of and depth in which community officials think about and operationalize resilience in their community's recovery process varied across communities (Table 7). Officials from Boulder, a high capacity community (along fiscal, technical, and human measures) discussed resilience across all four themes, while Greeley officials did not discuss any type of resilience. Almost all communities framed resilience in terms of physical infrastructure, including strengthening and making redundant existing water, storm water, and waste water systems, with Loveland (low civic capacity) discussing new physical systems for resilience, including replacing hydroelectricity with a more flood resilient solar facilities. Estes Park emphasized ecological resilience of river corridors more than physical or social resilience and more frequently than other communities.

As defined above, our conceptualization of community resilience also includes evidence of in-depth deliberative processes, learning, and policy changes. Evidence

Table 7. Summary of Resilience Measures Across Case Communities

Community	Capacity Building and Resources[a,b]	Policy Change[b]	Learning[b]	Resilience[c]
Boulder	High (F, H, T, C)	Broad and numerous	Governmental Instrumental Policy Moderate social	Financial Physical Ecological Social
Longmont	Medium (F, H, C)	Broad and numerous	Governmental Instrumental Policy Moderate social	Ecological Social
Lyons	High (F, H, T, C)	Broad and numerous	Governmental Instrumental Policy Social	Physical Ecological Social
Estes Park	Medium (F, T, C)	Moderate, broad changes within a specific corridor of town	Instrumental Policy Moderate social	Ecological
Loveland	Medium (F, T)	Narrow, focused on infrastructure	Instrumental Policy	Financial Physical Ecological
Evans	Limited (F, limited C)	Narrow, focused on downtown	Instrumental Policy	Financial Social
Greeley	Minimal	Minimal	Minimal	Minimal

[a]In column 2, F = fiscal capacity, H = human capacity, T = technical capacity, C = community capacity
[b]Findings reported in columns 2, 3, and 4 are a summary of findings from Tables 3–6.
[c]Findings in Column 5 (Resilience) are from analysis of transcripts from interviews with flood personnel.

from our case communities suggests that hypothesis 5 largely holds, as shown in Table 7. Lyons, and to a lesser extent Boulder, Longmont, and Estes Park, demonstrated the greatest extent of community resilience, based on the measures used here. Lyons, a severely damaged community that adopted strategies to increase all four types of capacity (fiscal, technical, human, and civic), demonstrated community resilience to the greatest extent of all communities. This small community engaged its community members in the recovery process substantively, demonstrated in-depth learning processes, and adopted policy changes across a number of sectors, including formalizing the changes in a broad community-wide recovery plan.

Boulder, a community that also adopted varied capacity building strategies, although less of a focus on civic capacity building, showed a great depth of postflood policy deliberation (measured by number of policy failures, lessons learned, and goals discussed) and interpreted postflood resilience broadly, providing additional evidence in support of hypothesis 5. It is important to note that Boulder did not engage with community members at the depth or breadth as Lyons. While Boulder mentioned policy failures in its documents most frequently, a large percentage of these were associated with specific flood-risk reductions, potentially suggesting a narrower or potentially more technical focus on recovery, compared to Lyons which mentioned failures in policies that address broad community needs (e.g., affordable housing and health). The comparison of Lyons with Boulder underscores a potential association between civic capacity development and the breadth of reflection across a broad range of risks, beyond narrow localized flood hazards. This association also appears to hold true in Loveland with minimal citizen engagement observed and a narrower focus on resilient infrastructure.

These community resilience findings point to a potentially important relationship between a community's adoption of capacity-building strategies and extent to which a community thinks about and frames resilience in the aftermath of an extreme flood event. Decisions a local government makes in the immediate postflood period regarding resources and capacity, including decisions about how to engage the public or whether to increase technical capacity or government staff, may influence the depth of deliberation about existing policies and the breadth of how risks and needs in the community are considered during the recovery process.

Discussion

Understanding the pathways that lead to or impede policy change at the local level may be critical in understanding what encourages long-term resilience to disasters. Analyzing the variables that promote learning and change toward community resilience will produce policy relevant knowledge that will contribute to understanding long-term local-level resilience to natural hazards. It will also further develop our knowledge of community-level disaster recovery and the processes that promote successful long-term recovery.

In this study, we analyzed whether types of capacity-building strategies that governments engage in during disaster recovery may interact with the depth of

deliberation conducted to predict the extent of learning observed in a community and the types of policy changes made after a disaster. We find that, indeed, communities that experienced greater extent of damages attempted to mobilize more and more diverse types of resources, as compared to less damaged communities. However, one community, Evans, did not follow this trend, as it was significantly damaged with flood recovery costs that were much greater than capacity but were not able to mobilize resources to the same extent of other affected communities. Further, we found that moderately damaged communities, such as Boulder and Estes Park, also mobilized moderate (Boulder) and moderate/high (Estes Park) levels of civic resources. This finding suggests that severity of damage (or similarly proximity to disaster) does not tell the whole resource mobilization story. We also found that greater resource mobilization (in terms of diversity of types of resources) is associated with more in-depth deliberative processes and consideration of substantive changes, failures, and longer-term planning. This result differs from Nohrstedt and Nyberg's findings (2015) that resources did not significantly influence local-level flood crisis policy change in Sweden, but rather found that new understanding of risks from experiencing floods and learning motivated policy change in municipalities. They also found that communities in the same county demonstrated similar patterns of flood crisis policy development and provided evidence of policy diffusion across nearby municipalities. Policy diffusion across communities is a potential driver of policy change that needs further investigation in future analysis of the Colorado floods, in particular, examining how county- and watershed-level factors may influence policy adoption and change after an extreme flood event.

We also measured whether type and depth of learning was connected to capacity-building strategies adopted by communities. The findings indicate that multiple types of learning occurred across communities, which can be tied to capacity-building strategies and resource availabilities. Aligning with the quantitative study of Brody et al. (2009), we found that significant postdisaster policy changes occurred, in part, depending on extent of flood damages, such as in Lyons, although extent of damages did not tell the full story (e.g., limited policy changes in Evans). Similar to the work of Godschalk et al. (2003), we found a diversity of public engagement processes across communities. More in-depth learning occurred in communities with deeper and broader community member engagement. Findings suggest that policy changes occurred to varying degrees across communities. Communities that engaged in greater depth of civic capacity building also saw greater breadth and depth of policy change. Finally, community resilience is a multifaceted concept as outlined in the literature. According to the definition that we presented above, communities emphasized different aspects of resilience, including one or more physical, ecological, financial, or social components.

Aligning with the work of Magis (2010), Smith (2012), and others, evidence from our study suggests that community members can be vital in deliberative recovery processes, processes that may be associated with greater depth and breadth of postdisaster policy change. In a few of the case communities, public engaged with sustained high levels of interests, somewhat different than what was found in the work of Burby (2003) and Godschalk et al. (2003), of disinterested publics in hazard mitigation.

Similar to the work of Berke and Campanella (2006), Smith (2012), and others, recovery planning with engaged publics was found to be critical in promoting resilience, as found in Lyons, although in Lyons, the recovery plan was developed in the wake of the disaster, not before. Much of the disaster recovery planning literature suggests that disaster recovery plans, to be most effective in increasing resilience and reducing vulnerabilities, should be developed before a disaster strikes (Berke & Beatley, 1992; Berke & Campanella, 2006; Berke et al., 2014; Smith, 2012), but none of our case communities had comprehensive recovery plans in place before the flood of 2013.

To better understand community resilience and its drivers in the face of disaster, we need to consider how resources, resource availability, and capacity-building strategies may lead to or inhibit enhancing community resilience. The study presented here contributes to our understanding of several aspects of local-level policy learning and disaster recovery processes which are currently poorly articulated or understood. In our cases, local-level policy processes in response to a disaster diverged from what has been commonly found at the national level. Central to this difference is the engagement of the public in postdisaster policymaking. At the federal level, hazard mitigation and disaster policymaking generally rests in the hands of experts with limited engaged publics. The analysis presented here adds to our understanding of policy learning and change at the local-level but it also suggests that policy theories and frameworks may need to adapt in order to adequately explain local processes since they are developed in the context of national-level policymaking in most cases.

Conclusion

While this study moved the scholarship forward in understanding the factors that lead to policy change and learning after a disaster, and whether those processes lead to higher levels of resilience, much more is still unknown or unclear with regard to these lingering policy process questions. Greater clarity is needed to understand the drivers of postdisaster policy learning happens commonly at the local level (rather than national level as studied by Birkland), the degree to which those changes move a community toward resilience in the face of future disasters, and the connections between significant variables that are most often presented disparately in the literature such as resources, deliberation, learning, change, and resilience. Additionally, many postdisaster studies examine a single case, offering less leverage to draw conclusions about causal mechanisms explaining policy change and community resilience. This study offers increased explanatory leverage by constructing a longitudinal comparative case research design wherein federal and state-level processes are constant, allowing us to focus on local governments and their role in responding to extreme events in multiple cases within a single disaster event. The findings of this study and others opens multiple doors for further study. Using additional longitudinal comparative cases in other disaster contexts could be applied to local learning processes in other geographic contexts that have also experienced flooding or in regions that have experienced other hazards such as wildfire, to more clearly test the relationships we posit between local-level policy learning,

and experiencing disaster, capacity building, policy change, and resilience. Further investigation is needed into understanding potential impediments of learning, as well as clarification of the links between learning and policy change.

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Notes

This research is funded through the Infrastructure, Management, and Extreme Events Program of the National Science Foundation, Award #1461923, 1461565.

1. Codebook can be found at the research website: http://www.learningfromdisasters.org.
2. The survey instrument can be found at the research website: http://www.learningfromdisasters.org.
3. All of these figures apply after insurance has been paid on covered properties or assets.
4. Community members in Greeley were not included in the public survey because of the minimal flood damage that occurred in their community.

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Supporting Information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Table S1. Survey response rates for both waves of community resident survey.

Table S2. Mean responses to a series of Likert-scale questions about adequacy of financial, human and technical resources needed for recovery in their community (standard deviations). Strongly agree = 5; strongly disagree = 1. The H denotes significantly higher mean than at least two other communities at 0.05 level. Significant differences were found across communities in perception of adequacy of financial resources ($p < 0.01$; Kruskal Wallis, post-hoc Bonferroni tests, Boulder and Greeley significantly greater than all other communities). Two-way ANOVA calculated with community and department, community was significant ($p < 0.01$), but department was not significant ($p = 0.62$). The L denotes significantly lower mean than at least two other communities.

Table S3. Mean responses to survey questions about perceptions of change in financial resources from FEMA, state and county sources after the flood.

Table S4. Flood Damage, Financial Capacity, and Financial Capacity-building Strategies.

Table S5. Civic capacity: role of public in flood recovery participatory processes.

Table S6. Civic engagement: Measures of transparency, openness, fairness and community participation in flood recovery process. Agreement with the statements below were measured on a five-point scale, Strongly disagree (1) to Strongly agree (5).[2] Of the 903 residents that responded to the survey, 802 answered the section on community engagement.

Table S7. Flood-related technical capacity demonstrated after the 2013 flood. The first column contains the number of documents of mentions of studies of total documents. Greeley is not included in the table due to its minimal discussion of studies.