RESILIENCE GRAMMAR

A VALUE SENSITIVE DESIGN METHOD FOR RESILIENCE THINKING

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Overview

The *resilience grammar* is a method for bringing a value sensitive design sensibility to resilience thinking. The method provides a systematic process for researchers, designers, and policymakers to identify and trace resilience pathways in the context of real world responses to stressors and obstacles. The grammar is composed of seven statement types, which bring forward aspects of resilience. Each statement type is composed of a *connecting phrase* and an element, in the form of "resilience connecting-phrase <element>." In this report, we define each statement type in the resilience grammar, provide two brief illustrations of the grammar in action, and conclude with six suggestions for use. Taken together, the resilience grammar enables the expression and integration of diverse stakeholders, values, value tensions, and worldview into an account of resilience thinking.

WHO Intended to be used by researchers, designers, and policymakers for analyzing and designing systems through resilience thinking

WHAT A value sensitive design method for tracing and analyzing system pathways related to resilience

WHEN For carrying out comparative policy analysis, qualitative data analysis, learning, and public education

WHERE Developed in agriculture but likely applicable to such fields as community-driven planning and innovation, energy, security, and transportation

HOW Foregrounds stakeholders and values as well as emphasizes the situatedness of human experience within resilience thinking

STATEMENT TYPES AND SHORT DEFINITIONS

Resilience For/Not For <stakeholder>
Refers to the stakeholders either directly or indirectly affected by the system under consideration, including non-human entities with moral standing.

Resilience To Ensure <value>
Refers to the core values, aspirations, and goals that stakeholders are trying to achieve with the system.

Resilience Of <thing>
Refers to the natural resources, ecologies, tools, technology, and infrastructure that underlie the system.

Resilience In the Event Of <stressor>
Refers to the primary perturbations and stressors that disrupt a system from its familiar functioning state into some other state.

Resilience In the Face Of <obstacle>
Refers to the secondary challenges and obstacles that slow or inhibit recovery of a perturbed or stressed system either to the prior (within a threshold) state or to a transformed new state.

Resilience With <asset>
Refers to pre-existing resources, capacities, and other assets that individuals, communities, institutions, and other societal entities can activate, draw upon, or utilize in their response to challenges and obstacles.

Resilience Through <strategy>
Refers to the strategies, interventions, and mechanisms that can be employed to overcome challenges and obstacles, with the aim of adapting or transforming the system to a new state, stable within thresholds.

INTRODUCTION

Resilience thinking considers systems in terms of time, expected and unexpected stressors, adaptive capacity, transformation from one stable state to another, and other aspects related to ongoing change. Adding to this framing, the resilience grammar foregrounds stakeholders and values. In practice, the resilience grammar enables researchers, designers, and policymakers to analyze systems in terms of resilience by tracing pathways in systems, such as social-ecological and socio-technical systems. A resilience pathway refers to a sequence of statements from the grammar that link stressors and obstacles to stakeholders, values, and things and, in turn, to response strategies and assets. The resilience grammar draws particular attention to the dependencies and interactions within and among these aspects.

The construct of resilience has a long and complicated history, beginning with definitions in the 1970s from within physics about material properties (Gordon 1978) and extending to social-ecological, socio-technical, and other systems (for a review, see Norris, Stevens, Pfefferbaum, Wyche, and Pfefferbaum 2008; and, Biggs, Schluter, and Schoon, 2015). We build on this literature, paying special attention to Folke, Carpenter, Walker, Scheffer, Chapin, and Rockström's (2010) ideas not only of return to state but also of adaptability and transformability.

According to Walker, Hoolling, Carpenter, and Kinzig (2004, p.4), resilience refers to "the capacity of a system to absorb disturbance and reorganize while undergoing change so as to still retain essentially the same function, structure, identity, and feedbacks" (cited in Folke et al. 2010, p. 20). Within this context, according to Folke et al. (2010, p. 20), adaptability is part of resilience; namely, "the capacity to adjust responses to changing external drivers and internal processes and thereby allow for development along the current trajectory" and transformability is "the capacity to cross thresholds into new development trajectories."

Operationalizing how much change can occur and still be within the bounds of adaptability (versus moving into transformability) remains an open and challenging question. Importantly, within this framing, resilience can be understood as a process-oriented characterization of system capacity, which emphasizes ongoing processes and practices (Norris et al. 2008).

We further observe that any model or description of a system foregrounds some aspects and hides others. As such, the boundaries of the system under investigation are of critical importance, as are the set of particular entities, sub-systems, communication flows, and so forth. In agriculture, for example, soil conditions might be operationalized by a quantity indicating the carrying capacity of an acre of land for a particular crop. Such an indicator foregrounds production while hiding both the complexity of the biome in which the crops are grown as well as consideration of the lives of farm workers and their families. Or for a digital example, free and open source software could be examined in terms of ability to be repurposed and reused. Such criteria would foreground the possibility for future use, flexibility, and extension, but would not reflect the stakeholder roles and social structures needed to maintain and advance systems, nor reflect the computation needed for such reuse, nor the necessary underlying physical computing machinery, energy and material resources.

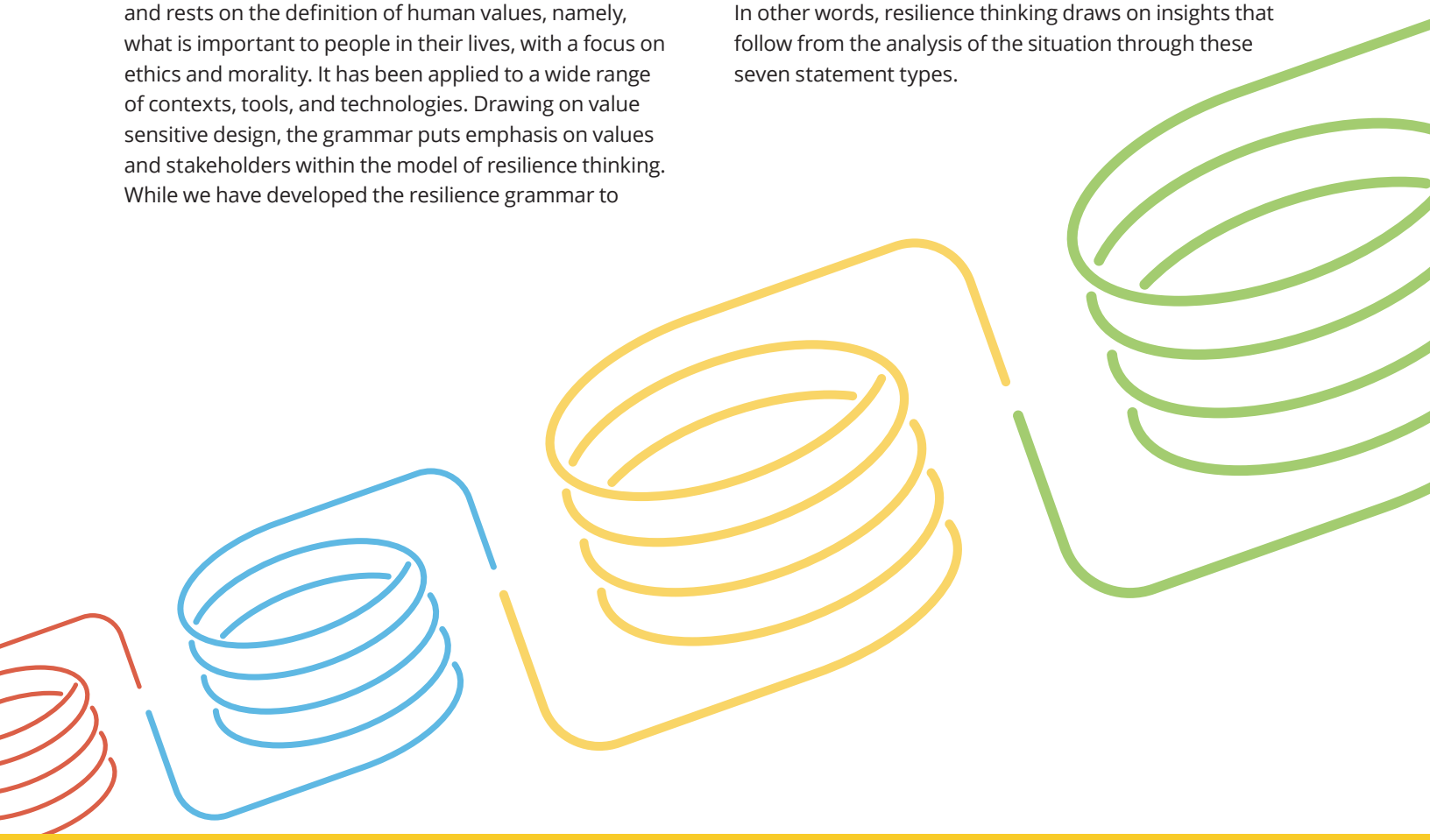
Within resilience thinking, the importance of place, along with stakeholder views and meanings, are clear. Following Berry (1987) and his commitments to a caring relationship with the natural world, there are three essential questions: "What is here? What will nature permit us to do here? And, what will nature help us to do here?" (p. 142). The first question orients us to both the natural, technical, and human resources of a place and its historical development. While the first question is descriptive (e.g., an audit of the

We present the resilience grammar, a value sensitive design method (Friedman and Hendry, 2019) to support "resilience thinking" (Folke et al. 2010).

available resources), the second and third questions are analytic, with the second asking for the identification of constraints and thresholds, and the third asking for the identification of affordances. These framing questions intentionally encompass ecological resources, weather and environmental conditions, physical infrastructure and buildings, and institutions that support collective action and governance, land ethics, and community values.

The resilience grammar is a method of value sensitive design, an approach that provides "theory, method, and practice to account for human values in a principled and systematic manner throughout the technical design process" (Friedman and Hendry, 2019, p. 4). Value sensitive design emphasizes the situatedness of human experience and rests on the definition of human values, namely, what is important to people in their lives, with a focus on ethics and morality. It has been applied to a wide range of contexts, tools, and technologies. Drawing on value sensitive design, the grammar puts emphasis on values and stakeholders within the model of resilience thinking. While we have developed the resilience grammar to further our work on food resilience (Ballard et al., 2022; Logler et al., under review), we believe the structure to be more general and applicable to many systems including energy, security, shelter, transportation, water, and others.

We use the word grammar to refer to a structured approach for clarifying aspects of resilience in a particular situation. The grammar comprises seven unique statement types, each in the form of "resilience connecting-phrase <element>." For example, resilience for whom? Or resilience to ensure what? Or resilience with what? A sequence of such statements can be used to explore or reason about a situation through the concept of resilience, thus constituting resilience thinking. In other words, resilience thinking draws on insights that follow from the analysis of the situation through these seven statement types.



RESILIENCE GRAMMAR

Resilience For/Not For <stakeholder>

Refers to the stakeholders either directly or indirectly affected by the system under consideration, including non-human entities with moral standing. Potential stakeholders include people; groups; communities; organizations; institutions; non-human animals; land; water; and other natural entities. Drawing from value sensitive design (Friedman and Hendry 2019), we identify both direct stakeholders (e.g., for a food system: farmer owners, farm laborers, fertilizer companies, investors) as well as indirect stakeholders (e.g., for a food system: people who cannot afford to buy the food produced, people who live alongside waterways that carry excessive fertilizer and manure waste).

Resilience To Ensure <value>

Refers to the core values, aspirations, and goals that stakeholders are trying to achieve with the system (e.g., to feed a community, to produce nourishing food, to create profit, to create employment). Drawing from value sensitive design (Friedman and Hendry 2019), values identify what stakeholders consider to be important. The core values, aspirations, and goals can be employed as criteria for examining the resilience of the system. Specifically, if the system incurs a perturbation or stressor and then returns to a state where the values, aspirations, and goals are met, at least within some threshold (Folke et al. 2010), this could be one way to assess resilience.

Resilience Of <thing>

Refers to the natural resources, ecologies, tools, technology, and infrastructure that underlie the system. Following Carpenter et al. (2001 in Folke et al. 2010), these include materials, tools, and physical infrastructure; natural resources such as land, water, and air; and human resources such as labor. It can also refer to single parts of a system (e.g., the tires of a tractor rather than the entire tractor). In such instances, if specific parts but not others are considered the whole system can be at risk, because a focus on specific parts might lead to considering both fewer stressors and fewer points of failure.

Resilience In the Event Of <stressor>

Refers to the primary perturbations and stressors that disrupt a system from its familiar functioning state into some other state. Primary perturbations and stressors may stem from natural events (e.g., when a volcano erupts and lava covers an agricultural field), human action (e.g., when a person accidentally or by intent sets an agricultural field on fire), or a combination (following Folke et al. 2010) known as social-ecological (e.g., when forest management strategies and climate change together lead to massive, uncontrollable wildfires).

We provide concise general definitions of each statement type in the grammar along with examples drawn largely from the domain of food and agriculture.

Resilience In the Face Of <obstacle>

Refers to the secondary challenges and obstacles that slow or inhibit recovery of a perturbed or stressed system either to the prior (within a threshold) state or to a transformed new state (Folke et al. 2010). These secondary challenges or obstacles may come from a wide range of social-ecological disruptions including but not limited to communication (e.g., unable to market to potential customers in changed environment), cooperation (e.g., unable to share farm equipment and food processing spaces), economics (e.g., unable to sell food products to restaurants), geophysical properties (e.g., flooding), information (e.g., unable to access agricultural stipends), labor (e.g., unable to obtain ad hoc temporary farm labor), natural resources (e.g., unable to get adequate water for crops), storage (e.g., unable to adequately store food that cannot be sold immediately), and transportation (e.g., unable to obtain packaging materials).

Resilience With <asset>

Refers to pre-existing resources, capacities, and other assets that individuals, communities, institutions, and other societal entities can activate, draw upon, or utilize in their response to challenges and obstacles (cf. community resilience and network adaptive capacities in Norris et al. 2008). These resources, capacities and other assets can take many forms including cultural (e.g., widely shared views to preserve character of a landscape), educational (e.g., knowledge about growing food), environmental (e.g., availability of clean water and healthy soil), financial (e.g., community-oriented individuals with personal wealth), institutional (e.g., non-profit organizations), personal (e.g., experience with responding to uncertainty) and so forth. In effect, these underlie and enable the available strategies, interventions, and mechanisms that might be undertaken.

Resilience Through <strategy>

Refers to the strategies, interventions, and mechanisms that can be employed to overcome challenges and obstacles, with the aim of adapting or transforming the system to a new state, stable within thresholds (Folke et al. 2010). These strategies, interventions, and mechanisms are expansive and may include intermingling of resources, knowledge, and opportunities (e.g., when one farmer needs seeds due to a supply chain disruption and another farmer with surplus can fill the gap); innovation (e.g., when new means for delivering food to the local community are invented to meet COVID-19 social distancing requirements); generosity (e.g., when those with surplus resources offer those resources to others for the wellbeing of all); personal creativity (e.g., individuals who their ideas and imagination on an on-going basis and can apply it to challenges and obstacles); policy (e.g., federal, state, county, and local policy that helps to mitigate challenges and obstacles); reframing of products and services (e.g., reconceptualizing the farmers market in terms of a CSA to overcome challenges and obstacles from COVID-19); redundancy (e.g., able to complete a harvest with human labor when mechanical harvesters breakdown; see Bruneau et al. 2003 in Norris et al. 2008, p.134); robustness (a dam that can withstand an earthquake; see Bruneau et al. 2003 in Norris et al. 2008, p.134); and timing (responding to a wildfire flare-up before it turns into an uncontrolled fire; cf. “rapidity” in Bruneau et al. 2003 in Norris et al. 2008, p. 134).

APPLICATION NOTES

In applying the grammar we note several practical considerations. In these notes, "researcher" refers to researchers, designers, or policymakers, working alone or in a project team.

1. *Valence of resilience.* In any given situation, the valence of stressors and other entities of the system can be positive or negative. For example, while resilience in a civic agricultural system might be seen as positive because it helps to sustains the planet and the people on it, resilience in a human trafficking system would be seen as negative because of the harms to those who are enslaved, their families, and society writ large. The resilience grammar, in and of itself, does not explicitly answer these questions of valence concerning the system, stressors, or other entities. That said, the resilience grammar positions the researcher to move forward through a value sensitive design process, to address benefits and harms, to legitimate stakeholders' views, and to address value tensions (Friedman and Hendry, 2019).

2. *Ordering and completeness.* The statement types can be applied in any order and not all of the statement types need be applied. A specific approach would depend on the goals of the researcher and the details of the situation.

3. *Meaning of specific elements.* With a statement type, "resilience *connecting-phrase* <element>," the grammar does not specify the contents of the element nor their meanings. Rather the meaning of specific elements is left to the researcher, who would take into account how different stakeholders might understand particular content. For example, the distinction between Resilience for/*not for* <stakeholder> and Resilience of <thing> depends, in part, on an element's moral standing as a person or non-person. To make such a determination and others like it, a researcher might appeal to different worldviews or ethical frameworks (e.g., an indigenous worldview, deontological or utilitarian framework, etc.).

4. *Resilience for/not for <stakeholder>*: *Who identifies stakeholders?* Resilience for/*not for* <stakeholder> does not specify who decides who will count as a direct or indirect stakeholder. When applying the resilience grammar, some set of actors will need to be identified to make these decisions. That actor or set of actors could be policymakers, community members, technologists, or others, potentially in combination. Extensive empirical work might be required.

5. *Resilience with <asset> or through <strategy>.* Oftentimes, in countering stressors and obstacles, strategies may be employed by individuals, communities, and governments that leverage existing assets or lead to the creation of new assets. For example, a "program that is paid for through financial donations" leverages a financial asset that is the result of a programmatic strategy which solicited donations. In a similar vein, "developing a planning document" employs the strategy of engaging in a planning process while also resulting in the asset of the planning document itself. Thus, at times, it can be difficult to separate an asset from the strategy that leveraged or resulted in that asset. When the emphasis is on the asset itself, consider this Resilience *with* <asset>; when it is on the strategy or process of leveraging or generating the asset then consider this Resilience *through* <strategy>.

RESILIENCE GRAMMAR IN ACTION

This resilience grammar guides a researcher to attend to particular aspects of the system under consideration and their interrelationships. Here we provide two brief examples followed by several suggestions for use.

Two Brief Examples

To illustrate use of the resilience grammar to identify and trace a resilience pathway among actors, events, and outcomes, we provide two examples from a research project on food resilience conducted in a rural community in Eastern Washington in the United States (Logler et al., under review). We applied the resilience grammar to analyze transcripts of semi-structured interviews that describe participant accounts of the impacts of the COVID-19 pandemic. The following examples come from two study participants:

EXAMPLE 1: SPRING LAMBS

In the spring of 2020, Valley food producers confronted a major stressor in **COVID-19** (*in the event of* <stressor>). **A lamb producer** (*for* <stakeholder>) reported that COVID-19 had no impact on the lambing season in April. However, while birthing lambs was not affected, the same could not be said for the sale of lamb meat. The lamb producer noted that **local restaurants** (*with* <asset>), the biggest customers, **closed overnight** (*in face of* <obstacle>) and **stopped purchasing wholesale cuts** (*in face of* <obstacle>), such as full racks of lamb. According to [the lamb producer], with meat packing plants in the news because of **labor shortages** (*in face of* <obstacle>) and **health concerns** (*in face of* <obstacle>), retail consumers sought out reliable local meat supplies. The **farmers market** (*with* <asset>) was a crucial **sales outlet** (*though* <strategy>). Also important was a **self-serve pick-up freezer** (*of* <thing>) **at a roadside stand** (*with* <asset>), which allowed customers to pick up purchased meat **without interacting with anyone** (*through* <strategy>). Because of **scheduling bottlenecks** (*in face of* <obstacle>) **at meat packing plants** (*with* <asset>), the lamb producer's supply of smaller consumer cuts was depleted by June.

EXAMPLE 2: THE FOOD BANK

For many **Valley families** (*for* <stakeholder>), the **food bank** (*with* <asset>) is a crucial resource. With the **loss of jobs** (*in the face of* <obstacle>) due to **COVID-19** (*in the event of* <stressor>), its use increased by about 50% in 2020. To address the increased need, the **valley conservancy** (*for* <stakeholder>) developed a new program called **"From Farms to Neighbors: Sharing the Bounty"** (*though* <strategy>) that purchases **produce** (a <thing>) from **local farmers** (*for* <stakeholder>) to be distributed for free through the **food bank** (*with* <asset>). This program is paid for through **financial donations** (*with* <asset>) from other **Valley residents** (*for* <stakeholder>). **Valley residents** (*for* <stakeholder>) have been incredibly generous with **financial donations** (*with* <asset>) and **plans are being developed** (*though* <strategy>) to maintain **interest in the program** (*with* <asset>) and **increase the number of participating farmers** (*with* <asset>).

SUGGESTIONS FOR USE

The grammar directs researchers, designers, or policymakers to conceptualize and apply the statement types (Resilience *connecting-phrase* <element>) in concrete terms within the theory and practice of value sensitive design. Because of this broad framing, the resilience grammar holds opportunities for many purposes and contexts.

1. Identification of temporal, process, and material dependencies in a resilience pathway. Through a series of statements, the grammar holds the potential to link the key entities of systems to reveal structures and dependencies across scale and time. For example, specific obstacles that are experienced by a community would be linked to more sweeping obstacles experienced by a region, and, in turn, linked to a stressor with planetary impact.

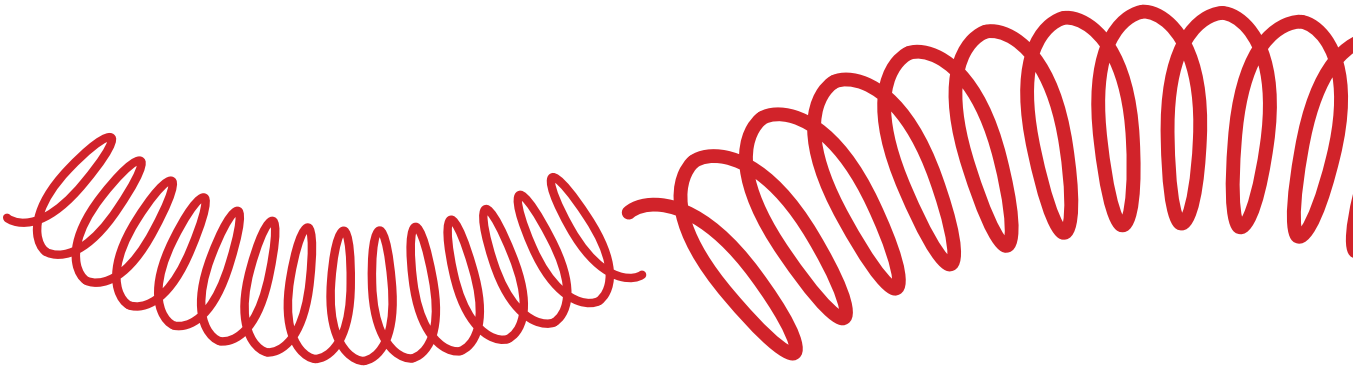
2. Development of participatory methods. The resilience grammar might be used to inform the design of specific methods that enable social innovation, cooperative design (co-design), and participation among diverse stakeholder groups. One such direction would be to represent the resilience grammar in a card-based form, similar to the Envisioning Cards (Friedman, Nathan, Kane, and Lin, 2011).

3. Analysis of qualitative data. The resilience grammar can be used to analyze qualitative data such as interview transcripts to identify and trace resilience pathways.

4. Retrospective analysis of interventions. Given an account of an intervention to improve the capacity of a system, for example published in the scientific literature, the resilience grammar might be used to identify, trace, and represent the structure and rationale of the intervention.

5. Comparative analysis of policy proposals. Given two or more policy proposals, the resilience grammar might be used to surface their potential impact on stakeholder groups. Such a comparative analysis might be used to surface value tensions among stakeholder groups, which, in turn, might be used to shape public dialogue for addressing contested viewpoints.

6. Learning and public education. Toward supporting public discourse, the resilience grammar might be used to structure forums and design charrettes to systematically bring attention to different values, tensions, dependencies, and gaps in thinking about resilience. In so doing, the resilience grammar would provide structured openings to give a broader range of people access to the challenges of understanding and designing for social-ecological adaptation.



FUTURE WORK

We point to three directions for future work, each of which explores generalizing the resilience grammar along a different dimension.

Application Domain. We developed the resilience grammar for the domain of agriculture (Logler er al., under review). Future work could explore its application to other domains, such as community-driven planning and innovation, energy, security, and transportation.

Public Engagement. We developed the resilience grammar to account for how stakeholders in an agricultural community consider resilience for systems. Future work could explore how the grammar might position community members to envision resilience of particular local places and community systems and to pursue social innovation and public dialogue.

Framing of Resilience. We developed the resilience grammar within a "resilience thinking" frame (Folke et al. 2010). Future work could explore other framings of resilience, change, adaptation, and transformation.

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