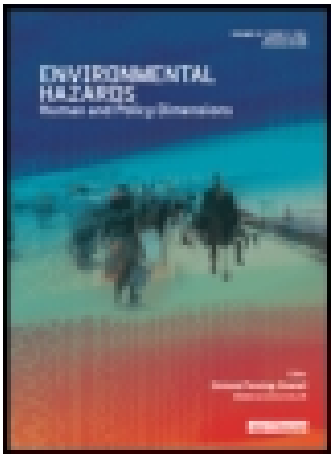

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Foundations of community disaster resilience: well-being, identity, services, and capitals

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Foundations of community disaster resilience: well-being, identity, services, and capitals

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If community disaster resilience is to mature into a robust and lasting area of research, methodologically facilitated dialogue between empirical observations and theory is necessary. However, methodological and empirical research has outpaced community disaster resilience theory. To address this gap, a theoretical framework called WISC is presented. WISC is named after four constructs of the framework: well-being, identity, services, and capitals. WISC relates the two concepts of community and infrastructure, broadly defined, to the four constructs it is named after. The 4 constructs are respectively defined by 29 variables. The broadest interpretation of WISC is that infrastructure supports and facilitates components of community within human settlements. Infrastructure is represented as combinations of capitals and services; community is represented by connections of identity and well-being. Ultimately, well-being of a community is dependent on that community's collective capital. But these two constructs are mediated by the intervening constructs of identity and services. WISC goes beyond existing frameworks by addressing essential elements of theory building that have been overlooked in the literature, while synthesizing other frameworks and areas of knowledge. WISC provides a powerful foundation for posing and evaluating hypotheses, improving data collection efforts, and, most importantly, enabling critical theory building.

Keywords: resilience; disasters; community; infrastructure; well-being; theory

1. Introduction

In 1986, Henry Quarantelli – pioneer of the social science of disasters and founder of the Disaster Research Center – stated during his presidential address to the International Research Committee on Disasters that the field of disaster research would only advance if scholars prioritize the construction of theoretical frameworks. Twenty years later, he published this sentiment while lamenting that theory building in disaster research had still barely begun (Quarantelli, 2005). Quarantelli stresses that the disaster research agenda for the twenty-first century 'need[s] more theory and abstract thinking and less mucking around in practical matters and concrete details. The heart of any scientific activity is basic knowledge and curiosity driven, and is not concerned with immediate outcomes or products' (2005, p. 329). Perry (2005) observes that there is a vast backlog of disaster research that requires integration in theoretically meaningful ways. 'Progress [in disaster research] will be measured when many [theoretical frameworks] exist – some complimentary some competing – and when researchers use them' (p. 324). Lindell (2013) cautions that

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the field of disaster research will move forward only when there is both inductive (building theory from data) and deductive (making projections about data based on theory) inquiry. Of course, both inductive and deductive research of disasters requires the existence of complimentary and competing theoretical frameworks.

Community disaster resilience is a relatively new focus of disaster researchers that is rapidly growing in popularity. Depending on the reference database searched, as many or more articles on the subject have been published in the past five years than all previous years. The popularity suggests that many disaster researchers believe that a deeper understanding of the resilience of communities to disasters will eventually benefit society. Considering the above imperatives for disaster research, construction of theoretical frameworks about community disaster resilience is needed if the subject is to be a robust and long-lasting subfield of disaster research that makes meaningful contributions to knowledge, as well as practice.

Unfortunately, to date there is little theoretical research on community resilience to disasters in the literature. The National Research Council report 'Disaster Resilience: A National Imperative' makes no mention of existing theory or the need for theoretical research in their recommendations to meet this national imperative (NRC, 2012). Instead, there is an urgency to develop indicators, metrics, and capacity-building interventions to help communities become more resilient (Gilbert, 2011; Jordan & Javernick-Will, 2012; Manyena, 2006). Clearly, methodological research and, to a lesser extent, empirical research have outpaced theory-building efforts (Brown & Westaway, 2011; Jordan & Javernick-Will, 2012; Kulig, Edge, Townshend, Lightfoot, & Reimer, 2013). Few published works about community disaster resilience explicitly discuss or develop theory (Liao, 2012; Norris, Stevens, Pfefferbaum, Wyche, & Pfefferbaum, 2008; Wilson, 2012). There does not appear to be any deductive research studies of the subject, where theoretically based hypotheses are empirically analyzed. Very few peer-reviewed studies even suggest the need for posing and evaluating hypotheses (Norris et al., 2008). This is true for closely related research areas that could be drawn upon (mitigation and recovery, in particular), which are also under-theorized and in need of detailed, testable theoretical frameworks that link knowledge about the social, economic, political, and built environments (Chang & Rose, 2012; Tierney, 1989). This situation is not necessarily surprising given that disaster 'researchers have often been more concerned with solving problems that are important for governmental institutions and practitioners than with advancing theory' (Tierney, 2007, p. 516).

The research literature does include many alternative definitions and conceptual models of community resilience to disasters. However, these do not constitute mature theoretical contributions. There are meta-studies that review the various definitions and frameworks, but few attempt to comprehensively and meaningfully synthesize relevant components into a theoretically grounded proposal. Most, such as NRC (2012), conclude with the selection a single alternative or propose a new one. More critically, Kulig et al. (2013) review five popular conceptual models of community disaster resilience and conclude 'that several of them are incongruent, needing conceptual clarification and empirical testing or a determination of their usefulness for assessment, and are not suitable for theoretical development of the concept' (p. 772). Indeed, this might be because researchers feel that resilience is not worthy of theoretical development (Anderies, Walker, & Kinzig, 2006; Wilson, 2012). Norris et al. (2008), who developed a highly cited conceptual framework, suggest that resilience is just a metaphor – not a theory – whose utility is measured by its tendency to inspire effective interventions and policies.

It is not true that community disaster resilience is unworthy of theory building and by implication, based on Quarantelli's and others' standards, that it is not an area for scientific disaster research. It is quite the opposite: in line with Alexander (2013), resilience is one of the most promising threads in the literature for understanding the relationships between static and dynamic components of communities and their evolution between pre- and post-event contexts. Within disaster

research, definitions 'delineate an area of study and in so doing set the stage for knowledge accumulation and theory construction' (Perry, 2007, p. 3). Given the vigorous discussion of definitions and conceptual models, it is appropriate and constructive to begin the difficult work of theory building as part of a collective research agenda on community disaster resilience. Antecedently, there must be a shift in attitudes of researchers that community disaster resilience can be elevated and evolved toward theory.

It is critical to not get distracted by debates regarding the origins and applicability of discipline-specific definitions of resilience (Cutter, Ash, & Emrich, 2014). Instead, it is better to present and debate definitions that explicitly delineate community disaster resilience from discipline-specific or unrelated conceptions of resilience. More important is to build and integrate knowledge that is specific to the needs of describing human settlements and their many communities after hazard events (Cutter et al., 2014). Collective and concerted construction of complimentary and competing theories will unlock the possibility of conducting both inductive and deductive research on the resilience of communities to disasters, allowing researchers to have dialogues between data and theory. While the practical benefits may not be immediate, this dialogue will eventually lead to significantly more impactful means of monitoring, simulating, and promoting the resilience of communities.

Furthering the state-of-the-art of community disaster resilience scholarship and practice requires synthesizing a coherence of knowledge for the sole purpose of better understanding the subject. This theoretical study attempts to affirm, challenge, extend, and interweave disaster resilience-focused literature, while cohering this knowledge with relevant non-resilience literature. This is opposed to the more common attempts to unify or debate disciplinary perspectives of resilience that were not originally developed for the study of community disaster resilience. For instance, definitions or frameworks of engineering resilience for understanding the response of buildings to hazards are not enough to facilitate investigating the question of whether a built environment engineered to be completely resilient to hazards is best for promoting social, cultural, or economic identity and well-being. Alternatively, psychosocial resilience frameworks do not include constructs for understanding the impact on people's sense of pride or attachment to place associated with rebuilding a 'new' or 'better' built environment.

This study also attempts to ground relevant components of existing community resilience frameworks with essential elements of theory. Whetten (1989) states that there are four essential elements needed to make a theoretical contribution to knowledge: (1) the elements (concepts, constructs, and variables) that must be considered to explain the theory, (2) how and why these elements relate, (3) the assumptions underlying the theory, and (4) the limitations for generalizing hypotheses generated from the theory. Based on Rowlands (2005), these four elements are adopted and addressed. The goal of this is to add precision to community disaster resilience and avoid it being a catch-all disaster metaphor that is symbolic of everything and thus nothing.

The theoretical framework presented here is called WISC. WISC is named after the four constructs of the framework – well-being, identity, services, and capitals. WISC represents foundational (static) components of resilience to disasters for describing the state of communities at a given point in time. The dynamic components for understanding changes of communities across space and time are beyond the scope of this paper. WISC provides additional utility to existing frameworks by unpacking and synthesizing their respective components and theoretically linking these components with knowledge from outside of the disaster literature. WISC adds to the few frameworks that integrate well-being as a significant component of disaster resilience. WISC is one of the few comprehensive frameworks that include community identity as a core component. Finally, it is the only instance in the community disaster resilience literature where infrastructure is defined explicitly as the connection between the services and capitals accessible to communities.

2. Community disaster resilience frameworks

A brief review of existing frameworks is useful in identifying the purposes of these frameworks and how components of resilience can be organized. This helps to distinguish the purpose of WISC (theory-building and researching hypotheses), as well as its current scope. Additionally, the review is useful in illustrating some elements that are missing in the literature that are needed to make robust theoretical contributions. The selection and critique of frameworks below are not done to suggest that the frameworks are somehow wrong or not useful. Many of the frameworks could very well form the basis of theory and have informed the development of WISC. The purpose of the discussion is to help situate the endeavor of constructing theoretical frameworks and, specifically, WISC with more familiar frameworks.

A number of frameworks have emerged to help qualitatively describe disaster resilience (Berkes, 2007; Cutter et al., 2008; Norris et al., 2008; Paton & Johnston, 2001). Norris et al. (2008) is one of the most influential and cited of these frameworks (Kulig et al., 2013). Norris et al. (2008) argue that resilience requires four fundamental capacities for adapting to hazards and other disturbances: economic development, social capital, information/communication, and community competence. Their framework explicitly and implicitly integrates constructs or variables from other frameworks, such as the four capacities of Berkes (2007): ability to deal with change and uncertainty, presence of diversity, capacity to synthesize disparate knowledge and information, and opportunities for self-organization. It similarly integrates the components from Paton and Johnston (2001): sense of community, coping style, self-efficacy, and social support.

Kulig et al. (2013) argue that the framework of Norris et al. (2008) falls short of a theoretical contribution because the boundaries and limitations of components in the framework are 'unclear' and 'conflated' (p. 763). These elements are essential for evolving concept to theory (Grover, Lyytinen, & Srinivasan, 2008; Rowlands, 2005; Whetten, 1989). Without these elements, Kulig et al. (2013) argue that there is no way to pose and evaluate hypotheses using Norris et al. (2008). As noted above, the intention of Norris et al. (2008) was not to develop theory to foster hypothesis-driven research but to elucidate a means for promoting practical interventions and policies. A reading of the above-cited qualitative frameworks suggests that an overt statement of assumptions, theoretical boundaries, and limits to generalizability are collectively missing. These qualitative frameworks are presented more as metaphor or a 'collection of ideas about how to interpret complex systems' (Anderies et al., 2006).

In addition to qualitative frameworks, there are a growing number of quantitative frameworks for calculating indices of community resilience (Cutter, Burton, & Emrich, 2010; Joerin & Shaw, 2011; Sherrieb, Norris, & Galea, 2010; Verrucci, Rossetto, Twigg, & Adams, 2012). These frameworks often include a conceptual model that graphically depicts what indicators are used to compute the respective index and in some cases how the indicators are combined. These conceptual models are typically a means to present input data requirements, rather than to represent theoretical knowledge or facilitate the posing of hypotheses (Kulig et al., 2013). However, just as in the case of the qualitative frameworks in the literature, these conceptual models can be viewed as proposals for theoretical consideration.

Kulig et al. (2013) take the example of the quantitative framework by Sherrieb et al. (2010) for computing a community resilience index. This framework employs an approach similar to the other quantitative frameworks cited above. Kulig et al. (2013) disagree with the claim of Sherrieb et al. (2010) that their framework is theoretically grounded because assumptions and limits are not stated. This results in a 'wish list' of indicators that cannot be used to pose and research hypotheses (Kulig et al., 2013, p. 763). Another critique by Kulig et al. (2013) of the Sherrieb et al. (2010) framework and similar ones is that indicators of resilience and variables for understanding

resilience are often conflated, resulting in tautological untestable relationships. Kulig et al. (2013) conclude their review to say that

> [i]n most cases [framework] indicators are more properly conceived as antecedents or consequences of resilience and should therefore be posited as independent from resilience, so that we can conduct the empirical investigations to determine the most important conditions for its enhancement. (p. 772)

Or as Norris et al. (2008) put it, 'there is no variable called "relativity" in the Theory of Relativity' (p. 146). Community resilience cannot be a variable in a theoretical framework if the framework is used to guide scientific research because resilience is the subject under study.

Alexander (2013) argues that the concept of resilience holds most promise in enabling researchers to bridge the static and dynamic components of disasters across pre- and post-event contexts. Thus, a useful way of organizing components of community disaster resilience is to develop separate static and dynamic conceptual models (NRC, 2012; Rose, 2007). The value of having explicit and distinct static and dynamic models of theoretical knowledge is cited within several disciplines, including sociology, ecology, economics, urban planning, and information science (Abbink, Braber, & Cohen, 1995; Batty, 2009; Blaha & Premerlani, 1991; Carroll, Phillips, Schumaker, & Smith, 2003; Perry-Smith & Shalley, 2003). For example, Walker and Salt (2006) presents a popular framework where ecological resilience is represented as a static landscape upon which a ball might dynamically move, depending on attributes of the metaphorical landscape and a given disturbance event.

A static model of community disaster resilience must identify and organize critical variables and relationships between those variables that are sufficient for describing conditions of a community before and after a disaster. A static model presents the ontology of community disaster resilience. It provides the vocabulary to explain the state of a community at any point in time or space relative to some event. NRC (2012) states that 'effective community resilience is similar to a healthy human body' (p. 17). Adopting this metaphor, one can view a static model as a skeleton that shows what components are meaningful and how those components fit together. Conversely, a dynamic model represents how and why the variables of a static model change across time and space. It helps explain the happenings of community resilience and provides the vocabulary to describe the evolution of states. A dynamic model can be thought of the muscles and metabolic system that propel the metaphorical skeleton.

While it is important to make the distinction between static and dynamic representations of resilience, researchers often do not explicitly do so or acknowledge the need (Irajifar, Alizadeh, & Sipe, 2013; Kulig et al., 2013). Kulig et al. (2013) observe that authors of one popular framework misclassified their own framework as dynamic, when only static components are included. (The distinction is often clear depending on whether time (dynamics) is considered.) Promisingly, there are a growing number of research studies that propose and link static and dynamic conceptual models, though not all make the distinction explicit (Bruneau et al., 2003; Cutter et al., 2008; Miles & Chang, 2006, 2011; Simonovic & Peck, 2013; Wilson, 2014; Zhou, Wang, Wan, & Jia, 2010).

The present paper only describes static components for understanding community resilience to disasters. This is not because dynamic components are unnecessary, but because of the length needed to describe the static components of WISC. In the future, WISC can be evolved to incorporate dynamic components, as advocated elsewhere (Miles, 2014a, 2014b).

3. The WISC framework and conceptual model

Before introducing WISC and its conceptual model, it is useful to note that concepts, constructs, and variables are hierarchical abstractions of increasing specificity (Whetten, 1989). Concepts,

constructs, and variables are the components that define the 'what' in a theoretical framework. These components are the necessary first step in any theory-building process (Whetten, 1989). The conceptual model of a theoretical framework is simply a graphical depiction of the components to help illustrate how these components relate (Corley & Gioia, 2011).

The parsimony of WISC comes from the small number of explicitly defined constructs that frame wide-ranging knowledge and insights about the subject of community resilience to disasters. The small number of familiar constructs is intended to inspire and facilitate creation of hypotheses specific to the subject. WISC includes a large number of variables because in the early stage of any theory-building process – the current stage for community resilience theory building – it is key to err on the side of too many components (Whetten, 1989). Additionally, a variety of variables ensure internal validity when operationalizing a framework because of the availability of multiple proxies for representing the framework constructs. After a brief introduction below, the components of WISC are discussed in the following two sections. In the remainder of this section the assumptions, theoretical boundaries, and limits to generalizability of WISC are discussed.

Figure 1 presents the conceptual model of WISC; it summarizes and relates two concepts (community and infrastructure), 4 constructs (well-being, identity, services, and capitals), and 29 variables with respect to a theoretical boundary (human settlement). The broadest interpretation of Figure 1 is that components of infrastructure support and facilitate components of community (UN-HABITAT, 1987). Communities 'sit atop' infrastructure. Ultimately, well-being of a community (top of Figure 1) is dependent on its capital (bottom of Figure 1) (Costanza, 2000). While community well-being is dependent on capitals, these constructs are mediated by the two intervening constructs of identity and services. In the context of resilience, 'disasters are forcing us to recognize the interrelatedness of … different capitals and their valuable contributions to sustainable … well-being' (Costanza & Farley, 2007, p. 252).

The theoretical spatial and conceptual boundary of WISC is a particular human settlement. A human settlement contains multiple communities and types of infrastructure. The United Nations defines human settlements as 'the spatial dimension as well as the physical expression of economic and social activity … no matter how small or physically or economically isolated' (UN-HABITAT, 1987, p. 3). For WISC, a human settlement is not necessarily synonymous with any particular jurisdiction; instead human settlements have overlapping and fragmented

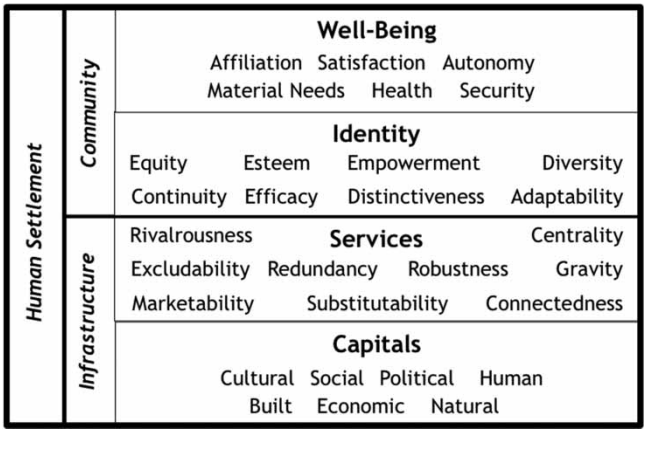

Figure 1. Conceptual model of static community resilience for the theoretical framework WISC, showing relationships between the concepts of community and infrastructure, constructs of well-being, identity, services, capitals, and 29 collective variables for the 4 constructs.

governance structures, both formal and informal (Amin, 2007). The theoretical representations of WISC apply to communities within a human settlement, but not to the human settlement itself (or beyond). WISC is for studying *community* resilience to disasters, not human settlement resilience to disasters. Within WISC, human settlements are assumed to be infinitely resilient and so do not collapse due to any hazard event. Empirically, this is true much more often than not (Page, 2005; Vale & Campanella, 2005). WISC instead focuses on communities with the assumption that their resilience is variable and heterogeneous. Practically, these assumptions only mean that care and precision have to be put into explicitly defining the boundary of a human settlement under study, as well as the criteria for identifying the communities of interest within it.

Human settlements can be conceived as a community of communities (Hempel, 1999; Keller, 1988; Pavlich, 2001). A community is defined for WISC as any social group that refer to themselves as 'members' or 'us' (Dalby & Mackenzie, 1997; Haslam, Jetten, Postmes, & Haslam, 2009; Lewis & Kelman, 2010). Communities are more than a 'list of the socio-demographic groups that can be used to classify individuals (e.g. gender, age, ethnicity, and religion)' (Haslam et al., 2009, p. 6). Communities might manifest as 'family and friends, work and sports teams, community and religious groups, regional and national entities' (p. 6). There has been debate whether community should be physically defined or socially defined (Hidalgo & Hernandez, 2001; Puddifoot, 1995; Scannell & Gifford, 2010). Puddifoot (1995) asserts that community is constructed by both physical place and social relationships (via common interests, values, culture, etc.). This assertion is adopted for WISC to maximize applicability of the framework. Members of the same community can reside in multiple different human settlements and jurisdictions; they can also be members of multiple other communities (Sonn & Fisher, 1999).

Defining the theoretical temporal boundary of WISC requires adoption of definitions for disaster and vulnerability – concepts that facilitate linkages to components of time and dynamism. These definitions for WISC are drawn from social vulnerability theory (Wisner, Blaikie, Cannon, & Davis, 2003) because of the central role of time and access to resources (infrastructure). Vulnerability manifests in the present as specific unsafe conditions but is socially constructed over time by more distant forces (spatially and temporally), such as national policies, historical decisions, cultural norms, or institutionalized power dynamics. These forces influence what resources people or groups can access or the capacity they have to manage them. A hazard event at a given point in time may breach community vulnerabilities and result in a disaster. Livelihoods and community functioning are disrupted beyond a community's capacity to cope using its own resources (United Nations, 2004).

To be consistent with the adopted definitions for vulnerability and disaster, the temporal boundary for WISC is one just large enough to represent the social construction of the vulnerability of the communities under investigation, as well as to represent meaningful changes to some WISC variables caused by a single hazard event. This is likely to be on the order of years to decades. For example, in appropriate applications of WISC, orogenisis would be assumed fixed and climate change impacts should be decomposed into separate, sequential hazard events. The temporal boundary is defined to avoid a normative statement about when a community has recovered. The goal of WISC is to help understand components of community resilience to disasters; it is not necessarily intended to predict the potential for recovery, which would require an operationalizable definition of recovery.

WISC is applicable only to communities that can experience or have experienced disaster. If there is no (potential for) disaster there will be a positive conclusion (complete resilience) from a negative premise (no disaster), which is a logical fallacy. There will always be hazard events that communities have the capacity to deal with. However, communities can never be resilient to all hazard events. If a community enters a new state that is invulnerable to a previously harmful hazard event, WISC is no longer useful for studying the community for that particular

vulnerability–hazard combination. This means that hypotheses based on WISC can be empirically evaluated only using communities where a hazard event has changed the state of some WISC variables (i.e. impacted those communities). In comparing two or more communities, all communities must have been impacted to make meaningful cross-case conclusions. This constraint may seem unnecessary but it distinguishes vulnerability and resilience, which are often confused or erroneously seen as opposites (Cutter et al., 2014; Kennedy, Ashmore, Babister, & Kelman, 2008; Lewis & Kelman, 2010; Zhou et al., 2010). In WISC vulnerability and resilience are treated as potentially independent. This allows for the possibility that high vulnerability does not lead to negative assessments of a community's resilience. The constraint ensures that vulnerability is a premise in arguments or hypotheses about community resilience to disasters. If vulnerability is treated as the opposite of resilience, it is part of the conclusion of any hypothesis about resilience. This makes the relationship between vulnerability and resilience untestable.

4. Infrastructure: the relationship between capitals and services

For WISC, infrastructure refers to any combination of a given service and the capital used to derive that service. Services are the link between capitals and their benefits to communities (Ash et al., 2010; Costanza, 2000; Costanza & Farley, 2007; Robeyns, 2005). The definition of infrastructure as any combination of capitals and services goes beyond the typical understanding of infrastructure as physical lifelines, such as roads, utilities, and other horizontal elements of the built environment. Infrastructure can be inanimate or animate, material or non-material. An example is entrepreneurial social infrastructure, defined as collective action derived from social capital (Flora & Flora, 1993).

People and communities view capitals and services as inextricably linked and typically as a 'black box' (Graham & Marvin, 2001; Monstadt, 2009). Services give capitals meaning because capitals are primarily experienced via the services derived from them. For example, employees need transportation infrastructure in order to go to work. Employees might have a negative experience when the service of mobility is disrupted, regardless of the specific capitals the service depends on, such as a freeway or bike path. A service can be derived from a single capital but more often depends on multiple capitals, as well as other intermediate services.

In the post-disaster context, temporary capital can provide the same service as damaged 'permanent' capital. This is illustrated by the provision of water before and after the 2011 Great East Japan earthquake (Kuwata & Ohnishi, 2012). Prior to the earthquake, the capital that provided residents of Miyagi Prefecture drinking water was a modern water network. Drinking water service was disrupted because of damage from the earthquake. However, the service was partially restored using the alternative capital of water trucks until repairs could be made to the pipes and pumps of the water network. Of course, the temporary infrastructure may have negatively impacted communities because of issues such as delivery times, access to smaller volumes of water, or the inability for water trucks to reach remote locations.

The incorporation of capital and infrastructure is common within the community resilience literature, as described below. In general, the distinction of infrastructure as capitals and services is uncommon in the disaster literature (Davis, 2013; Kameda, 2000). Specific to community resilience, it appears that no other framework explicitly links capitals and services as infrastructure.

4.1. *Capitals*

Originally an economic construct, capital refers to a stock of assets used to create or obtain additional assets or derive services. The construct has been broadened to the idea of community capital, which refers to any asset, whether corporeal, material, or non-material, that is utilized as

part of the metabolic flows supporting human settlements (Costanza, 2000; Emery & Flora, 2006; Putnam, 2001). There is no accepted set of community capital variables. There is also little justification in the literature for preferring one set of capitals to another. In some cases, the choice depends on the context and scale of application. For example, Costanza (2000) uses four constructs – built, natural, human, and social – to define economic systems. Inclusion of economic capital as a variable in that framework would be circular. In the case of a framework for community resilience to disasters the inclusion of economic capital is not circular. As another example, the triple bottom line framework (social, natural, and economic capital) was developed specifically to raise understanding of the social and environmental impacts of economic growth (Elkington, 1998), so purposely does not include other capitals.

The capitals construct is widespread, either explicitly or implicitly, within the community resilience literature (Gilbert, 2011). While the construct is popular, there is no agreement on what specific variables are minimally sufficient. This seems to be the case for non-disaster community capital frameworks, as well. Aldrich (2012) links just social capital to community resilience. Norris et al. (2008) incorporate social and economic capital. Bruneau et al. (2003) propose technical, organizational, social, and economic variables of capital. The framework of Berkes (2007) is an example where the term resources is used instead of capital; access to political, social, and ecological resources are core components of the framework. Paton and Johnston (2001) focuses on just social and personal resources, but argues that these influence people's ability to access physical and economic resources. Cutter et al. (2014) propose the capitals of social, economic, housing and infrastructure, institutional, community, and environmental. Gilbert (2011) includes human, built, economic, government, social, and natural capital. The similar framework of Cimellaro and Arcidiacomo (2013) has two variables of capital in place of social capital: 'lifestyle and community competence' and socio-cultural capital. The prominence of the community capitals concept in the disaster research literature has notably influenced practice. For example, the Canterbury Earthquake Recovery Authority has adopted a recovery strategy that explicitly considers economic, social, cultural, natural, and built capital (CERA, 2012).

For the WISC framework, seven variables of community capital are adopted*: social, political, cultural, human, economic, built, and natural*. This list is taken from Emery and Flora (2006). The choice should be treated as an assumption that is intended to capture the wide range of propositions in the literature. Perhaps not all variables of capital will influence all other components of WISC; perhaps some variables, as defined, will have no influence on other components. The validity of this list is subject to future deductive research. Certainly there will be some relationships between the variables of capitals. For example, it is known that built capital mediates a community's access to natural capital (Costanza, 2000; Gunderson, 2010; Monstadt, 2009).

4.2. *Services*

Services are typically defined in economic terms as measurable flows, such as perishable goods, that are provided and consumed by communities. Suggesting that this definition is too narrow, Costanza (2008) defines services as the benefits that communities derive from capital, where the 'end or goal [of services] is sustainable human well-being' (p. 351). Unlike the economic definition, which assumes that people explicitly perceive and exchange services, Constanza's (2008) definition recognizes that many services, such as carbon sequestration, go largely unnoticed and provide benefits without market-based exchange.

The definition adopted for the WISC framework recognizes that different services require different variables of capital (Costanza, 2000; Olewiler, 2006). Services have variables; the specific values of these variables make each variable unique and potentially beneficial or detrimental (Davis, 2013). The services construct consists of nine variables (see Figure 1 for the

list). All of the services variables are relevant to all six of the capitals variables. A particular value or instance of a variable not only characterizes the particular service, but also the capitals that it is connected to. In this way, some variables that might typically be associated with a type of capital are associated with services. The values of the variables are all a matter of degree and should not be considered binary or necessarily mutually exclusive. For example, a service can be partially rivalrous, not absolutely rivalrous or non-rivalrous.

Rivalrous means that consumption by community members results in capital depletion and thus less opportunity for consumption by others; non-rivalrous means the opposite (Fisher, Turner, & Morling, 2009; Frischmann, 2005). *Excludable* means that consumption of a service can be limited by physical and financial means, as well as explicit or institutionalized access qualifications – for example, through institutionalized racism (Fisher et al., 2009; Frischmann, 2005; Green, Bates, & Smyth, 2007). Non-excludable means that access cannot be realistically limited, such as access to oxygen to breath. *Marketability* refers to the degree to which a particular infrastructure service is managed by private markets, or, conversely, whether it is managed as a public commons (Frischmann, 2005). Together, the variables of rivalrousness, excludability, and marketability define the relative opportunity for community members to access and consume particular infrastructure services (Costanza, 2008).

Redundancy identifies whether some element of infrastructure can be omitted without significant overall loss of meaning or function. This contrasts with the definition of Bruneau et al. (2003), which conflates the potential for substitution (i.e. *substitutability*) with that of omission. For example, *redundancy* describes a case in which a high voltage transformer goes offline, but power customers still receive electricity via one or more additional transmission lines serving the area. In an example of substitutability, the redundant transmission lines do not exist, but the customer has or can obtain a generator (substitute) to meet her service needs.

Robustness means the strength or ability to resist degradation or loss, as defined in Bruneau et al. (2003). It also refers to the brittleness of a service and its underlying capitals and whether failure will occur suddenly or gradually (Barrett, Eubank, Kumar, & Marathe, 2004; Kahan, Allen, & George, 2009). Contrasting examples are the gradual decline of storm buffering as mangroves die off versus the lights suddenly going out if an electrical transformer explodes on a distribution pole.

Centrality refers to the degree to which infrastructure is centralized. For example, the political infrastructure that exists between the informal political coalitions of the precarious settlement residents in Guatemala City is less centralized than that of the formal government of the Guatemala Metropolitan Region (Miles, Green, & Svekla, 2011). *Gravity* refers to the level of importance of the infrastructure with respect to different communities at various scales (Kahan et al., 2009). For instance, crop-yield decline resulting from climate change may impact migrant workers in one way, local economic development in another way, and national economic development in yet another way. Finally, the *connectedness* variable represents the relative degree of an infrastructure's network effect. A network effect is when the benefit to one user of an infrastructure network increases if additional users join the network (Frischmann, 2005). Social media infrastructure, such as Facebook and Twitter, is an example of high connectedness. In the case of electric infrastructure, on the other hand, the addition of new customers to a grid does not significantly benefit existing customers; there is little network effect and so connectedness is low.

5. Community: the relationship between well-being and identity

Above, the theoretical boundary of community was given as a social group with members who distinguish themselves as 'us' because of both geographical location and social relationships. This boundary makes a distinction between human settlements, jurisdictions, and communities.

More importantly, it helps to develop criteria for identifying communities to study and compare. However, it is not specifically intended to help construct arguments or hypotheses about community resilience.

Instead, within WISC the community concept comprises the constructs well-being and identity. This is because the challenges of community are reflected in identity and well-being (Sonn, 2002). Having a primary community 'reinforces … identities and … provide[s] structures and social support systems that are crucial to … well-being' (Sonn & Fisher, 1999, p. 715). Not identifying with a community can have negative effects on well-being and, in turn, resilience (Jetten, Haslam, Haslam, & Alexander, 2012; Sonn & Fisher, 1998). Haslam et al. (2009) summarize the connection of community, identity, and well-being, introducing some variables of WISC in the process: '[Community identities] make us feel distinctive and special, efficacious and successful. They enhance our self-esteem and sense of worth. These effects can buffer well-being when it is threatened, and can also help people cope … ' (p. 3). As an alternative to the two constructs of WISC, McMillan and Chavis (1986) set out four constructs for understanding the concept of community: membership, influence, shared emotional connection, and integration and fulfillment of needs. Within WISC, the first two constructs of McMillan and Chavis (1986) are considered components of identity, while the latter two are part of well-being.

5.1. *Well-being*

In most of the literature the goal of community resilience is a functioning system, agent, or community. The goal of resilience, however, should go beyond safety or functioning and ultimately ensure the well-being of communities and their members (Adler, 2006; Costanza & Farley, 2007). Norris et al. (2008) observe that the construct of well-being sets a higher bar than is typical in the literature and is an appropriate and necessary standard for community resilience. An increasing number of studies in the disaster literature have focused on the construct of well-being as central to community resilience (Brown & Westaway, 2011; Colliard & Baggio, 2007; Kellezi, Reicher, & Cassidy, 2009; Kirmayer, Sehdev, Whitley, Dandeneau, & Isaac, 2009; Norris et al., 2008; Nyamwanza & Nyamwanza, 2012). WISC builds upon these studies and incorporates insights from outside disaster research.

Costanza et al. (1997) argue that well-being must be conceived using both non-market-based and market-based variables. Norris et al. (2008) define well-being 'as high and non-disparate levels of mental and behavioral health, role functioning [at home, school, and/or work], and quality of life' (p. 133). In relating ecosystem services to well-being, Ash et al. (2010) propose five variables of well-being achievements: material needs, security safety and predictability, mental/physical health, social relations, affiliation, role functioning, mutual respect, ability to help, freedom of choice, autonomy, and control. Nussbaum (2003) sets out 10 variables of well-being capacities intended to help evaluate and design policies for social change. The variables of Nussbaum (2003) that are not redundant of Ash et al. (2010) can be related to achievements of pleasure and satisfaction (i.e. capability for imagination, emotions, reason, play, and interaction with other species).

Synthesizing and simplifying insights from Ash et al. (2010), Norris et al. (2008), and Nussbaum (2003), WISC incorporates six variables of well-being: *material needs, security, health, affiliation, autonomy*, and *satisfaction*. As Robeyns (2005) and Gasper (2004) observe, it is important to distinguish well-being as either capabilities (Nussbaum, 2003) or achievements (Ash et al., 2010). Two people given equal capabilities may freely choose different achievements that meet their culturally rooted idea of a good life (Nyamwanza & Nyamwanza, 2012). There is a meaningful difference between someone who has the capability (access) to eat healthily and does so versus someone with similar capability that 'freely' chooses not to. In employing WISC, one

must choose to treat the six constructs as either 'opportunities for' or 'achievements of'. This decision is dependent on the particular study objectives. For consistency with social vulnerability theory (Wisner et al., 2003), which focuses on access to resources, it is more important to focus on capabilities (Nussbaum, 2003; Robeyns, 2005). Alternatively, an achievement perspective makes quantitative measurement easier (Gasper, 2004).

5.2. *Identity*

Variables of the construct community identity have been empirically linked to variables of well-being (Adger, Barnett, Chapin, & Ellemor, 2011; David & Bar-Tal, 2009; Haslam et al., 2009; Kellezi et al., 2009; Zottarelli, 2008). Puddifoot (1995) observes that community identity is the link between services and quality of life. A strong case has been made within the disaster and community resilience literature for inclusion of the construct of identity or, more precisely, particular variables of identity (Berkes, 2007; Cutter et al., 2008; Kulig et al., 2013; Norris et al., 2008; Paton, Millar, & Johnston, 2001). Adger et al. (2011) define disaster risk as the risk of harmful changes to community identity and, in turn, well-being. Community identity provides a strong connection to social vulnerability theory because it 'constitutes a foundation for a variety of social effects, from humans' ability to feel, act, and think as members of a social group to intergroup behaviors, such as discrimination, confrontation, and cooperation'. (David & Bar-Tal, 2009) Consideration of identity is important for applications of community disaster resilience because it has been shown to play a large role in place-based improvements and planning (Manzo & Perkins, 2006). Tobin (1999) argues that it is doubtful that successful community resilience planning 'can be accomplished without due consideration of the contextual issues of place' (p. 23).

The WISC construct of community identity is built up from the work of Breakwell (1992) and Twigger-Ross and Uzzell (1996). These studies empirically show that community identity is influenced by four variables: *efficacy, esteem, distinctiveness*, *continuity, and empowerment*. To these, the WISC framework adds *equity*, *empowerment*, *diversity*, and *adaptability* (Berkes & Ross, 2012).

The variables of *esteem* and *efficacy* are included in the framework of Norris et al. (2008). Efficacy and esteem have been functionally related to indicators of competence, community attachment, sense of place, social support, and coping (Adger et al., 2011; Haslam et al., 2009; Kellezi et al., 2009), which are commonly included within resilience frameworks. Holding in high esteem the community a person most identifies with has been shown to improve availability of social support and reduce the importance of individual coping strategies after disasters (Kennedy et al., 2008). This was observed after Hurricane Katrina within the Vietnamese community of east New Orleans who maintained their collective sense of worth after the hurricane (Campanella, 2006). As a result, community members formed new neighborhood groups to rebuild and decontaminate homes, as well as provide tetanus shots and acupuncture to fellow community members.

An important role of community identity is promoting a feeling and understanding of *distinctiveness* (Haslam et al., 2009). The variable of distinctiveness is strongly linked to people's sense of place and attachment (Twigger-Ross & Uzzell, 1996). Hazards and vulnerability play a role in the construction of a community's identity (Dalby & Mackenzie, 1997). For example, residents of San Francisco likely feel distinctive from residents of Miami in part because of their identification with earthquakes and not hurricanes. The meaning of the impacts of a hazard event for a particular community is tied to what makes that community feel distinctive from other communities (Kellezi et al., 2009). A rural community may place greater meaning on the loss of a few small businesses. Whereas some communities in the Seattle area may be more distressed by impacts to Boeing, Starbucks, or Microsoft, if they do not feel that small businesses make their community unique.

Closely related to distinctiveness is *diversity*, which is a central variable of the framework of Berkes (2007). Diversity refers to the relative variety of infrastructure constructs (not just built infrastructure) within or connected to a human settlement (e.g. through trade) (Berkes, 2007; Norris et al., 2008). Gunderson (2010) notes that numerical diversity is less important than functional diversity. Further, the diversity of infrastructure that communities have access to is more important than the overall diversity of infrastructure access across an entire human settlement (Wisner et al., 2003). This is because diversity of access promotes the livelihoods that communities identify with and are identified by (Berkes & Ross, 2012).

Community identity requires maintenance of some acceptable level of *continuity* in the face of threats to infrastructure or access to it (Gillson, 2009; Pendall, Foster, & Cowell, 2007). If continuity of identity is disrupted – for example, because of an extreme event (Adger et al., 2011; Kellezi et al., 2009) – or if membership significantly changes – for example, because of disaster migration (David & Bar-Tal, 2009; Haslam et al., 2009) – there tends to be negative consequences for the ability to cope, public health, and well-being (Iyer & Jetten, 2011). *Adaptability*, which is incorporated into many definitions of resilience (Manyena, 2006), is also included in the WISC framework. Community adaptive capacity to deal with hazard events relies on cultural infrastructure, feedback loops of experimentation and learning, and the synthesis of knowledge from different sources, collective experiences, and value systems (Berkes & Ross, 2012; Gunderson, 2010). Adaptability is considered here to be largely synonymous with absorptive capacity, flexibility, and creativity. If given too much priority or considered in isolation, however, adaptability can have a negative impact on communities (Lewis & Kelman, 2010). This is because a community might effectively absorb a hazard event, while retaining its pre-event vulnerability.

Understanding of identity requires consideration of the variable *equity* (Norris et al., 2008). Here equity is applied to communities and not necessarily individuals. Communities that have poor access to infrastructure have high potential to suffer inequitable impacts from hazard events (Cutter, 2003; Wisner et al., 2003). This differential vulnerability produces heterogeneous patterns of recovery with respect to different demographics (Miles & Chang, 2011; Tierney, 2006). Population recovery after the 1906 San Francisco earthquake provides a useful example. By 1910, population in most neighborhoods returned to pre-event levels. However, multiple neighborhoods, such as Outer Mission and Chinatown, inequitably experienced significant increases in unemployment (Davies, 2011). In contrast to equity, the variable of *empowerment* relates identity to whether agents or communities can access the infrastructure they need or want (Adger et al., 2011; Kellezi et al., 2009). Empowerment also relates to whether they can improve their ability to avoid loss and achieve recovery, which can positively influence esteem before and after a disaster (Muldoon, Schmid, & Downes, 2009). The acceptance and ultimate success of post-disaster decisions and outcomes requires that affected communities are empowered to participate in the reconstruction and recovery of their collective identity (Berkes & Ross, 2012; Kamani-Fard, 2012).

6. Conclusion

This paper proposes a foundation for enabling future theoretical research toward maturing community disaster resilience knowledge and creating greater balance with the methodological and empirical work conducted to date. The constructs of WISC are offered as minimally sufficient to characterize community resilience. Using WISC, existing studies can be extended, deepened, and rooted in more formal knowledge particular to community disaster resilience. WISC is developed under the supposition that a theoretical framework built specifically for understanding community resilience to disasters will alleviate the need for debating disciplinary specific definitions of resilience and avoid community disaster resilience becoming a catch-all. This will quicken the

pace of establishing knowledge about the subject through methodologically facilitated dialogues between data and theory.

WISC enables researchers and practitioners to generalize community resilience across past disasters, forecast it for future disasters, and decide what data are important to collect (and how), given limited opportunities and resources for data collection. The framework benefits efforts to develop and evaluate associated computational models, geovisualization interfaces, and decision support systems by theoretically justifying what elements and relationships are represented.

The constructs of well-being, identity, services, and capitals provide a simple but powerful foundation for making arguments and testing hypotheses to investigate community disaster resilience. A pressing set of arguments that can be studied with WISC is whether recovery should be defined as 'back to normal' or 'to a new normal' and whether recovery should be rapid or deliberate (Olshansky, Johnson, Horne, & Nee, 2008). WISC can help to reveal nuance in these dichotomous arguments, potentially allowing for all assertions to be true based on selected components of community resilience and their hypothesized relationships. For example, assuming a community's well-being is desirable, members of the community may not welcome changes to capitals, services, and identity that result in a new normal of reduced well-being. It is likely that most community members will want their electricity service back as fast as possible to power their lights as normal. Some may welcome the chance to replace the capital of a damaged nuclear power plant with solar power generation, while the value systems of others may color this change as undesirable. A community that identifies strongly with their natural capital may choose to strengthen their identity in the event that built capital is damaged by liquefaction. Such a community may be eager to abandon that built capital in favor of services provided by additional parkland. Another community may not feel their parks make them distinctive and so not view a similar future as better.

Many other arguments for inquiry are possible. WISC can frame research to understand how much damage or loss can occur to different community capital before a community's identity changes enough to negatively impact their well-being. In what instances can critical services be maintained after an event using temporary strategies and alternative capitals to ensure continuity of positive well-being? It is useful to question how relevant financial loss due to direct damage of built capital is to constructs of community well-being, identity, and resilience. How far beyond life safety does the vulnerability of distinctive built capital have to be reduced in order to protect a community's identity? Resources may be more efficiently used to maintain services associated with built capital that is not strongly tied to a community's identity, rather than the undistinguished built capital itself.

WISC is intended to shift attitudes about the value of community disaster resilience as theory and stimulate research that strongly incorporates theory. The WISC constructs are universally relevant and justifiably related. However, the variables of WISC are necessarily provisional and so only loosely related at this point. The components and relationships of WISC need to be debated, evaluated, strengthened, and revised. Future research studies can be designed to propose and investigate hypotheses between WISC variables to gain insights into which are relevant, which can be discarded without losing explanatory or predictive power, and which should be added. In parallel, WISC should be extended in order to represent dynamic aspects of community resilience (Miles, 2014a, 2014b).

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