



Research

Incorporating multilevel values into the social-ecological systems framework

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ABSTRACT. The social-ecological systems framework has guided investigations of complex interactions among ecosystems, society, and economies. In recent years, academics and practitioners have taken steps to strengthen this framework by calling for more systematic engagement with the cognitive and affective bases of human behavior. We suggest research that engages with multilevel values (i.e., individual, cultural, assigned) will be better positioned to understand how and why people cooperate in natural resource comanagement situations, and in turn, develop more effective strategies for mitigating and adapting to a changing world. We review three conceptualizations of the value concept operating within environmental governance regimes to offer a deeper understanding of how multilevel values fit within the social-ecological systems framework. Drawing on a conceptual model of these relationships, we share results from three example studies that demonstrate how values and governance can be more explicitly integrated in future research. We aim to stimulate a dialogue about the mutual benefits that can emerge from a fuller characterization of the relationship between values and environmental governance to manage for complexities of social-ecological systems.

Key Words: *comanagement; governance; social-ecological system; social learning; values*

INTRODUCTION

Elinor Ostrom's (2007, 2009) social-ecological systems framework (SESF) has advanced theoretical knowledge of the factors that enhance the sustainability of self-organizing natural resource governance institutions and their influence on human decision-making. This framework has enabled researchers to consider the interdependencies of ecological systems (resource systems and units) and social systems (governance systems and actors), with a particular focus on interactions and outcomes of collective action situations (McGinnis and Ostrom 2014). In this vein, scholars have underlined the importance of comanagement and place-based research that engages communities involved in collective action whereby governing authorities and local stakeholders share power, knowledge, and responsibility for decisions (Berkes 2009). This, in turn, warrants consideration of human values because they inform behavioral patterns (Schwartz and Bardi 2001) and play a fundamental role in determining the likelihood of collective action needed for collaborative governance (Olsson et al. 2004, Jones et al. 2016). However, the value concept has remained largely absent from the social-ecological systems discourse. We contend that more systematic engagement with social psychological theories and scales that measure and compare values over time will aid in the design and implementation of SESF research. In particular, knowledge of human values will provide insight into colearning and coexperimenting that occur at different scales and account for shifts in stakeholder perspectives (Galappaththi and Berkes 2015).

We argue that explicit recognition of heterogeneous, multilevel values grounded in cognition and effect will offer a more complete understanding of the decisions and trade-offs made by individuals in a collective. That is, variation in different types of values influences transaction costs and benefits (Poteete et al. 2010, Thiel

et al. 2015). The more diverse the values of stakeholders engaged in collective action, the greater the investment in communication required to negotiate and minimize intergroup conflicts (McCann 2013, Enengel et al. 2014). A second assertion we make is that greater focus on individuals relative to collectives will provide an opportunity for measuring processes that operate at multiple scales (e.g., individual personalities, cultural cognition) and shape human behavior (Newell et al. 2014, Manfredi et al. 2014, Jones et al. 2016, Raymond and Kenter 2016). Research focused on the psychology of behavior change is underrepresented in the SESF literature, despite its contributions to knowledge of the drivers of decisions that influence how human and nonhuman activities create new dynamics and form complex, adaptive networks over time (Berkes et al. 2003, Liu et al. 2007, Collins et al. 2011, Muhar et al. 2018). Finally, the bidirectional relationships between both individual and group values on the one hand and collective action on the other hand must be considered in future SESF research because single and double-loop feedbacks facilitate social learning in collectives that stimulate value shifts over time. Although rare due to the prevalence of causal modeling and assumptions about linear decision-making (Oskamp and Schultz 2005), there is a strong need to look beyond the static, list layout of the SESF (Poteete et al. 2010) and engage with more dynamic, temporal social-ecological relationships (Miller 2014). This approach would be in keeping with Ostrom's (2005) intention to establish a processual framework and better understand the dynamic coevolutionary trajectories of resource management institutions.

In the sections that follow, we discuss the SESF, multiple levels of values, and value dynamics at play within evolving collective action situations. Next, we present a conceptual model that illustrates how the value-governance relationship changes over three temporal phases. This model was developed during three

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interdisciplinary workshops held at Lungau-Nockberge Biosphere Park (Austria), the Center for Environmental Systems Research at Kassel University (Germany), and the University of Natural Resources and Life Sciences (Austria). Drawing on several prominent theoretical frameworks and the research programs of our working group members, in the next section we review three example studies that demonstrate how tenets of the conceptual model can be operationalized in practice. Building on insights from these studies, we then identify multiple management options and research implications that emerge during the three temporal phases of the conceptual model. We build on a growing body of research that suggests that conservation initiatives related to collective action will be more likely to succeed if distinctions among values concepts are recognized in social-ecological systems research and practice (Schwartz and Bardi 2001, Chan et al. 2012, 2016, Manfredi et al. 2014, Kenter et al. 2015). That is, greater recognition of how values interact alongside comanagement and learning will yield more nuanced and directed approaches for governing complex social-ecological systems over time.

LITERATURE REVIEW

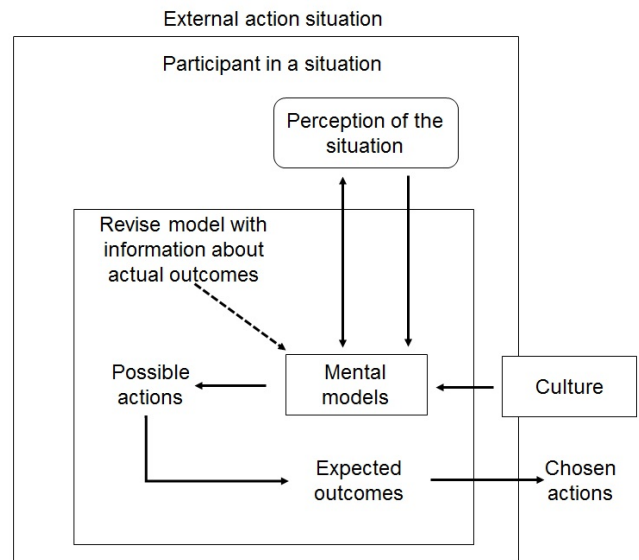
Collective action in the social-ecological systems framework

Interactions and outcomes from collective action situations lie at the heart of the SESF (Ostrom 2007, 2009). This framework assumes that stakeholders act rationally (Ostrom et al. 1994, Ostrom 1998) and that self-organizing groups can sustain social and ecological systems if the perceived net benefits in a collective action situation outweigh the costs associated with establishing and maintaining relationships, transitioning from one institutional arrangement to another, enforcing policies, and transforming inputs into desired outputs (Challen 2000, Basurto and Ostrom 2009, Ostrom 2009). Within the SESF, the categories of a governance system, resource unit, resource system, and actors specify the diversity of variables that influence corresponding costs and benefits that are considered by actors engaging in collective action (McGinnis 2011). Previous research has indicated that these situations can support the sustainability of social-ecological systems for actors such as the state, market, and civil society (Bridge and Perreault 2009).

Concepts such as mental models, belief systems, and values were recognized by Ostrom (2005) as playing important roles in explaining the behavior of stakeholders engaged in collective action (Fig. 1). In particular, Ostrom's conceptualization of mental models organized the complex facets of human perception that were directly influenced by culture through pathways such as shared models originating from previous generations. Although mental models apply to individuals, Ostrom asserted that they were more akin to a metatheory that broadly conceptualizes perception rather than explains theoretical relationships among constructs that enable researchers to test hypotheses. A stronger understanding of the drivers of individual behavior within the SESF are therefore needed because mental models and belief systems developed within groups become residual explanations for social cohesion (Thiel et al. 2015) and indicate that social norms are established from intergroup communication (Walker et al. 2006). Given the diversity of actors often engaged in collective action, heterogeneous values—represented in the SESF as mental models—can lead to

cumbersome negotiations that heighten the transaction costs necessary for agreement (Varughese and Ostrom 2001, Bardhan 2002).

Fig. 1. The role of mental models for individuals engaged in a collective action situation. Adapted from Ostrom (2005).



Multiple levels of the value concept

Values operate on multiple levels of social organization, and influence both individual and group behavior. Building on past research that has distinguished among multilevel values (Klein and Kozlowski 2000, Manfredi et al. 2014, Kenter et al. 2015), we identified three categories that are relevant to the collective action situation in Ostrom's SESF: Cultural, Individual, and Assigned. First, Cultural values are guiding worldviews—or “ways of life”—that define a society (Inglehart et al. 1998, Milton 2013). They encompass the dominant normative, attitudinal, and behavioral patterns that exist within and between collectives (Stigler et al. 1990, Chai et al. 2009, Kitayama and Cohen 2010), and have been used to explain social constructions of risk (Dake 1991), responses to environmental policies (Price et al. 2014), cultural differences in environmental attitudes (Steg and Sievers 2000), and behavioral intentions (Yazdanpanah et al. 2014). Secondly, Individual values are fundamental, guiding principles in life that reflect the most basic elements of cognition (Allport et al. 1960, Rokeach 1973). They tap the universal needs of people as biological agents, social interaction requirements, and human welfare on a global scale (Schwartz 2012), and thus define moral codes of conduct that shape behavior (Stern et al. 1999, Dietz et al. 2005, Howell 2013). Research on Individual values has provided insight into human–wildlife interactions (Vaske and Donnelly 1999), park and protected area management (van Riper and Kyle 2014), and origins of predispositions toward nature (Kellert 1996). Finally, Assigned values are the social aggregations of beliefs (Brown 1984), which are not nested within Individual and Cultural values; rather, they are emergent preferences for landscape qualities such as aesthetics and perceived biodiversity (van Riper et al. 2017). Assigned values research encompasses

ranking and trade-off analysis (Martín-López et al. 2012), spatial assessments of social-ecological systems (Sherrouse et al. 2011), and reflexivity achieved through the research process (Palomo et al. 2014, Ramirez-Gomez et al. 2015).

Research that recognizes multiple levels of the value concept offers a more nuanced and theoretically grounded perspective on human–environment interactions. This approach lies in contrast to Ostrom’s (2005) treatment of values and related categories in the SESF, which was limited to the concept of mental models and economic values. Although similar, mental models are broad frameworks that explain human perception, and economic values most closely align with what we explained were Assigned values. Moreover, our multilevel differentiation goes beyond the SESF’s approach because it accommodates normative aspects of Assigned and Individual values (Irvine et al. 2016), provides access to a body of literature that specifies scales of measurement and corresponding methods (van Riper and Kyle 2014), and introduces a group-level dynamic represented by Cultural values that is otherwise absent (Manfredo et al. 2016). Moreover, scholarship that considers three levels of values provides a basis to conceptualize dynamics between collective action and changes in human preferences, particularly surrounding Assigned values that are deliberated and negotiated within stakeholder groups (Kenter et al. 2015). Specifically, we assert that Cultural, Individual, and Assigned values are the foundation of inner views and expressed preferences that influence how natural resources are governed over time (Hoff-Elimari et al. 2014).

Interactions among multiple levels of values and collective action

The interactions among multiple levels (i.e., Cultural, Individual, and Assigned) of values are important to consider, particularly for research guided by the SESF. We assert that Cultural values lead to Individual values through the process of socialization (Baland and Platteau 2000). That is, cultural standards and norms exist at a mesolevel that forms through emergent properties from individuals. Individual values transfer to Cultural values through internalization that occurs over extended periods (Marks 1997, Haski-Leventhal and Bargal 2008). In other words, cognition and effect emerge in a social structure and are referenced to guide interpretation of interpersonal dynamics. Also highlighted in this model is the transition from Individual and Cultural values to Assigned values. Through the process of deduction, Assigned values are expressed by individuals and groups (Brown 1984). These place-based values stem from underlying psychological orientations, genetic predispositions, and evaluations of social stimuli that indicate congruence with dominant cultural patterns (Manfredo et al. 2014).

The relationship between values and collective action can be approached as a social learning process and thus become an outcome variable (i.e., “social performance measure”) of the SESF (Ostrom 2009). Individuals implicitly exchange values in collective action situations, which forces them to reflect on their reference frames and guiding assumptions (Pahl-Wostl 2009). This exchange was described by Kenter et al. (2016) as a deliberative process that yields changes in systemic understandings of others’ values as well as enhanced individual capacity to recognize one’s own dormant tendencies. Indeed, different types of action situations are associated with social

learning, as evidenced by the Management and Transition Framework (Pahl-Wostl 2009) that is closely related to the SESF. Whereas some action situations support single-loop learning (i.e., an incremental improvement of prevailing action strategies without questioning the underlying assumptions), others foster double-loop learning (i.e., revisiting of assumptions about cause-effect relationships) or even triple-loop learning and reconsidering underlying values and beliefs (Argyris and Schön 1978, Pahl-Wostl et al. 2010). Such gradual learning involves a complex interplay between increased understanding of ecosystems and changing societal values (Biggs et al. 2010).

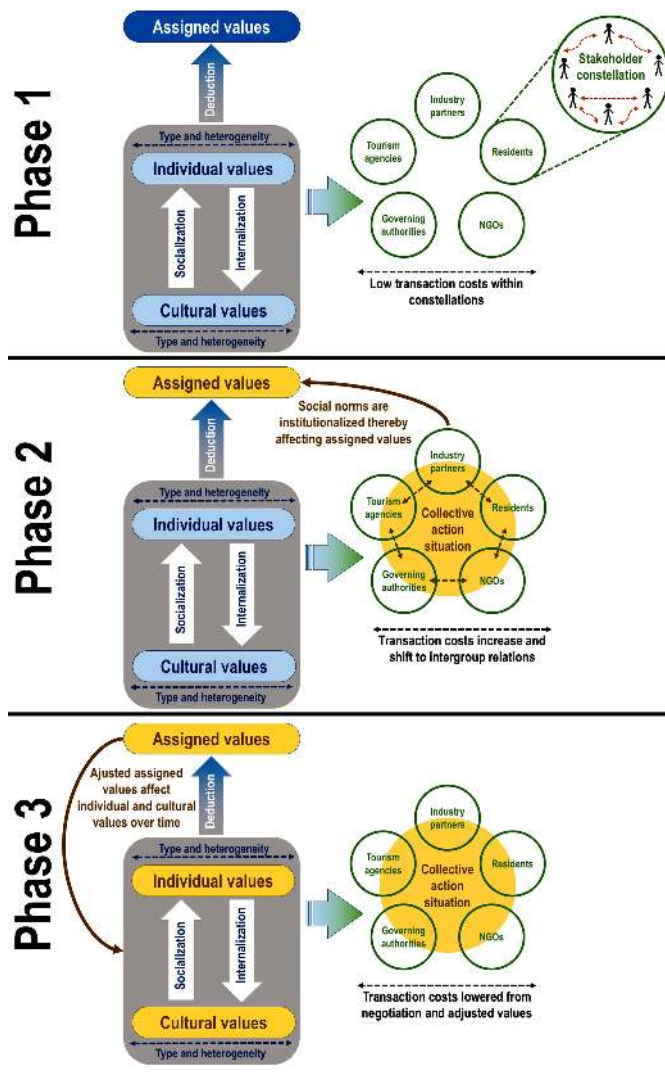
CONCEPTUAL FRAMEWORK

We assert that Cultural, Individual, and Assigned values are related to collective action situations over a three-phase model (Fig. 2). We do not intend to supplant or compete with existing approaches; rather, we suggest that multilevel values are integral to the success of collective action and need to be considered in future SESF research. Our conceptual model depicts three phases that illustrate the relationships among multilevel human values, their connections to the SESF, and their evolution over time. In Phase 1, three types of values are linked to a context that includes multiple subgroups (e.g., stakeholder groups) that have a common interest but are not yet engaged in collective action. Each subgroup is comprised of constellations of individuals, each of which draws on their individual values and negotiates with others on the basis of shared interests. Constellations are characterized by low transaction costs. In Phase 2, an action situation is activated due to potential development or change in shared conditions. This situation involves a shift in transaction costs, such as increased need for communication or negotiation from within a subgroup to among subgroups that have a stake in management of shared resources. The identities of subgroups are likely solidified when compared with others and delineated by shared values at specific levels (Pratto 1999, Carpenter and Cardenas 2011). Also, prolonged interactions among subgroups create new social norms, and through the process of institutionalization and social learning, the common practices and beliefs of individuals engaged in collective action affect Assigned values. In Phase 3, negotiations and the consequential adjustment of Assigned values can increase consensus and motivation for collaboration and thus lower transaction costs. As diverse viewpoints are legitimized and (in) formal rules are accepted, we suggest that interaction influences Individual values, and in turn, Cultural values over long time periods. We also acknowledge that some differences in values should be maintained for communities to build resilience and foster the long-term success of collective action situations.

EXAMPLE STUDIES

We next present three research examples to highlight values dynamics that have been left implicit in SESF research. By engaging with value concepts directly, the authors have extracted meaningful information that has informed management and led to a better understanding of collective action situations. In these example studies, heterogeneous values were held and assigned by both individuals and groups over time. Specifically, the formation of values influenced collective behavior over three phases highlighted in the conceptual model (Table 1).

Fig. 2. A three-phased conceptual model that shows the relationship among multitiered values and a hypothetical collective action situation involving five constellations of stakeholders. Phase 1 shows that Individual, Cultural, and Assigned values exist within stakeholders facing low transaction costs and benefits. In Phase 2, a collective action situation is activated, transaction costs increase, and social norms become institutionalized, thereby calling on Assigned values to guide negotiation. Finally, in Phase 3, the sustained collective action situation reduces transaction costs, and in turn, adjusted Assigned values influence Individual and Cultural values over time.



Example Study 1: Assigned and Individual values at Hinchinbrook Island National Park, Australia

Assigned and Individual values were examined in the context of Hinchinbrook Island National Park located within the Great Barrier Reef World Heritage Area in northeast Queensland, Australia. This uninhabited island is managed primarily by a state agency, Queensland Department of National Parks, Sport and

Racing, that works in cooperation with community groups and other government entities (e.g., Great Barrier Reef Marine Park Authority) to sustain the area’s natural, cultural, and scenic values in perpetuity. The island hosts extraordinarily diverse ecosystems from mountainous terrain to mangrove communities and active sand dunes, as well as a number of endangered and threatened species. The constellations of stakeholder groups in this context included tourists who visited the island to participate in activities such as hiking and camping, residents who used adjacent waters for fishing and prawning, and Aborigines who had restricted access to a cultural site on the island called Muhr Amalee. To advance the spatial prioritization of conservation, the Assigned and Individual values of stakeholders were examined.

Table 1. Illustrative examples of value heterogeneity and collective action situations highlighted in the conceptual model.

	Phase 1	Phase 2	Phase 3
Example study sites	Multilevel values shape interactions among stakeholders groups	Engagement in collective action influenced by assigned and individual values	Collective action influences multilevel values over time
Example Study 1: Hinchinbrook Island National Park, Australia	X		
Example Study 2: Solar power investments in Italy and Austria		X	
Example Study 3: Montaña Camapara Community Watershed Reserve, Honduras			X

Results from a participatory mapping exercise included in a self-administered onsite and mailback survey ($n = 209$) indicated that respondents valued the protected area for a variety of reasons (van Ripper et al. 2012). More specifically, respondents believed the land and seascapes of Hinchinbrook embodied Aesthetics, Recreation, and Biological Diversity values. These Assigned values were evaluated in relation to Individual values measured using Dunlap et al.’s (2000) New Ecological Paradigm scale. Results from the assessment of Individual values indicated that two subgroups of stakeholders defined by their engagement in consumptive and nonconsumptive activities adopted human-based and nature-based worldviews, respectively. The spatial analysis of Assigned values also showed that respondents with human-based worldviews valued larger expanses of the protected area, particularly the aquatic environment. Thus, the preference heterogeneity of stakeholders was more fully captured by multilevel value assessment. As indicated by Phase 1 of the conceptual model, Assigned and Individual values were factored into decisions, while low transaction costs existed due to limited communication between stakeholder groups. A better

understanding of how stakeholders valued Hinchinbrook Island, and the relative sources of these values, allowed managers to anticipate intergroup conflicts that require cooperation to achieve common goals in planning.

Example Study 2: Individual values and collective photovoltaic investments among residents in Styria, Austria

Example Study 2 evaluated the values of individuals who collectively organized and financed solar power plants (CSPP) in Styria, Austria. The CSPPs in Austria are organized and financed by groups of citizens and have become more prevalent in recent years. Given a research need to understand this trend, this work was conducted to understand how people holding a diversity of Individual values collectively engaged in solar power production and climate change mitigation. After 22 exploratory qualitative interviews in 2014, a questionnaire-based survey was conducted in 2015 (drop-off/pick-up method and postal) using items from Schwartz (2012) to assess Individual values of members ($n = 158$) and nonmembers ($n = 124$) regarding CSPPs.

Results suggested that Self-Transcendence and Conservation values were present in the survey population, whereas Self-Enhancing and Openness to Change values impeded collective action (Braito et al. 2017). Members of the CSPP held significantly lower values of Power and Hedonism but had stronger value orientations centered on Conformity. Given that values were examined only at one point of time and could not be compared to the situation when collective action had been activated, it was unclear whether homogenous values evolved from group interactions or individuals with similar values were attracted to the idea of collective action. However, qualitative interviews suggested CSPP campaigns aided in building shared values, including social cohesion, trust, and communal spirit. This process may have crowded out people with stronger Self-Enhancement and Openness to Change values, as discussed by Gneezy et al. (2011). Moreover, qualitative data collected from CSPP project leaders indicated that attracting individuals with weak Self-Transcendence values was difficult, required lengthy discussions and negotiations, and therefore led to increased transaction costs. Additionally, respondents with pronounced Self-Enhancement values reported higher levels of education and supported collective action. Thus, Example Study 2 demonstrated how homogenous Individual values complemented collective action, and underlined the importance of future longitudinal research focused on the interplay between values and collective action.

Example Study 3: Cultural values and the evolution of Assigned values through collective action for the Montaña Camapara Reserve, Honduras

Longitudinal research in western Honduras, including interviews and participant observation (e.g., Tucker 1999, 2008), examined collective action to create a watershed reserve, which revealed Cultural values, conflicting Individual values, and the evolution of Assigned values. In Phase 1 (Fig. 2), several villages had overcome a shortage of drinking water by building systems that drew water from springs on Montaña Camapara, which supports a biologically diverse cloud forest. Then in the 1990s, a group of local farmers began clearing Montaña Camapara's forest to plant crops. As soil erosion and agrochemical runoff threatened water systems, village water boards asked the farmers to leave, and

started a collective action effort to protect the springs and create a watershed reserve (i.e., Phase 2 of the conceptual model). Early on, few people saw the need for a reserve but did want clean water (Tucker 2008). While most of the population prioritized egalitarian Cultural values linked to their indigenous heritage, farmers working on the mountain emphasized values related to self-determination.

Negotiations and therefore also transaction costs increased in intensity as the struggle over Montaña Camapara's water intensified. In municipal meetings, community leaders who were engaged in collective action argued that water was a human right and "water is life" (*agua es vida*). This phrase expresses a core Cultural value, evidenced through interviews and participant observation, and quoted in municipal archive records starting in 1930. Farmers acknowledged water's importance but defended their right to livelihoods. Actors who favored the reserve continually discussed water protection and forest conservation as an ethical and civic duty for the common good. This strategy increased public support for the reserve, and a range of Assigned values evolved to favor environmental conservation. After protracted negotiations, the parties reached a settlement in 2003, whereby farmers left the mountain, water boards provided compensation through higher water fees, and municipal authorities created the Montaña Camapara Reserve (i.e., Phase 3 of the conceptual model). Twenty-five interviews conducted with key actors in 2010 revealed that the value of "water is life" undergirded the eventual agreement, which protected water quality and livelihoods. Several farmers explained that they supported protecting water but needed recompense for their land (Tucker 2014). In this sense, Example Study 3 indicated that in some circumstances, Cultural values could be leveraged to overcome conflicts that arise through heterogeneous Individual values, and that Assigned values can evolve through collective action.

DISCUSSION OF EXAMPLE STUDIES

The three example studies we have highlighted demonstrated how diverse values and the dynamics of value change interface with collective action situations that lie at the heart of the SESF. In the case of Hinchinbrook Island (Example Study 1), Assigned values provided evidence of the dynamic interplay between individual and social processes that framed human-environment interactions in a protected area. Assigned values mapped by survey respondents reflected preferences for landscape features that were related to Individual values. This study also directed managerial attention to "hot spots," which were valued locations used by different stakeholder groups. However, these stakeholder groups were not in close communication and therefore maintained low transaction costs. Although collective action had not yet been activated in Example Study 1, Individual values were distinguishable from Assigned values, therefore confirming our assertion that value pluralism was important to recognize and could provide a basis for future deliberation about conservation initiatives.

In the case of Styria, Austria (Example Study 2), Individual values influenced a collective of people who supported sustainable energy production. On one hand, people with shared Individual values were likely to have similar levels of selective attention to environmental stimuli and sought similar solutions to collective

resource management problems. This, in turn, revealed that shared values reduced transaction costs throughout the process of finding acceptable solutions to policy change, in line with Phase 2 of the conceptual model. On the other hand, the motivational factors that led individuals with different value structures (e.g., Self-Enhancement versus Self-Transcendence) to engage (or not) in CSPP were noticeably distinct and may have increased transaction costs in negotiation. Decision-makers should keep in mind the challenges of value heterogeneity when engaging with stakeholders to more effectively manage and sustain collective action. Moreover, given the diversity of Individual value structures that could be held by stakeholders affected by management of a contested resource such as energy, the assumptions of rational utility and one dimensional economic values highlighted in the SESF will likely fall short. Building on previous research (Manfredo et al. 2016), we suggest that sustainability initiatives work within the context of multilevel values and complexity rather than seek to change existing values.

In addition to Assigned and Individual values, Cultural values facilitated a sustainable solution to a pressing resource dilemma in the case of Montaña Camapara (Example Study 3). These results demonstrated one way that Cultural values could influence group dynamics and, therefore, sustain an environmental governance regime over time. In a social learning process taking about one decade, engagement and negotiation of a collective action problem highlighted conflicting Assigned values that evolved and were reconciled by a shared Cultural value focused on equal access to water. These findings aligned with Phase 3 of the conceptual model, and raise caution that negotiations can fail in contexts where stakeholder groups do not possess a common ethos because heterogeneity in Cultural values increases the transaction costs from reconciling diverging interests. This example study illustrated the dynamic, bilateral relationship between values and collective action over time. Similarly, collective action and associated social learning processes affected value heterogeneity, in that shared Cultural values enabled residents to align their Assigned values for the sake of the community.

CONCLUSIONS

Ostrom's (2009) SESF provides a practical guide for transdisciplinary research. Given the pervasive and fundamental role of values in shaping key decision-making processes, we argue that more explicit inclusion of multiple levels of values in the SESF will augment understanding of the factors that contribute to collective action and adaptability over time. Assigned values, for example, are less psychologically stable than Cultural and Individual values and therefore more likely to change when disruptions are introduced into a system (e.g., policy change, traumatic experiences, new knowledge) (Dietz et al. 2005). Although the SESF engages with economic values (i.e., one type of Assigned value), we suggest that SESF research take into account a broader array of Assigned values, such as perceived biological diversity, aesthetics, and recreation (van Riper et al. 2012). Depending on the context, too narrow a focus on economic values can overlook complementary intrinsic motivations and normative dynamics that influence collective action. These multiple Assigned values are negotiated and adjusted during the initial stage of intergroup interactions, and thus can be seen as socio-psychological points of leverage for change and

adaptability among slower and deeper variables, such as culture, identity, and worldviews (Folke et al. 2010).

The array of values we have highlighted have different rates of change that need to be considered for the continued evolution of the SESF. Specifically, the mental models variable in the SESF cannot be fully grasped without looking at the underlying Individual and Cultural values that frame interpretation and perception of social-ecological situations that are tied to resource dilemmas. Insights into heterogeneity and evolution of values in collective action will explain why different types of comanagement policies and interventions are perceived differently and sometimes have unintended effects, such as backfiring and the erosion of compliance (Kinzig et al. 2013). Achieving social and ecological sustainability will require a significant shift in the fundamental basis of environmentalism; however, Individual and Cultural values are slow to change (Manfredo et al. 2016). Given that this shift would create fertile ground for the emergence and adoption of new approaches to conservation of natural resources, future research needs to engage with not only multilevel values but also a range of other factors that influence behavior (van Riper and Kyle 2014). That is, considering how multilevel values relate to established and validated models of proenvironmental behavior is an important area of future SESF research. The effects of deliberation on the evolution of Assigned values and social learning will inform new positions on complex environmental problems and complement existing models of the drivers of human behavior.

Future SESF research should measure values on at least three levels to scrutinize group heterogeneity, while also identifying shared Cultural values that can reconcile diverging interests. More specifically, increased value alignment may reduce transaction costs and risks of collective action (McCann 2013, Enengel et al. 2014). Intragroup heterogeneity analyzed using measures such as income levels, professional or political affiliation, and ethnicity (Poteete et al. 2010) plays an important role in determining degrees of divergence in viewpoints that may impede collective action. Research that prioritizes the investigation of different and potentially conflicting values will thus be better equipped to resolve conflicts and reduce transaction costs through negotiation and deliberation (Irvine et al. 2016). Documenting how patterns of Individual values engage with the mutual expectations of other people will provide a basis for comparing and understanding value shifts among people who are making collective resource management decisions.

Research guided by the SESF should be deepened by focusing on bidirectional interactions between values and collective action situations over time. Social psychological models tend to suggest decisions are linear given unidirectional pathways that lead from values to intentions and behavior. Indeed, values provide crucial insight into behavior (Sagiv et al. 2017), albeit through other social psychological processes. However, behavior, in turn, can also affect value formation over time (Oskamp and Schultz 2005). That is, participation in collective action has feedback loops, either via a direct outward effect on a group or by affecting individual variables that lead up to decisions (Mosler 2005). Agrawal (2005), for example, illustrated how community empowerment in India reshaped collective action dynamics and underlying notions of values. Deci (1971) reinforced the notion that members of

Table 2. Research implications and management options that emerge from consideration of the relationship between multilevel values and the governance of social-ecological systems.

	Research implications	Management options
Phase 1	Multilevel values influence intragroup interactions among stakeholders Low transaction costs exist before a collective action situation is activated	Identify stakeholder groups that are relevant to management situations Engage with smaller groups to foster trust and solidify collective identities Develop a culture of tolerance to acknowledge value heterogeneity before conflicts emerge
Phase 2	Formation of collective action situation may parallel proposed development or changes to shared resources Intergroup relations will increase transaction costs Social norms become institutionalized when assigned values are negotiated	Identify tools and group activities (e.g., participatory mapping, exchanges) to facilitate discussions and visualize value heterogeneity and trade-offs Visualize different assigned values and discuss individual values to enhance quality of life and well-being of future generations Employ knowledge brokers and governance strategies to manage contentious issues and value heterogeneity (e.g., zoning, compensation payments, nonmonetary rewards) Ensure individual and cultural value differences are transparent and respected
Phase 3	Collective action situation continues Transaction costs decrease Adjusted assigned values affect individual and cultural values	Keep in mind long-term outcomes such as participant turn-over and shared higher level values Monitor conditions to show convergence/divergence of pluralistic assigned values Maintain flexibility in practices and a culture of trust that could be generated with “playful” activities (e.g., role playing) that engage different value perspectives

communities were more likely to engage in community-based management when they had the right to influence management decisions. In response to these findings, future research will need to explore how Cultural, Individual, and Assigned values are transferred. The rich bodies of literature underpinning socialization (Baland and Platteau 2000) and internalization (Haski-Leventhal and Bargal 2008) highlighted in the conceptual model can be engaged to ensure the bidirectional effects of values on behavior are more clearly understood and assessed. Given that complexities of cognition and effect are increasingly recognized as crucial pieces of the SES puzzle (Manfredo et al. 2014, Scheffer et al. 2015), the interplay between group interactions and social norms will not only initiate learning processes but also result in shifting values that can influence collective action over time.

RESEARCH IMPLICATIONS AND MANAGEMENT OPTIONS

Although the SESF encouraged dynamic perspectives on the evolution of social and ecological systems (Ostrom 2005), most research applications have maintained static, case study approaches (Poteete et al. 2010; exceptions include Pahl-Wostl et al. 2010, Anderies and Janssen 2013). The framework we have presented and preliminary empirical insights from three example studies suggest that future SESF research could deepen investigation of social learning processes and evolving Assigned and Individual values to better understand adaptive governance and regime shifts over time. Acknowledging group members’ interests and priorities, and the relative sources of those priorities, can generate longer lasting engagement that responds to the cognitive and emotional drivers of decisions that aid in the negotiation of constraints to collective action.

Recognizing the multilevel nature of values and incorporating this information into management decisions has practical relevance and implications for research (Table 2). Information on the dominant value structures and degree of value heterogeneity among individuals can enhance the success of community-based

conservation initiatives and facilitate discussions about management of collective resources. If shared and conflicting values are identified and made visible, stakeholder buy-in will be more likely to ensue (Jones et al. 2016). Natural resource management strategies can be further refined to focus on zoning, compromises, trade-offs, and/or compensation payments to facilitate collaborative governance. These adaptations have generally been conceptualized as single-loop learning processes whereby there is an exchange and development of knowledge from information sharing, deliberation, conflict management, and evaluative activities. However, we suggest that double-loop learning processes are also necessary to consider in light of how values evolve in response to behavior. This could result in reframed perspectives on collective action to (a) find alternative management approaches, (b) overcome conflicts stemming from implicit differences in stakeholders’ values, (c) facilitate stakeholder deliberation that embraces value heterogeneity, and (d) raise visibility of shared visions and values that dissolve barriers to communication and collective action.

Responses to this article can be read online at:

<http://www.ecologyandsociety.org/issues/responses.php/10047>

Acknowledgments:

This paper is an outcome of the workshop “The role of human nature relationship concepts in the governance of socio-ecological systems in mountain areas,” held in the Lungau-Nockberge Biosphere Park, Austria, May 4–8, 2015, jointly funded by the Austrian Academy of Sciences in the context of the UNESCO Man and the Biosphere Programme, and by the Mountain Research Initiative, Bern, Switzerland. Research for this paper also benefited from the People Programme (Marie Curie Actions) of the European Union’s

Seventh Framework Programme (under REA agreement N° 289374: “ENTITLE”) and from a grant by the Einstein Foundation Berlin (EJF-2011-57) and the Deutsche Forschungsgemeinschaft (DFG) (TH 1459/2-1). We would also like to thank Dr. Michael Manfredo for his helpful feedback on an earlier draft of this paper, as well as Drs. Courtney Flint and Andreas Muhar for their support in the development of our ideas.

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