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Cognitive Methods and a Case Study for Assessing Shared Perspectives as a Result of Social Learning

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Measuring shared perspectives as a result of social learning has largely been limited to document reviews, participant observations, and interviews. Systematic methods that allow for quantitative analysis and minimize response effects may also be informative. This article discusses the use of consensus analysis and salience for analyzing the first stages of Cognitive Domain Analysis and the Conceptual Content Cognitive Map (3CM) to explore shared perspectives as a result of social learning. A case study compares perspectives about ideal use of communal forests in the Bolivian Amazon, where structured 3CM was implemented with 16 extension agents and 34 residents of two rural communities. Salience described the relative importance of communal forest concepts and consensus analysis described whether those who participated in a social learning process had similar content to their models as compared to nonparticipants. These tools promise to be engaging, effective methods to test the impacts of social learning.

Keywords cognitive methods, community forest management, social learning

Social learning, a collaborative learning process that can enhance environmental management, is hypothesized to result in the development of shared perspectives around environmental issues (e.g., Buck et al. 2001; Keen et al. 2005; Muro and Jeffrey 2008). When individuals engage over time in a trusting and open learning atmosphere, where diverse ideas are shared, considered, tested, and modified, it is theorized that participating individuals will become more knowledgeable and their perspectives on the topics will converge. Social learning environments can spontaneously evolve but are also purposefully created under the belief that promoting

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dialogue can result in a common understanding of complex problems and can lead to more diverse solutions, greater adoption of resource management decisions, and less likelihood of resistance (Keen et al. 2005). In the case of communal resource management, shared perspectives should contain technical as well as interpersonal knowledge about values and management preferences (Muro and Jeffrey 2008; Schusler et al. 2003), potentially resulting in greater communal identity and dedication to managing communal lands jointly.

Empirical evidence that social learning results in shared perspectives has generally been limited to the qualitative methods of document reviews, participant observation, interviews, and surveys (e.g., Mostert et al. 2007; Rist et al. 2006; Schusler et al. 2003; Steyaert and Jiggins 2007; Tippet et al. 2005). Mostert et al. (2007) and Tippet et al. (2005), for example, used document analysis, interviews, and some observations to code the results of 10 social learning case studies. Rist et al. (2006) used action research from four case studies to describe emerging narratives of collective understandings of natural resource situations. Steyaert and Jiggins (2007) used participant and nonparticipant observation and reflective meetings to explore changed understandings about wetland issues. And Schusler et al. (2003) used observations and interviews to identify whether social learning contributed to a perceived common purpose. While these methods have contributed to our qualitative understanding that social learning can promote shared perspectives, they are prone to response effects and provide limited insight to the specific differences and similarities in perspectives in a systematic, quantifiable way that can be used to compare groups and test hypotheses.

Standard interviewing and observation, for example, are subject to various response effects such as acquiescence (telling the researcher what is perceived he wants to hear), third-party-present (succumbing to social desirability if there is someone else in the room), threatening questions, and expectancy (the tendency for researchers to get the responses they expect to obtain) (Bernard 2006). Recently, cognitive mapping has been explored as a mechanism for gathering knowledge and subjective perspectives in a systematic format easily analyzed using common statistical packages. It could improve upon more standard methods by avoiding some response effects, since it is more difficult for participants to discern the "right" answer and the engaging, uncontrolled process minimizes the effect of third-party presence and the perception of questions as threatening. Additionally, it can be an effective tool at eliciting emic perspectives in a systematic, comparable format. This article discusses the use of cognitive methods common for eliciting mental models to explore shared perspectives in communal forest management among participants and nonparticipants of social learning groups. It further describes how two specific analyses, consensus analysis and measures of salience, can be used to summarize and compare cognitive data.

Cognitive analysis methods are commonly applied in cognitive anthropology and various fields of psychology (e.g., Austin 1993; D'Andrade 1995; Kearney and Kaplan 1997). In cognitive anthropology, cultural domain analysis explores "how people in a group think about lists of things that somehow go together" (Bernard 2006, 299). A domain is "an area of conceptualization like space, color, the human body" (D'Andrade 1995, 34), and the concepts that belong to a domain can be both physical and conceptual (Borgatti 1993; 1994). Cultural domain analysis seeks to uncover the components of a domain through several tasks such as free listing, pile sorts, ratings, and rankings, among others (Bernard 2006). Free listing involves

respondents listing the first words that come to their minds when given a specific domain. Pile sorts require participants to group cards with items that have been elicited through free listing based on perceived similarity. Ratings ask respondents to assign a value on a scale to each item and ranking asks for a rank order of importance for each item. While only the second of these tasks relies on card sorting, all tasks have the overall objective of uncovering and comparing how groups of people identify and organize concepts within a central conceptual domain, thus making them intriguing methods for exploring whether and how participants of social learning groups perceive specific environmental issues differently from nonparticipants.

In cognitive psychology, similar methods have been used with individuals to explore cognitive map theory. This theory states that people have mental models representing their perspective, knowledge, and opinion about a topic and can be characterized through their spatial organization of words and/or images that identify the components within the topic (Kaplan and Kaplan 1982; Kearney and Kaplan 1997; Ozdogru 2002). Mental models are built and modified through experience, and various tools can be used to represent them outside the brain. The first step to representing one's cognitive map is becoming aware of important items (freelisting or selecting items). It then requires physically organizing written or drawn representations of the items in a way that demonstrates their relationship to each other. In a Conceptual Content Cognitive Map (3CM) exercise, items are selected and grouped nonspatially based on how participants perceive they belong together (Kearney and Kaplan 1997). As with Cultural Domain Analysis, 3CM is a process to understand the content and structure of knowledge. In the "open" version of 3CM the interview begins by asking respondents to list items they believe to be important about a specific issue. The items are written, or represented with an image, on separate cards. The "structured" version provides each respondent with a set of cards containing previously elicited items that were developed from prior interviews and literature review. Respondents are asked to select the cards that are important for explaining their perspective. In both structured and open 3CM, respondents are then asked to sort the cards in separate piles according to how they think they should go together. The criteria they use to sort is determined and explained by the respondents. Some researchers incorporate a final stage that involves asking respondents to rank order the piles, and sometimes the items within piles, based on a specific characteristic (e.g., most important, most complex, etc.) (e.g., Kant and Lee 2004). 3CM has been applied in dozens of natural resource management studies (e.g., Booth et al. 2001; Fischer and Bliss 2006; Kant and Brubacher 2008; Kearney et al. 1999; Kearney and Gordon 1998; Tikkanen et al. 2006) to explore how individuals perceive natural resource issues and how groups of individuals differ in these perceptions and is thus another promising tool for exploring the hypothesis that participants in a social learning exercise will develop shared perspectives around an environmental issue.

Although Cultural Domain Analysis and 3CM use almost identical tasks, the methods used in data analysis have varied. With the initial phase of the tasks, where participants freelist or select items belonging to a domain, both methods tend to present frequencies and analyses of relative importance. While ranking is sometimes employed in 3CM activities, generally it is only the frequency of item selection that is mentioned as a measure of how important the item is to the research group. In Cultural Domain Analysis, item importance is often determined by calculating the Smith's Salience index from the freelists. Unlike a standard average rank, which is

the average position of the item for each respondent, salience is a weighted average of the inverse rank across all lists (Borgatti 1996). As such, the statistic does not allow high prioritization of an item infrequently selected, and thus better represents the entire group of respondents' perspective of item importance. We thus present the analysis of salience as an important tool in analyzing card sort data for social learning studies.

Consensus analysis is an even more powerful measurement of item selection and freelist data. It confirms group consensus among the items selected to be part of the mental models and correlates individuals to the group to determine who is least like the aggregate in their selection of items (Romney et al. 1987; Romney et al. 1986; Weller 2007). The formal model, found in Anthropac (Borgatti 1996), uses dichotomous (i.e., yes/no) data, whereas the informal model, in most statistical packages such as SPSS, can be used with fully ranked, interval or ratio-scaled data (Weller 2007). Although consensus analysis has been used widely in Cultural Domain Analysis, it has not been used with 3CM or other cognitive mapping data. It could be particularly useful for social learning measures, since influential communication among decision makers has been found to be a likely precursor of reaching consensus (though not necessarily resulting in better decisions) (D'Andrade 1995). This would make testing for consensus a possible proxy for influential communication, and thus would respond to the research objective of measuring the effectiveness of social learning.

Both Smith's Salience and Consensus Analysis allow us to explore qualitative data on individual and group perspectives. As exploratory tools, they are a promising addition to multimethod analyses of social learning for environmental management. This article describes how these methods can be used to analyze the initial item selection and ranking tasks of Cultural Domain Analysis and 3CM through a case study exploring whether social learning influenced shared perspectives about forest use in the Bolivian Amazon.

Case Study Question and Context

The initial phases of Cultural Domain Analysis and structured 3CM were implemented as part of a larger 15-month study to test social learning theories in community forest management projects in the Bolivian Amazon. We hypothesized that people who participated in open, active, and supportive knowledge sharing activities were likely to develop similar perspectives about the issue. The cognitive methods were used specifically to gather data about community-member and extension-agent perspectives about ideal use of communal forests after a subset of the respondents had interacted over 2 years in the design and implementation of timber management activities on communal lands.

The study was conducted in the Bolivian Amazon, where recent policies have devolved land ownership to rural communities and allowed them to develop management plans to extract timber and nontimber resources. Since most communities had never formally managed their timber, various extension projects provided support through 3- to 5-year projects focused on technical and administrative training with experiential, multiway interactions. Two of these projects represented social learning processes because of the equitable participation of community members and extension agents, the longevity and frequency of interaction, the openness to debate multiple perspectives of communal management decisions, and the shared responsibilities of all members of the groups. One social learning group, in the

community of Rio, consisted of 10 self-selected community members belonging to the ''Forestry Committee'' and four extension agents from organization A, although other community members and extension agents were welcome to participate as they wished. Although organization A had worked with Rio in several capacities for more than 10 years, this specific social learning group and topic had been active for only 2 years. The other social learning group, in the small community of Villa, was made up of four self-selected community members as part of their ''Forestry Committee'' and four extension agents from organization B. This group had also been interacting on a monthly average for 2 years, but with no prior relationship between organization B and the community. Both groups were focused on the same problem: managing the community's timber resources.

Participant Selection and Methods

To test the hypothesis that members of social learning groups had more similar perspectives than with those who had not participated in social learning, we conducted household interviews in both communities and personal interviews with extension agents in five organizations. Rio was home to approximately 76 households whose workers engaged in various wage-paying jobs, some agriculture, and the extraction of Brazil nuts. About 20% of the households had a family member who worked at the nearby sawmill, though none of them had experience in timber management. In Rio, 22 household heads were randomly selected for interviews, five of which had participated in the social learning group.

Villa was smaller than Rio, with only 16 households. The population of Villa was segregated into two classes; the lower class survived entirely from Brazil nut extraction and agriculture, while the higher class managed cattle farms and purchased Brazil nuts from regional extractivists, including those from Villa. Because of the small size of Villa, all household heads present during a two-week visit (12) were interviewed, including the four participants in the social learning process.

In addition to these two social learning groups, there were several other social learning groups dedicated to developing communal timber management plans in the region. All were participants in one of five community forest management (CFM) projects hosted by different agencies. To be able to compare the participating Rio and Villa extension agents to other agents with similar objectives but different social learning groups, we used convenience sampling to select a total of 16 extension agents with diverse backgrounds representing the five CFM projects.

Key to the analysis was that some community respondents had interacted much more often with the extension agents than others, and some extension agents had never interacted with the community members. Thus, testing the social learning theory was a matter of comparing community members and extension agents who participated to those who did not. If all other variables are equal (e.g., gender, education level, previous knowledge, experience, and overall activism), participating community members and extension agents should have perspectives about ideal use of community forests that are more similar to each other than to those held by nonparticipating neighbors and extension colleagues.

The structured version of 3CM, where participants are asked to select among a group of predefined items, was used to facilitate quantitative data analysis and make the task less onerous. Developing the items for the domain required soliciting freelists from approximately 12 community members, researchers, and extension

agents who represented these stakeholder groups but did not participate in this study's final data collection. The freelists were composed of words and concepts that came to mind when they thought of ideal forest use and community forest management. After 12 respondents, few new concepts emerged; the list stabilized at about 20. Key ideas were then added from the literature about community forest management and Amazon forest management, bringing the final number of items to 29. Items were diverse and included resource use options (i.e., timber extraction and Brazil nut collection), management concerns (i.e., timber management plan), tenure concerns (i.e., individual vs. collective property), social organization (i.e., participation and organization), and environmental conservation and livelihood concerns (i.e., conservation and economics).

The exercise required 15 to 30 minutes of a 45-minute interview with extension agents. It was also the first activity of a 1.5- to 2-hour interview with community members. The remaining interview questions determined level of participation in the social learning process. Participants were asked to visualize what ideal forest use in a Bolivian Amazon community would look like and how they would describe it to a friend who was not familiar with the region. They were then handed a stack of 29 shuffled cards, each with a unique number on the back and a word and a representational image on the front. The images were selected from a database of images used by nongovernmental organizations (NGOs) and government extension agents in their pamphlets about natural resource management.

The first task was for respondents to select from the pile of all the cards that were necessary to describe their vision of ideal forest use. Once they selected the representative cards, they were asked if there were any concepts they would like to add to fully describe their idea. Detailed notes were taken as they discussed what each card represented to them and the relationships among cards. Next, all respondents were requested to rank their selected cards from most to least important for their ideal vision. Weller and Romney believe that rank data provide the most amount of information for the time spent with respondents (Weller and Romney 1988). At the same time, however, they suggest that asking illiterate people to rank abstract concepts using cards is inappropriate. In this case, the number of concepts selected by the respondents was small enough that they seemed to have no problem rank ordering. Finally, we asked respondents to take their selected cards and any added cards and sort them into categories that made sense to them and then provide a description for each group. While this task was easy for extension agents, the first six community members resisted this step and demonstrated either confusion or disinterest. We removed this task from the activity for community members to avoid discomfort, but retained the extension-agent results for this article because of the usefulness of the groupings for data interpretation.

Analysis was completed using Anthropac (Borgatti 1996), which was developed for cognitive anthropology data, including freelists, pile sorts, rankings, and ratings. After producing descriptive statistics, data were analyzed with consensus analysis, Smith's Salience (S), and hierarchical clustering. As the consensus model is essentially a factor analysis, the output presents eigenvalues for the multiple factors generated from the data. It is generally agreed that consensus is likely if the ratio of the eigenvalue for the first factor is at least three times the eigenvalue of the last factor (Borgatti 1996; Romney et al. 1987), demonstrating essentially a single-factor response. If this is not the case, the presence of multiple-factor loadings suggests a lack of consensus about which items belong to the domain.

Relative importance of items was measured using Smith's S within Anthropac. Smith's S scale ranges from 0 to 1, and a higher Smith's S is considered a higher average importance. Data were input to Anthropac as freelists with concepts listed in order of importance declared by each respondent. Five items mentioned by fewer than three people were omitted from the Smith's S analysis.

Finally, to analyze the extension-agent card sorting, we performed hierarchical cluster analysis using average link to explore how extension agents structured their mental models on ideal use of communal forests and investigate whether any of these conceptual categories were differentially important for social learning groups as compared to nonparticipating community members and extension agents based on their ranking of items within the categories. Hierarchical cluster analysis is the most common analysis for 3CM card sorts. It is a qualitative data reduction technique that categorizes items based on the frequency with which they are grouped together (Manly 2004). Clustering considers how often two items were mentioned in the same pile and categorizes items most often mentioned together. When conducting the card sort in 3CM we asked extension agents to name and describe the piles they created. This information was used to validate and provide descriptive names and content for the group's aggregate piles. Categories were determined by comparing Anthropac's output dendrogram with a multidimensional scaling (MDS) model and the individual piles created by respondents using the same data. To explore the relative importance of each of these conceptual categories to community and extension-agent participants and nonparticipants, we recoded each item for the relevant conceptual category and calculated how often items from each category were selected and highly ranked.

Case Study Results

Because a cognitive map model is incomplete without some description of the relationship among items, the lack of card sorting by community members means that this study was unable to analyze the structure of their mental models. It did, however, compare individual knowledge and perspectives about ideal use of communal forests based on the selection and ranking of items related to the idea. This section describes the case study results and briefly links them to the social learning research question.

Item Selection

Overall, 33 concepts were selected or added and the average number of concepts in a respondent's list was 10.9 with a minimum of 2 and maximum of 23. Extension agents averaged larger lists (14.4 concepts) than community members (9.2 concepts). There was not a significant difference, however, between community members who participated in the social learning (9.9, std = 5.3) and nonparticipating community members (9.0, std = 4.18). Community participants in general found fewer items to be important to describe "ideal use of communal forests," whereas extension agents either found more items to be important or were willing to share more items.

Consensus Analysis

To test the hypothesis of shared perspectives from social learning, consensus analysis was conducted on item selection for different groups: all extension agents ($n = 16$), all community members ($n = 34$), all members of Villa ($n = 9$), all members of Rio ($n = 22$), men in each community, women in each community, three categorized

age groups in each community, and, finally, the two social learning groups of extension agents and participating community members ($n = 7$ for each). Based on the criterion that the ratio of the eigenvalue of the first factor should be at least three times the eigenvalue of the last, no consensus was found in people of similar age groups within each community, the same gender within each community, extension agents as a group, community members as a group, or all members of either communities (Table 1). There were, however, single-factor loadings for both social learning groups. In other words, a single axis incorporating the responses of members of each social learning group explained the variance of their responses. Since it was only among these groups that the items selected to represent "ideal use of communal forests" were agreed upon, it can be suggested that information was being mutually shared and adopted between extension agents and their participating community members. Thus, even though the number of items selected did not significantly differ among participating and nonparticipating community members (as discussed earlier), participating community members were more similar to extension agents than to their fellow community members in the conceptual content of their mental model.

Salience

Since cultural consensus demonstrated that the two social learning groups uniquely agreed on the items to be included in the domain, our exploration of the items' relative importance was qualitatively compared among those two groups and among the nonparticipating extension agents and community members. The social learning groups showed preference for the organizational and management components of "ideal use of communal forests," nonparticipating community members prioritized fundamental individual activities, and other extension agents generally prioritized the communal sustainability of timber activities (Figure 1). Both social learning groups ranked organizational aspects of communal forest use higher than individual livelihood strategies (Figures 1a and 1b). The Rio social learning group placed Institutional Support first (0.69), followed by Participation (0.64), Organized (0.53), and the Forestry Committee (0.49) (Figure 1a). After noting the importance of Brazil nut (0.52), the Villa social learning group ranked Norms (0.46), Economic (0.38), and Association (0.30) among the most important items (Figure 1b).

The most important concept for nonparticipants of both communities was Agricultural Plots (Smith's $S = 0.62$ in Rio and 0.97 in Villa) (Figures 1c and 1d). Brazil Nuts was second for nonparticipants in Rio (0.53) and third for nonparticipants in

Table 1. Consensus analysis results for different groups

Group	N	Factor 1 Value (%)	Factor 2 Value (%)	Ratio 1:2
All extension agents	16	4.10 (60%)	1.56 (23%)	2.63
All community members	34	5.51 (56%)	2.60 (26%)	2.12
All Rio community members	21	3.94 (55%)	1.96 (27%)	2.01
All Villa community members	9	1.94 (52%)	1.03 (28%)	1.88
Social learning group 1 (Rio)	7	1.88 (100%)	N/A	N/A
Social learning group 2 (Villa)	7	0.92 (100%)	N/A	N/A

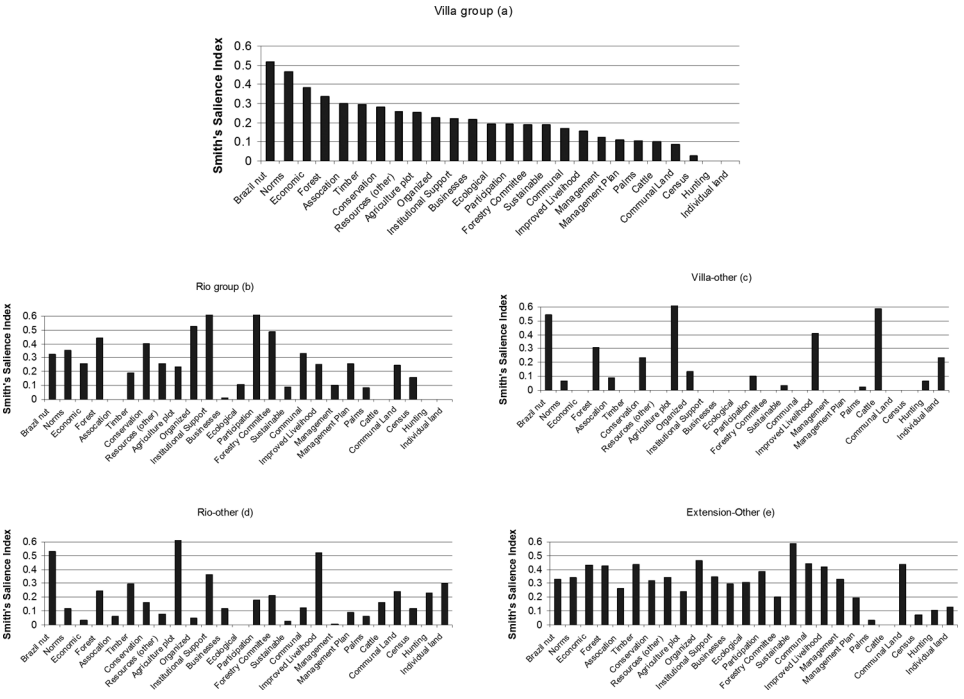

Figure 1. Smith's Salience index of items pertaining to the domain ''ideal use of communal forest'' for the two social learning groups (a and b), other members from each community (c and d), and nonparticipating extension agents (e).

Villa (0.54). Second most important for nonparticipating members of Villa was Cattle (0.59). Improved Livelihood (0.41) was fourth for Villa and third among Rio nonparticipants (0.52). Fourth for nonparticipants in Rio was Institutional Support (0.37). Extension agents who did not work with Rio or Villa prioritized Sustainable (0.59), Organized (0.47), Communal (0.44), Communal Land (0.44), Timber (0.43), and Economic (0.43) (Figure 1e).

Interestingly, several items that ranked highly among nonparticipating community members were not selected at all by extension agents, indicating a foundational difference in perception. Cattle was ranked second by Villa nonparticipants and within the top half of concepts in Rio. No extension agents, however, selected this item. Similarly, nonparticipants in Villa ranked Individual Land Parcels seventh and in Rio fifth in importance, while no extension agent selected this item. The only items not selected by any community member were those added by four extension agents to the original cards: Global Ecological Problems, the State, and Transversal Intercommunication. These results demonstrate that the social learning groups had adopted current discourse in development, prioritizing organizational and communal factors in ''ideal forest use'' whereas nonparticipating community members focused on the individual livelihood activities and benefits.

Similarity of Importance by Categories

We identified five categories of ideas about ideal forest management from the extension agent clusters (Figure 2). The quintenary level of branching on the hierarchical

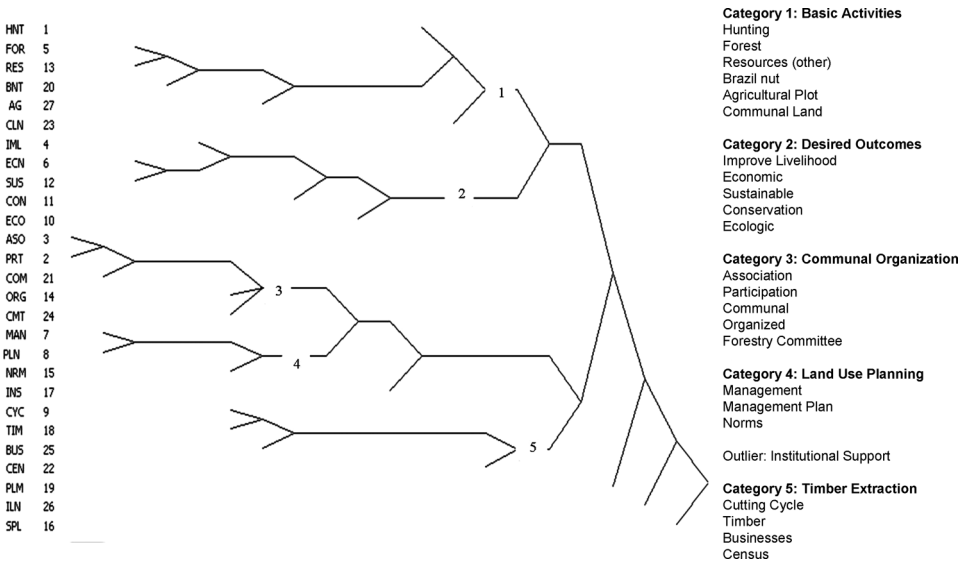

Figure 2. Hierarchical cluster analysis of extension agent card sorts.

cluster resulted in three categories that generally represented results from the MDS and respondent categories (categories 1, 2, and 5). The seventh level of branching resulted in two more categories (3 and 4) that completed the picture provided from these additional sources.

The basic activities category includes forest in general, other resources, Brazil nuts, agricultural plots, and hunting. These activities are the predominant and priority livelihood activities of community members in the Bolivian Amazon. (Note the absence of cattle, a predominant activity but not considered ideal by any extension agent.) Category 2 refers to the desired outcomes and worldview surrounding "ideal use of communal forests." It includes improving one's livelihood, sustainability, conservation, ecology, and economic factors. The third and most tightly related category includes concepts pertaining to communal organization, such as association, participation, communal, organized, and the forestry committee. The fourth group includes items representing land-use planning, such as management plans and norms. Along with the third category, the fourth category is also related to institutional support. Finally, the fifth category contains items relevant to the technical management of timber, such as cutting cycles, businesses, and the timber census. The enumeration of categories does not represent their order of importance for extension agents.

Items from category 5 (Timber Extraction) were least selected by all community members and extension agents. Items from category 1 (Basic Activities) were dominant for all residents of Villa and for the nonparticipants of Rio (incorporating 30% of the top five items ranked for Villa nonparticipants, 20% for participants, and 40% for Rio nonparticipants). Items from category 3 (Communal Organization) dominated the top five items ranked for participating community members of Rio (20%) and extension agents (60%). These results suggest that the technical knowledge of timber extraction provided through the extension practices was considered the least important aspect of these development projects by all actors. The communal organization aspects were most important among extension agents and those having

participated most in the social learning process (Rio), while basic livelihood strategies that were essentially individual remained the most important for all members of Villa and nonparticipants in Rio.

Implications for Using Cognitive Methods

As the cognitive mapping exercise was one component of a larger, semistructured interview, we were able to qualitatively compare both the response to and the data produced by cognitive methods as opposed to face-to-face interviewing. All participants genuinely engaged with the cards, often picking one up, describing what the concept meant to them, and searching for the next card to represent their train of thought. Participants interacted directly with the cards and were allowed to select and place them however they chose, making participants seem more at ease with the cognitive methods as compared to the interviews. As a result, response effects due to the researcher appeared minimized. Additionally, the data analysis approaches associated with cognitive methods provided an easy, systematic comparison of data that succinctly explored shared perspectives.

While demonstrating the possibility for applying cognitive methods to test for social learning, the case study also raised methodological questions that can be explored in future studies. First, why was it that the first community members we interviewed were reticent to categorize cards? These community members were not unique in any obvious way; they represented both men and women with diverse exposure to formal schooling, though no exposure to college level education. When asked to sort cards into categories, they simply expressed discomforts relating to lack of self-confidence to perform the task (as demonstrated by saying, ''I'm not educated, I don't know these things'') or not wanting to be forced into a method for representing their ideas (as demonstrated through annoyance at being asked to transfer their cyclical story into a set of piles). Because this step was not crucial for testing salience or consensus, we chose to remove it from the community-based interviews. These difficulties demonstrate that while cognitive methods may address some of the limitations of qualitative studies, their ability to do so depends on how they are used. In this case, they were effective as part of a larger interview. Future studies may want to explore the effectiveness of card sorting activities that include diverse conceptual items (such as ''ecology,'' ''timber management,'' and ''cooperation'') with diverse stakeholders as both independent and integrated methods.

Second, the case study demonstrated that while testing for agreement in salience and consensus are powerful tools for exploring shared learning, these alone do not reveal causality. Triangulated methods still need to be employed to understand the social learning process and qualitatively interpret the results. Two components of this case study speak to why one should be careful to not draw conclusions from a single method. First, the case study was a natural experiment in communities with small populations. While we employed a control-group design, a more ideal design would have included pre- and post-learning data collection. Second, because the 3CM method was only employed after engagement in a social learning process, it is unclear if differences found could be due to the self-selection of communal participants in social learning or the limited number of responses. This suggests that these systematic cognitive methods should be combined with more in-depth qualitative methods to confirm and provide greater description to the results. For example, the larger study with these same individuals (Biedenweg and Monroe, in press), showed that extension

agents did not differ in important ways from their colleagues (i.e., training, overall outlook, experience, etc.) and that participating community members represented the communal diversity in natural resource training, experience, gender, and age. Biedenweg and Monroe also observed that many of the concepts selected and prioritized by participants of the social learning groups were ideas that were generated and discussed throughout the social learning process. Thus, triangulating more in-depth knowledge of the context and comparing across participating and nonparticipating groups allowed for more rigorous interpretation of the cognitive data. An alternative route for future investigations would be to complete cognitive activities prior to and at several stages of the social learning process.

Conclusions

Social learning is an evolving topic for environmental management, with several hypotheses related to process and outcomes. This article expands the discussion by exploring methods to test the hypothesis that engaging in an interactive learning environment can result in shared perspectives about resource management. It does so by describing analysis methods for the item selection and ranking tasks of common cognitive methods, then uses a case study to demonstrate how measures of salience and consensus were particularly effective when testing theory about shared mental models.

We suggest, however, that the cognitive methods not be solely relied upon to prove causality. Our case study used a natural experiment with postintervention measurements, which is common in community-based resource management studies, and particularly with social learning as it relies on willing participation. At the same time, our case study was enhanced by data from a larger study incorporating observations, semistructured interviews, and document reviews. We suggest that future studies also triangulate methods and/or consider pre–during–post measurements.

As for the contribution of these methods to the overall study of social learning, care should be taken to not blindly interpret shared perspectives as evidence of social learning. A convergence into similar thinking does not necessarily mean that all participants' ideas have been equally considered and integrated. In some cases it is likely that more powerful participants of the social learning process can (perhaps subconsciously) co-opt the learning and result in a convergence toward their ideas. In the case of these two social learning groups, we believe that this may be the case in Villa, where two of the more powerful community members were more vocal in their opinions, although negotiation of ideas was certainly witnessed by one of the authors. In Rio, however, the social learning process was very much based on shared participation and idea generation. In future studies, this factor would need to be explored through a more in-depth analysis of the social learning process, paying particular attention to the role of power.

In conclusion, using cognitive methods to test social learning hypotheses, while not the only measure that should be employed, proved informative. This research explored the content and importance of items belonging to mental models, and, by comparing measures of salience and consensus across groups, was able to suggest that the process of social learning could have contributed to the similarity in perceptions. Further tests for the results of social learning should extend beyond the cognitive and measure the implementation of decisions made within the social learning atmosphere, while continuing to elucidate the procedural components that enable or inhibit social learning.

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