Influence of the expert effect on cultural models

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Abstract

We examined hunters' perceptions of fauna to see if expert hunters and other hunters perceive wildlife abundance similarly. We used cultural consensus analysis (CCA) to assess the knowledge of 25 hunters in the Bolivian Amazon about the abundance of 38 animals. CCA indicated highly shared beliefs among hunters concerning wildlife abundance (average agreement = .62). However, expert hunters (as judged by their reported successful hunts of rare species, having hunted recently, and consuming more game in their diet) perceived more animals as abundant than did non-experts, although they all shared the same model. Since the expert hunters did not always agree on which species was more abundant, they had low cultural knowledge scores in CCA results. These experts may be unwilling to curtail hunting efforts on key species that they perceive to be abundant.

Keywords: traditional ecological knowledge; expertise, cultural consensus, hunting

Introduction

The traditional ecological knowledge (TEK) of stakeholders is central to human dimensions of wildlife research and practice. Much TEK research addresses the mismatch between management and local-user needs (Berkes, Colding, & Folke, 2000; Tang & Gavin, 2010) with the goal of developing management programs that have local buy-in. We applied cultural consensus analysis (CCA), a method employed in TEK research, to estimate the knowledge of hunters in the Bolivian Amazon about species in their immediate environment. Variation across hunters' perceptions about the abundance of species may hold insights into why even local buy-in can fail. If hunters share a model of wildlife abundance, but the experts perceive some animals as more abundant than do the rest of the hunters, the experts, who likely catch more game, may be unwilling to curtail hunting efforts on a few key species, because they don't perceive a problem. We examined hunters' perceptions of local fauna to see if expert hunters and other hunters perceive wildlife abundance equally.

Cultural Consensus Analysis

Cultural-consensus theory uses agreement between respondents to estimate their cultural knowledge and is an appropriate model to estimate community perceptions of species occurrence. Experts in a specific cultural domain typically agree more with one another on questions about that domain than will non-experts, and consequently have higher cultural knowledge scores on questions about the domain than do other members of the culture. For example, Reyes-García, Vadez, Huanca, Leonard and Wilkie (2005) found that people living in the forest (forest experts) agreed more on questions about ethnobotanical knowledge than did people living in a village closer to the market. Cultural consensus theory indicated the presence of a single, shared model of ethnobotanical knowledge, with greater expertise among the forest dwellers. For experts in the forest, ethnobotanical knowledge and plant consumption were strongly correlated, while this correlation was not significant for informants who lived closer to the market. Garro (1986) found a shared model and higher agreement of folk medical knowledge among indigenous healers than among non-healers in Mexico.

People with specialized skills in a cultural domain (experts) may organize their knowledge of the domain differently than do non-experts and may have a separate model. Boster and Johnson (1989), for example, found that expert fishers categorized fish based on behavioral and functional characteristics (high- vs. low-value sport fish and high- vs. low-value meat) while novices (university students) categorized fish based on shape (e.g., round vs. elongated). Medin, Ross, Atran, Burnett, and Block (2002) found that Menominee Native American Indians who fished regularly for consumption had a slightly lower consensus than did majority-culture individuals who occasionally fished for sport and lived near the Menominee reservation. Similarly, Hopkins (2011) found that the few herbalists in her sample had lower competence on questions about folk herbal remedies than did non-specialists.

Interpretations of expertise based on estimates of competence from CCA assume a shared knowledge base results in higher agreement. When there is one cultural model with high agreement and the putative experts have specialized knowledge—perhaps different from one another—they may have lower cultural knowledge scores on a CCA test of knowledge. In fact true experts do not always agree with each other (i.e., see heated debates about almost any given scientific problem among experts).

The most compelling part of identifying differences in informants' perceptions is identifying the reasons for those differences, beyond simply pointing to differences in demographic features or in differences in ethnic culture groups. For example, Handwerker (2002) describes a single model of a successful parent-teacher relationship in the United States. While the informants agree on the factors that make up a successful relationship, they do not agree on whether parents are separate but equal partners with teachers or if parents and teachers are mutual decision makers. Our interest is to understand the distributiom of ecological knowledge concerning the abundance of animals and how that knowledge may vary with hunting expertise.

One solution to this problem is to clearly define what is meant by expertise and have an independent estimate of expertise. Hunting success (which we take as a proxy for expertise) has been operationalized by measuring catch per unit effort (CPUE) (Acheson, 1977; Hill & Kintigh, 2009; Palsson & Durrenberger, 1982; Russell & Alexander, 1996; Thorlindsson, 1988). Koster (2010) had CPUE data for 24 of 29 Miskito hunters in Nicaragua's Bosawás Reserve. He asked 41 informants in the reserve to rank order the photos of all 29 male household heads in the community in terms of the men's hunting skill. Consensus analysis showed strong agreement about the ranking of hunting expertise and the correlation between the CCA ranking and the CPUE data (for the 24 hunters) was $r = .594$ ($p = .002$) (Koster 2010, p. 257). Koster's results suggest that, in some cases, an ordered ranking (nomination) may be a reasonable proxy for hunting expertise. We operationalized expertise by creating an expertise index, combining information on reported consumption of game recently (a proxy for success) recent hunting (being an active hunter is also likely an indicator of expertise) (TIME), and having caught rare, sought after species (spider monkeys [*Ateles chamek*], for example, are rare and highly sought after for celebrations) (SPECIES).

Bias may also affect hunters' perceptions or their reports of perceptions. The availability heuristic is the tendency to recall (or overestimate the probability of) certain events because those events are more available in memory (Kahneman & Tversky, 1973). In the classic experiment on this bias subjects were asked to recall a list of names that included famous and non-famous people; more famous names were recalled even though the experiment provided more common names than famous ones. For hunting catching more prominent items (catching rare species) may affect people's perceptions of abundance and result in an overestimation of abundance.

In the shaman effect (Bernard 2011, p. 378), experts with specialized knowledge may withhold that knowledge from others. For example, if expert hunters share information with others about harvesting rare and valued species, then other hunters may deplete more game. If this were the case then if experts have different perceptions than the whole group, we would expect those experts to have lower scores than that of the whole group, even while sharing the overall model of the group.

We hypothesized that the best hunters perceive rarer species as relatively more abundant than do average hunters because expert hunters have more direct encounters with those rarer species. To test this hypothesis, we collected data on hunting expertise as well as hunters' rankings of the abundance of 38 local animals and compared the perception of expert hunters with other hunters.

Methods

In the lowland Bolivian village of Salvatierra Guarayos people depend on the collection of sub-tropical and chaco forest resources and swidden agriculture (Toledo & Salick, 2006). Hunting and fishing are an important part of people's livelihoods and species such as tapir (*Tapirus terrestris*), brocket deer (*Mazama* sp.), peccary (*Pecari tajacu* and *Tayassu pecari*), several species of monkeys including spider monkey (*Ateles chamek*), agouti (*Dasyprocta variegata*) and paca (*Cuniculus paca*) are hunted, and tiger fish (*Hoplias malabaricus*) and armored catfish (*Callichthys callichthys*) are fished. Salvatierra is located within the Guarayos Tierra Comunitaria de Origen (TCO) indigenous lands.

Sampling

From June to August 2001 we interviewed couples in Salvatierra about their hunting and food consumption habits. We began with a single hunter, known to one of the authors from an earlier study (Van Holt, Townsend, & Cronkelton, 2010) and asked him and his wife to identify other families in which the men hunted game. In each family, we asked to speak with the people who hunted wildlife. Using this nomination process, we interviewed the 25 (of the 59) couples in the community in which the man was reported to hunt game at least part time. Men responded to questions about wildlife and women responded to questions about food consumption.

Data Collection

To assess perceptions of wildlife abundance, we showed the men 38 laminated images of local fauna reproduced from published field guides (Eisenberg & Redford, 1999; Emmons, 1997). We discussed the local name of each animal to make sure that informants understood which animal was represented by each image. We then asked the men to select the images of the animals that were rare and those that were abundant. We coded the each response 0 for rare, 2 for abundant, and 1 if the animal was intermediate or mistakenly classified as both rare and abundant or was not selected as either rare or abundant. Twenty-five informants produced responses for the abundance questions (see Van Holt et al. 2010 for more details).

To independently assess hunting expertise, we asked the men: “How long ago did you last catch game?” for the TIME variable and “What species do you typically hunt?” for the SPECIES variables. We asked both the men and the women: “How often do you eat game?” (GAME). People cannot always give precise quantitative responses to questions like these (Bernard, Killworth, Kronenfeld, & Sailer, 1984), but the objective was to assess the *relative* importance of hunting in the families’ livelihood. For example, good hunters should report more game meat for their families, as it is the preferred meat source. Twenty male informants completed these questions on hunting expertise.

Analysis

We tested for the presence of a single, shared perception of animal abundance using the informal, ranked model of cultural-consensus analysis (CCA) (Romney, Batchelder, & Weller, 1987; Weller, 2007). We also used multidimensional scaling (MDS) to examine variation between hunters' responses. The cultural-consensus model assessed the agreement among respondents in their answers to a set of questions about abundance and a cultural domain (i.e., game hunted in the area of Salvatierra). To test the level of agreement, CCA uses factor analysis to obtain a single weighted combination of ratings. If the ratio of the first factor's eigenvalue to that of the second is large and if all first factor loadings are positive, then a single factor solution is present (i.e., there is a single response pattern) and the model fits.

If there is a single-factor solution, then the first factor loadings (the correlation of each person's responses to the aggregated responses of the group) can be interpreted as an estimate of individual knowledge about the domain. Informants with the highest first-factor loadings (ranging from 0 to 1) are assumed to have the highest competency or cultural knowledge in the cultural domain being tested, and the first factor loadings provide an estimate of the correct answers (ratings) to the question in the knowledge-of-domain test (i.e., the relative abundance of each type of game as judged by the sample studied). We then calculated the average competence and the average Pearson *r* among all respondents, which is the square root of the average competence. We also calculated the reliability of a simple aggregate (average ranks) using the level of agreement. The informal model of CCA can be estimated using the factor analysis programs in any major statistical analysis package. We used the procedure implemented in UCINET (Borgatti, Everett, & Freeman, 2002). To test for interpretable subgroup variation, we tested whether age or expertise were correlated with the first or second factor loadings. The second set of factor loadings have sometimes explained expertise and have indicated the presence of multiple models (Boster & Johnson 1989).

To test whether hunting expertise influenced the cultural models and perceptions of abundance, we used a principal components analysis (PCA) to create a single expertise scale to optimally combine the three related expertise variables and increase reliability: (a) Time elapsed since the last successful hunt (TIME) was coded 4 for those who hunted within the past three days, 3 for those who hunted four to seven days ago, 2 for two-three weeks ago, and 1 for those who hunted more than a month ago. (b) How often game was consumed (GAME) was coded 1 for families that reported consuming game once a month; 2 for twice monthly; and 3 for three or more times per month. (c) For all species mentioned by the informants as regular game caught (SPECIES), data were coded 1 if the informant hunted the species and 0 if he did not [for SPECIES, we included paca (*Cuniculus paca*), collared peccary (*Pecari tajacu*), white lipped peccary (*Tayassu pecari*) and spider monkey because, based on our ethnographic work, these are more sought after game, but only spider monkey loaded well on the PCA and all others were ultimately excluded].

To examine the distribution of cultural knowledge with expertise, we compared the expertise estimate from the CCA with the expertise scale score created by combining self-reports of hunting behaviors and identified whether the number of animals that were reported as abundant explained differences in competency scores. We examined the distribution of competency scores and represented individual variation in cultural knowledge scores with multi-dimensional scaling where the similarity between hunters and CCA culturally correct answers was represented spatially (Figure 1). We then evaluated the differences between low (≤. 5) and (>.5) high competency scores. This finding of fewer experts follows conventional wisdom of human populations on given domains. We evaluated if the expertise scale and the number of animals reported as abundant explained the different cultural competencies using ANOVAS.

Results

The three expertise questions created a single, coherent scale, capturing 53% of the variance of informant responses in the first factor of the principal components analysis of responses to expertise questions. Consuming game often and hunting recently, as well as hunting spider monkeys, loaded high on the first factor (loadings >.780, >.690, and >.700, respectively). Spider monkeys were the only species linked to hunting expertise, and this species also loaded positively on this factor.

There was shared knowledge consensus among expert and non-expert hunters about wildlife abundance in Salvatierra. Agreement was very high among all hunters. The average cultural knowledge score was .62 ± .17. A large portion of the variance was explained in the model since the average Pearson *r* among all respondents was .787, and the reliability of a simple aggregate (averaged ranks) was .92. The eigenvalue ratio of the first factor to the second factor was 4.3. There were no interpretable sub-groups identified by correlations of competency scores and 2nd factors with expertise ($r = -.176$, $p = .457$; $r = -.164$, $p = .490$) and age ($r = -.118$, $p = .701$; $r = .344$, $p = .249$). Informants agreed that the agouti was abundant and that the spider monkey, white-lipped peccary and the brocket deer were rare. All other animals were neither rare nor abundant (see Van Holt, Townsend, & Cronkelton, 2010 for rankings of all animals).

There is, to be sure, variation across hunters in several key indicators. For example, hunters did not all hunt the same species and the number of days that had passed since informants last hunted varied greatly (21.7 ± 27.6 days prior to the interview), as did average game consumption (3.6 ± 6.3 times per month), and their cultural knowledge scores ranged from .16 to .82.

The multidimensional scaling (MDS) of the agreement matrix (Figure 1) showed that all hunters shared a model and clustered around the culturally correct responses, shown in the center of the graph. (To produce Figure 1, we added a row—that is, a new "person"—with the culturally correct answers, to the data matrix. An MDS of the agreement places this new person—with the correct answers—at the center of the graph). As expected, the high scoring individuals (#'s 8, 9, and 22, for example) were close to the culturally correct responses (#30 in Figure 1). Note, however, that those with low competency scores (the expert hunters, #1, 5, 7, and 23) are at the periphery of the MDS and are not next to each other. In other words, the experts are not in the middle (because of their own specialized hunting knowledge) and they are not near each other (because they don't share that specialized knowledge).

While we did not find any meaningful subgroups, we did find that low ($\leq .5$) and high competency scores ($>.5$) were statistically different from each other according to expertise. Hunters with more expertise had lower competency (ANOVA $F = 7.78$, $p = .012$, $eta^2 = .302$, i.e., 30% of the variance in knowledge scores can be explained by expertise) (Figure 2a). Low and high scores were statistically different from each other according to the number of animals that the hunter reported as abundant on the cultural-consensus survey (ANOVA, $F = 9.05$, $p = .008$, $eta^2 = .335$). That is, the number of animals a hunter reports as abundant explains 33.5% of the variance in cultural knowledge (Figure 2b).

Discussion

In these data on hunters in Salvatierra, there was a single shared model of wildlife abundance. The expert effect was clear: hunters who had a recent successful hunt, hunted less abundant species, and consumed more game perceived *more* animals as abundant, which resulted in *lower* cultural knowledge scores. This appears to be a case of the availability heuristic, first described by Kahneman and Tversky (1973): things that are easier to recall are recalled with higher frequency than those that are more difficult to recall.

The eigenvalues of the consensus analysis and the average cultural knowledge scores, average Pearson *r*, and the reliability of a simple aggregate show that the expert hunters were not drawing on completely different cultural models than non-experts, despite their lower scores. There was agreement across all hunters and there were no interpretable sub-groups identified by correlations of competency scores and 2^{nd} factors with expertise and age. Experts scored lower because there was less agreement among the experts with each other on which animals were more abundant. If the expert hunters agreed more among themselves, as one would expect, they would drive the model. In our case, the hunters did not agree with each other more, and they did not drive the model, which is why they appeared less culturally competent.

Hunter experts in Salvatierra – those who could capture harder-to-find, higher-payoff game such as spider monkeys – agreed with the rest of the hunters about the easily hunted agouti but did not share the majority perspective about the status of rare species. Experts did not always agree on which species was abundant. This may have to do with specialized hunting experience and the shaman effect. Most people hunted with rifles; we did not observe people hunting with dogs and hunters did not report that they hunted with dogs as is typical in other hunting communities (see Koster & Noss, 2014). Our ethnographic work showed that one hunter exclusively trapped terrestrial animals, a technique not usually employed by other hunters; he indicated that the terrestrial paca was abundant because he trapped them often whereas 68% of the informants reported the paca as rare. This is evidence of the specialized knowledge of experts [similar to the shaman effect (Bernard, 2011)] where expert hunters benefit by keeping their specialized knowledge different from the mainstream (or even from other experts) in concern that other hunters might deplete more game if they had this expert information. In response to which species hunters captured most often, expert hunters reported at most four species in common with each other. The specialization and experience of individual hunters also explained why only hunting the spider monkey loaded on the expertise PCA and hunting other animals did not. Two of the four experts (not always the same two) perceived spider monkey, tapir, paca, squirrel monkey (*Saimiri sciureus*) or nine-banded armadillo (*Dasypus novemcinctus*) as abundant, while two (again, not always the same two) agreed with the majority on these species. The culturally-correct responses had low variation despite that all but one informant classified animals according to all levels (0-2), so small deviations in the majority had a large influence on the cultural knowledge scores.

Consensus analysis focuses on emic knowledge -- perceptions. Van Holt et al. (2010) compared the culturally correct (emic) responses to ecological studies (etic evaluation) of wildlife communities where species were overhunted. The abundance estimates matched well for animals that are especially sensitive and resilient to hunting pressure, such as white-lipped peccary and spider monkey that are sensitive to hunting and are among the first to disappear in active hunting communities, and agouti that are resilient to hunting and can sustain substantial harvest. Pérez-Peña, Ruck, Riveros, and Rojas (2012) also showed that cultural consensus models of wildlife abundance estimates match well (80%) to wildlife density surveys in the same location. Considering this and the independent measures of expertise, we accept our hypothesis, that the best hunters should perceive rarer species as relatively more abundant than do average hunters because expert hunters have more direct encounters with those rarer species. While experts are affected by cognitive biases such as the availability heuristic and perceived more animals as abundant, differences in hunting styles and the shaman effect explains why experts had lower scores (they did not agree on which animals were abundant because they used different skills to hunt wildlife and likely did not share their knowledge with one another).

These data represent a challenge in human-wildlife research where often only a few experts emerge within a community, or in fact, in most surveys about perceptions, because there will likely always be variation of expertise. Our approach offers an independent measure of expertise and offers insights into how cognitive biases, differences in experience, and the shaman effect may influence cultural models. Increasing the reliability and validity of cultural models requires collecting independent indicators of expertise, designing cultural-consensus surveys in a way that experts can be isolated, and understanding how expertise may influence the models. Our work shows that experts perceived overall that more wildlife species were abundant because they were engaged more with wildlife and encountered rare species more often. However, they did not agree on which animals were most abundant.

Experts may not agree on wildlife management plans because they may hold different perceptions of abundance contrary to the majority and possibly contrary to other experts. Hunting experts might have the greatest stake in conserving wildlife, but they might also be the slowest to recognize the need for conservation. Given that the hunting experts presumably harvest more wildlife than anything else, exploring the tension between the experts' conservationist goals and perceptions of declining wildlife densities could merit increased attention from wildlife conservationists. Reconciling individual perceptions and expertise therefore is central to integrating TEK into wildlife management and research.

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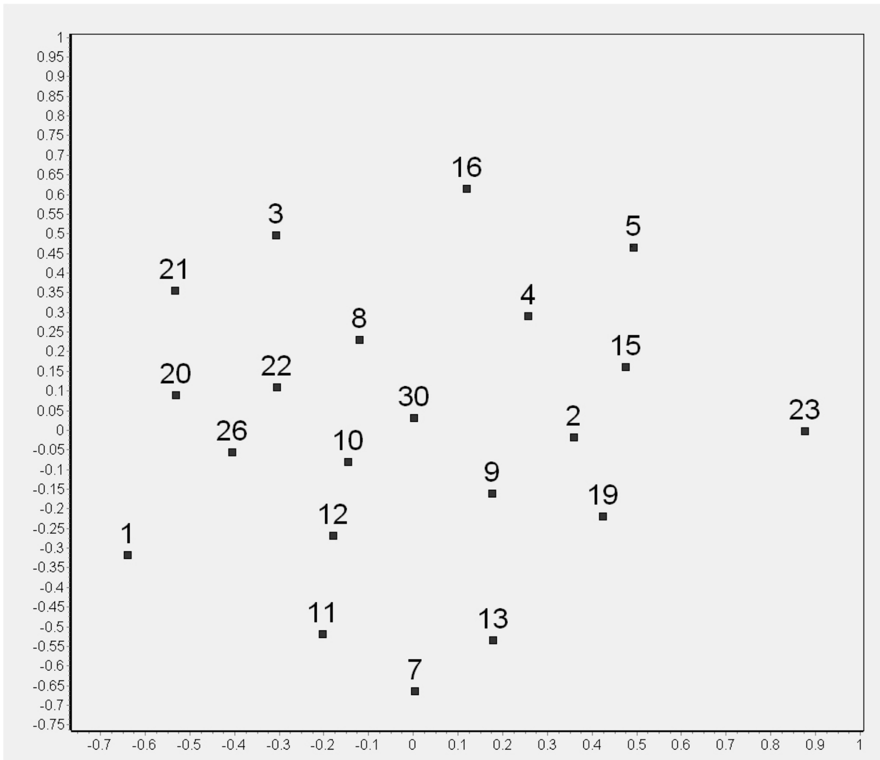

Figure 1. Multi dimensional scaling of informants, according to their responses to the CCA questions. Informant #30, in the center, represents the culturally correct response and those informants who scored highest (8, 9, and 22) are also near the center. The experts are on the periphery (#’s 1, 5, 7, and 23) and far from one another.

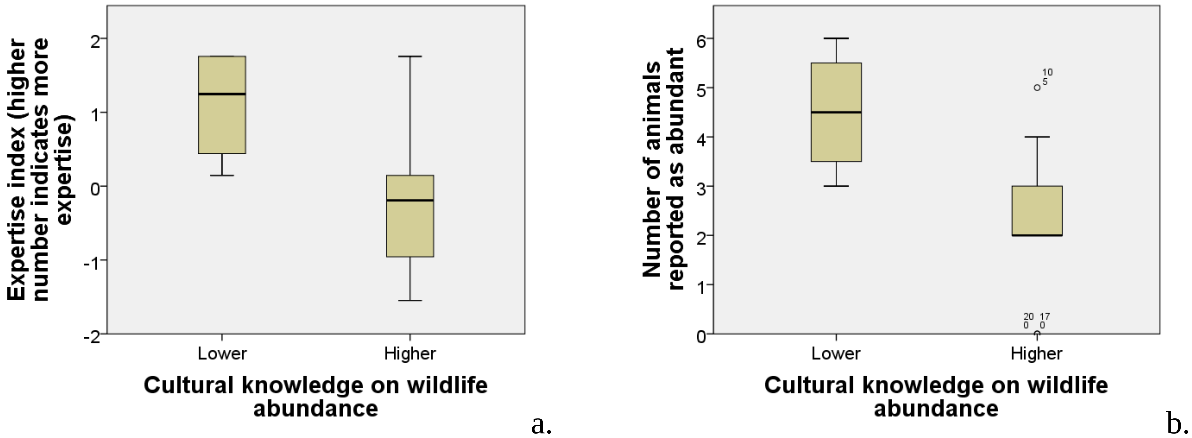

Figure 2. Hunters in the group with lower cultural-knowledge scores had higher expertise scores than hunters in the high cultural knowledge group (a). Hunters in the low cultural knowledge score group also perceived more animals as abundant than hunters in the high cultural knowledge group (b). The numbers in (b) are informants that are outside of the confidence intervals for the number of animals reported as abundant.