CAREER: BUILDING AN INTERDISCIPLINARY PROGRAM IN CULTURE AND COGNITION

For most of the 20th century the fields of anthropology, psychology and economics have become increasingly insular, despite the substantial overlaps in their domains of inquiry. Recently however, with a growing recognition across these disciplines that human psychology, culture and behavior cannot be understood independently from one another, researchers have begun to integrate across these fields (e.g. Nisbett, forthcoming; Medin & Atran 1999; Lancy 1996; Fiske et. al. 1998; Sperber 1996). To this end, this grant lays out an integrated program of educational and research activities aimed at further developing the emerging field of Culture and Cognition. The first of the project's five interrelated goals is to create an interdisciplinary network of international researchers from universities with nascent programs in Culture & Cognition. At planned conferences, on the project website, and through a seminar series, network researchers will exchange ideas, methods and students—and collaborative research projects will likely arise. Second, by developing the physical and technological infrastructure of both university-based labs and 'field labs,' the project will facilitate several educational and research activities. The university-based lab will provide faculty and students with specialized software for analyzing the full spectrum of field and laboratory data, as well as tools for designing and piloting field experiments and building tailored databases. Thus, this resource center will enhance student training in data collection, experimental design, and data analysis. Faculty and students will also be able to use the lab facilities in the research design and analysis stages of their own projects. Third, by combining the Culture & Cognition network of researchers (many of whom have ongoing field projects) with the construction of permanent field labs, both graduate and undergraduate students will find a substantially richer menu of opportunities for both field and laboratory research—and researchers will have convenient access to a larger pool of talented and trained RA's. With lab facilities and field research opportunities in place, the fourth goal is to develop a curriculum in Culture & Cognition to attract and train both graduate and undergraduate students from across the social sciences. Two core C&C courses will provide students with an interdisciplinary theoretical foundation and training in a range of methodologies, as well as opportunities for research. Fifth, the project will assemble and integrate a set of methodological and analytical tools that cannot currently be found in any one discipline. Methodologically, the major objective is to combine experimental techniques from psychology and economics with more traditional anthropological approaches involving long-term fieldwork, participant observation and in-depth interviews. Analytically, the project will recombine standard analytical methods for studying culture and social groups (e.g., consensus modeling and social networks) with novel analytical techniques aimed at measuring aspects of cognition and culture that have previously seemed intractable or difficult-to-quantify. After briefly summarizing my prior NSF-funded research, I discuss the planned Fijian fieldwork, emphasizing how this research contributes to both testing specific hypotheses about cultural transmission and the broader integration of methodological and analytical tools (the fifth goal). After this detailed description, I show how this field project promotes and integrates with the broader C&C goals (goals 1-4), and my own career objectives.

Results from Prior NSF Support

In 1997, I received an NSF Dissertation Grant for research on economic decision-making and cultural transmission among the Mapuche of Chile (SBR-9722857 Economic Behavior, Resource Use and Cultural Transmission). Four elements of this work are worthy of note. First, unlike most research on economic practices, I focused on understanding what individual farmers knew about *both* their own specific practices and about alternative practices (e.g., practices they had never used)—I explored their knowledge of details related to yields, input costs (e.g., seed, fertilizer, etc.) and processing requirements. Second, I asked farmers specific questions about the practices of other farmers in their local area to assess the depth of their knowledge about what others do. Third, I did this work in three separate Mapuche agricultural regions in order to compare across individuals from different social networks. Fourth, I integrated experimental tools from economics with traditional economic anthropology in order to more-precisely measure individuals' risk preferences and behavior in situations involving bargaining and cooperation.

Using these data in various ways, I've shown that most farmers knew extensive details about their own practices, but little about alternative practices. In combination with a substantial body of findings gleaned from decision-making psychology, I have argued that many farmers likely do not

evaluate costs and benefits of alternative practices because most lack the comparative information necessary to make such evaluations (Henrich 2002). Further, using comparative experimental data on risk from three different cultural groups, I've shown that the 'conservatism' of small-scale farmers in adopting new innovations likely does not result from risk aversion, as has often been thought (Henrich & McElreath 2002). With support from evolutionary theory and the psychological literature on social learning (Henrich & Boyd 1998; Henrich & Gil-White 2001), coauthors and I have proposed and shown that individuals often rely on social learning heuristics that allow them to acquire adaptive behavior in 'information poor' environments (more on this below). Two of these simple learning heuristics can be glossed as 'copy the majority' and 'copy the successful'. By comparatively analyzing the theoretical distributional patterns (derived using mathematical models) produced by such cultural learning and individual learning processes (and cost-benefit decision-making), vis-à-vis the actual distributions of practices across the three Mapuche regions (controlling for ecology), I have shown that individuals likely rely on these kinds of cultural learning heuristics. These findings and related themes have been published in the *American Anthropologist*, *Current Anthropology*, as well as in chapters in *Theory in Economic Anthropology* (Ensminger 2002) and *Bounded Rationality: The Adaptive Toolbox* (Gigerenzer & Selten 2002). A book on Mapuche economic life is in process.

In 2002, Ensminger and I received an NSF grant (#0136761: The Roots of Human Sociality) that was funded jointly by Economics, Decision, Risk and Management Science, and Cultural Anthropology. This project, which is currently underway, is the second phase of an ongoing line of research that I initiated in 1995, when I performed the first Ultimatum Game experiment among the Machiguenga (Peru) as part of a study on markets and economic behavior (Henrich 1997; Henrich 2000). Subsequently, with funding from the MacArthur Foundation, Rob Boyd and I assembled an interdisciplinary team of anthropologists and economists to perform a set of experiments in a sample of 15 small-scale societies. Our findings are too numerous to summarize here, but results from thousands of participants show: (1) substantial amounts of cross-cultural variation in experimentally-measured social behavior that can be predicted by a parsimonious set of variables related to local institutions, (2) decision-making models rooted only in self-interest do not perform well in any society, and (3) experimental behavior reflects real life in interesting and measurable ways. These results have been summarized in Henrich *et. al.* (2001, 2002) and at a recent AAA session (2001). Oxford University Press is publishing a comprehensive volume on our work (Henrich et. al., in press). We have also successfully communicated this work to the general public: Our project has been discussed in *New Scientist, Nature* and *Science News* magazines, *The Wall Street Journal* (front page, Jan. 24) and several European magazines and newspapers, as well as on British and German public radio.

In our current NSF-funded project, we have expanded our initial sample of societies, refined our methods based on our experience in the first round, and expanded the scope of our inquiry into new theoretical areas. We will have preliminary findings by fall 2002, and hope to have a rough draft of a second edited volume by winter 2003.

Career Development Plan

This section lays out the research, career and educational aspects of my proposed plan. First, I present the research component, and then link this to the educational and career-oriented components of the project.

Fijian Field Research: The Cognitive Mechanisms and Social Pathways of Culture

The goal of this research project is to better understand the cognitive and social processes by which individuals come to possess particular ideas, beliefs, habits, values, emotional responses and mental models—for these varied and overlapping concepts, I will use either the term 'mental representations' or 'knowledge'. In understanding the processes by which individuals come to acquire particular mental representations (i.e., how they 'learn culture'), an increasing body of evidence from psychology and anthropology suggests that three key aspects have often been overlooked. First, both children and adults acquire much of their knowledge by observing other individuals in an unconscious process of inference and imitation (Bandura 1977; Rosenthal & Zimmerman 1978; Boyd & Richerson 1985;Wyrwicka 1996). Unlike many middle class American families, active teaching and rewarding plays little role in the enculturation process in many societies (Fiske 1998; Lancy 1996). Second, individuals of any age are not passive receptacles into which mental representations and knowledge are poured. Instead, individuals actively direct their social learning efforts at specific individuals ("cultural models") with certain characteristics (e.g., same-sex peers with superior skills, achievements, or

prestige; Henrich & Gil-White 2001), or they rely on social learning heuristics that integrate information across cultural models—such as a heuristic like 'copy the majority' (Henrich & Boyd 1998; McElreath & Henrich 2002). This means that, contrary to the "nurture assumption" (Harris 1998), the available evidence suggests that only under particular circumstances do individuals acquire their mental representations directly from their parents (Whiting 1941; Mead 1934). Third, because the information available via observational learning to reconstruct the underlying mental representations of the individual(s) being observed is incomplete, learners must bring sets of inferential assumptions or mental models to bare on the patterns of behavior they observe (Shore 1996; Lakeoff 1987; Sperber 1996; Boyer 1994; Atran 2002; Toren 1990). Deploying such inferential processes not only makes an enormous amount of cultural learning possible, it also means that individuals who grow up in the same place may share aspects of knowledge and ways of thinking that they never "observed" or "learned" in the usual sense. They may share, for example, particular patterns of induction because they learned to apply a particular mental model to a certain kind of circumstance, and the model itself contains built-in assumptions that are not "learned" or "transmitted" (Atran 1998).

Recent work in applying evolutionary principles to understanding the development of our psychological capacities for cultural learning provides an overarching theoretical framework for both integrating and explaining the above observations about human enculturation, as well as a means for generating a wide range of hypotheses (Boyd and Richerson 1985; Henrich & McElreath 2002). This approach is founded on the assumption that human cultural learning *capacities* (e.g., imitation) evolved via natural selection to facilitate the acquisition of ecologically and socially adaptive information (skills, practices, mental models, emotional responses, etc.) from other members of their social group. With this approach, and with the aid of formal evolutionary models and computer simulations, my coauthors and I have predicted (1) the kinds of 'cues' that learners should deploy in figuring out which individuals in their social group they should focus on, observe and 'learn from' (i.e., who is most likely to have adaptive information), and (2) the kinds of social learning heuristics that will enable them to integrate their observations across different individuals and extract the most adaptive mental representations from the available pool.

Detailing the first line of predictions, Gil-White and I (2001) have argued that to improve the acquisition of adaptive skills, knowledge, strategies and other mental representations, natural selection favored cognitive abilities that allow individuals to use reliable *cues* that signal who among the available individuals are likely to possess useful, acquirable skills/knowledge. For example, aspiring hunters should focus on observing and imitating the most skilled hunters in the community. However, because an individual's 'skill' is not readily observable, learners may use cues such as hunting returns to figure out whom they should imitate. But, because the mental representations that an individual infers from attending to particularly skilled individuals may not be well-suited to the learner's particular context (e.g., because of their physical abilities or sex role), learners should also weigh their potential models' similarity (to themselves) in deciding from whom to learn. In children, for example, we have predicted and gathered evidence to show that individuals should preferentially imitate skilled or knowledgeable, same-sex peers, who are slightly older than themselves. Biasing by sex, age and skill (or cues of achievement) gives learners the best chance of acquiring mental representations that will be useful in their immediate and long-term future roles (6-year old girls become 8-year old girls, etc.).

Pressing this line a bit further, we showed that once a cognitive capacity for preferentially learning from skilled models has spread through the population, highly skilled individuals will be at a premium, and social learners will need to compete for access to the most skilled models. This creates a new selection pressure on social learners to pay deference benefits to those they assess as highly skilled in exchange for preferred access ('copying opportunities' and perhaps tips, hints, etc.). Deference benefits may take many forms including coalitional support, general assistance (help), caring for the offspring of the skilled individual, gifts, etc., as well as performing reliable ethological displays.[1]

Because such deference patterns inadvertently provide a costly signal of whom individuals believe are the most highly successful or skilled individuals, naïve individuals can use this emergent pattern to save on information gathering costs—on figuring out whom to learn from. For example, children and immigrants, lacking any detailed information about the relative skills and successes of

[1] These include maintaining proximity, diminutive body posture, yielding 'the floor' (not over-speaking them) and careful attention (e.g., eye-gaze). These patterns are predicted by assuming that selection favored behaviors that both maximized learning opportunities, and simultaneously signaled deferential intent to the skilled individual.

their potential models, may take advantage of the existing pattern of deference created by more knowledgeable individuals, and use 'received deference' as a cue of underlying skill. Assessing differences in deference patterns provides an initial 'best guess' of the skill ranking until more information can be accumulated over time.

The end point of this evolutionary process predicts the emergence of a uniquely human form of social status, which we have called *prestige*. Like the phylogenetically older dominance-status, prestige-derived status specifies a stable asymmetry in the flow of benefits across individuals. However, unlike the dominance case in which the asymmetrical flow results from coercive force, or force threat, prestige-based asymmetries result from the exchange of deference benefits for information (learning opportunities). The two forms of social status generate quite different psychological, ethological and sociological patterns that can be distinguished empirically. Because dominance psychologies are evoked by differences in control over costs and benefits, human institutional positions can produce dominance patterns—formalized positions like 'general' or 'boss' may evoke dominance. In contrast, prestige, as I just outlined above, arose as part of the evolution of human cultural capacities (thus, non-humans do not have this form of status). Hence, prestige-status can arise directly from perceived differences in skill, knowledge, achievement, etc., independent of any control over costs and benefits (e.g., Michael Jordan receives great deference and is imitated, but has no control over the costs and benefits of those who defer to, and imitate, him). Henrich & Gil-White (2001) detail this theory, derive predictions, and compile evidence from across the experimental and ethnographic literature.

In theorizing about what kinds of social learning heuristics people might use, Boyd and I used computer simulations to study the evolution of *conformist transmission* vis-à-vis vertical transmission (learning from one's parents) and individual learning (trial and error). Our work shows that conformist transmission (glossed as 'copy the majority') in combination with a small amount of individual learning is likely to have evolved under a wide range of conditions because it allows learners to aggregate across individuals with different experiences, and extract useful mental representations (Henrich & Boyd 1998). In a separate paper, we also show that conformist transmission facilitates the acquisition of adaptive representations by systematically correcting errors introduced during the inferential processes (Henrich & Boyd 2002). Ongoing work suggests that psychological processes that integrate model-ranking cues (based on high degrees of skill, deference and self-similarity) with conformist learning rules generate perhaps the most effective cognitive heuristics for acquiring adaptive information.

The above-described line of research suggests several general questions about the nature of cultural transmission: (1) What are the pathways of cultural learning? Do people preferentially learn from their parents, peers, prestigious peers, teachers, people similar to themselves, etc.? What is the relative importance of each of these in different cultural domains? Do individuals use integrative learning rules like 'copy the majority'? If so, under what circumstances? (4) How important is direct (personal) experience vs. social learning in acquiring mental representations of, and knowledge about, the world? (5) Under what circumstances do psychological and social processes generate widely shared cultural representations, and under what circumstances do they generate a high degree of intra-group variation. Below, after laying out the methods, I use the theoretical work just sketched to derive precise predictions vis-à-vis these general questions, and show how the data will be used to test these predictions. Because the data analysis is rather complex, I will discuss certain preliminary analyses in the *Methods* section, before I bring everything together in *Research Questions, Hypotheses and Data Analysis*.

Underlying these psychological learning processes is an array of inferential mechanisms that allow individuals to construct mental representations by observing others. For example, if a child sees her sister pick out a fish from her net and toss it back saying "it's poisonous," does the child infer that (a) that 'species' of fish is poisonous, (b) only that individual fish is poisonous, or (c) all fish that color are poisonous, etc. A substantial amount of work suggests that individuals rely on 'basic-level categories' for learning about a wide variety of things, and extending their knowledge about one category to others (category-based induction). Since this is best established in the realm of biological knowledge (Atran 1998; Medin & Atran 1999; Berlin 1992), this project will examine the ontogenetic trajectory of cultural knowledge about ecology and biology by comparing the similarity and differences between adults and children. Among other things, this research will allow us to (1) assess what aspects of cultural knowledge are readily acquired at young ages and what aspects require either more direct experience or longer periods of social learning, and (2) compare the effect of direct experience on adult knowledge by comparing three groups (different clans) from the same Fijian village that specialize

alternatively in fishing, agriculture and political leadership. By comparing the above findings on the ontogenetic trajectory of cultural knowledge about ecology (e.g., species categorization) with parallel trajectories in the domain of status differences and social categorization, I will be able to study the similarities and differences in how individuals learn, what they learn, and when they learn about these different domains.

As described above, my work with Gil-White on the evolution of prestige, as a particular form of status that derives from cultural transmission, suggests that individuals may have 'mental templates' that allow them to rapidly and efficiently organize the world by distinguishing dominant individuals from prestigious individuals—because dominant individuals must be avoided or appeased, and prestigious individuals are sought out, closely observed, listened to (for information) and emulated to the degree possible. This suggests that children at a relatively young age may develop a fairly accurate sense of who in their community is skilled and prestigious, and who is dominant (and know the corresponding emotions of fear and respect/honor) by unconsciously observing deference patterns. However, at the same time, children may require substantially longer to infer (or otherwise learn) all the precise details and causal explanations that enter into adult understandings of social ranking (Toren 1990). Similarly, some aspects of the Fijian concept of *mana* (an individual's power or effectiveness), which is thought by Fijians to be transmitted down lineages like 'biological essences', may reflect or partake of cognitive processes related to folkbiology, and thus may be readily learned by children, and easily apprehended by outsiders. However, building on this cognitive structure, the more nuanced details of the adult concept may take years to acquire.

Field Site

This research will be initiated on the island of Nacula in the Yasawa island-chain in the northwestern part of Fiji. The island is 10km long and approximately 1km wide with four villages of about 300 inhabitants each. Economically, the dry climate and infertile soils of the Yasawas (compared to the rest of Fiji) limits the production of root crops (manioc, yams & taro) and tropical fruits. Consequently, while still a mixed horticulture-foraging economy, these island populations are more heavily reliant on marine resources than other Fijian populations. In addition to household and community-level production, about 10% of the adult population participates in, or has participated in, wage labor in the Fijian commercial sector on Viti Levu and other islands.

Socially, each village consists of several ranked clans (*Yavusa*) and lineages (*Mataqali*). Political power is concentrated in the lineage head of the highest-ranked clan, and decision-making power depends principally on sex, age and clan rank. Village chiefs are hierarchically organized under an island chief, who is under a chief of the Yasawa island group. A variety of Christian churches play an important role in social and economic life. However, although institutional positions in church organizations do sometimes compete with traditional chiefly authority, they are typically subordinated to it. Marriages are lineage exogamous, with cross-cousins as the preferred spousal choice, and residence is usually patrilocal.[2]

Methodology

With the target of understanding the processes of cultural learning in the domains of marine ecology/biology and status-related social relations, the principle end product of these data-gathering methods will be a series of quantitative measures of mental representations and knowledge for the two cultural domains, and a set of data matrices intended to capture *Cultural Information Networks*. Many of the methods referred to below for quantifying cultural knowledge derive from fairly standard techniques in cognitive anthropology and psychology (e.g., pile sorts, free lists, paired-comparisons, etc.), but some new methods and applications will be introduced and explained in detail. Cultural Information Networks (CIN) are a subset of social networks, and are meant to represent the pathways through which cultural learning occurs. Using the language of social networks, each directional tie represents 'who learns from whom' or 'who pays attention to whom for the purposes of social learning'. I propose to measure CIN's using a variety of methods, including both interview- and observation-based techniques. In the section *Research Questions, Hypotheses and Data Analysis*, I explain how these two forms of data will be brought together to inform the theory presented above.

[2] While anthropological work has been done elsewhere in Fiji over the last century—on Viti Levu (Geddes 2000; Ravuvu 1983), Gau (Toren 1990, 1999), Kadavu (Tomlinson 2002; Calamia in prep) and in the Lau group (Salhins 1962; Hocart 1929; Thompson 1940)—no work has been done in the Yasawas.

In evaluating the feasibility of this project, keep in mind that I plan to lay important groundwork during the 3 summers prior to the full year of fieldwork, and make extensive use of six trained research assistants for much of the data collection. This groundwork will include (1) collecting basic demographic, kinship and economic data from all households in the study village, (2) digitally photographing every individual, (3) designing and assembling a database, (4) mapping the village, island and reef using a DGPS, (5) piloting our intranet server-based system for data collection and our methods for soliciting social networks, (6) training local research assistants, and (7) gaining proficiency in the local language (a Fijian dialect). At full steam, the team will have seven researchers: 3 or 4 non-Fijians (myself, Dr. Natalie Smith & 1-2 graduate students), two Fijians from the island, and two Fijians from elsewhere in Fiji.

Besides drastically increasing the quantity of data that can be gathered, multiple and diverse research assistants provide several advantages. First, by using a variety of interviewers, we can incorporate 'the interviewer' into the data analysis to assess how much the interviewer affects the data (Aunger 1994). Second, for some types of data, local interviewers or interviewers of a particular sex vis-à-vis the interviewee may be able to get better information, especially on certain topics—e.g., Aunger has shown that local interviewers get more reliable answers to questions about food taboos than anthropologists. By analyzing the data as it comes in, and working closely with key informants, I will be able to isolate and explore any interviewer effects. In my previous work with the Mapuche, I have used this method extensively, and have successfully identified and corrected for 'interview effects' during both data collection and analysis.

Measuring Local Knowledge of Marine Ecology/Biology

In order to assemble the structured data-gathering instruments that will be used to quantify cultural knowledge in the domain of marine ecology/biology, I will begin with a set of semi-structured interviews using a random sample of 30 adults from different households. First, each person will list as many marine plants and animals as they can. Depending on the advice of reliable local informants, I may incentivize this free listing by awarding a prize to the individuals who list the greatest number of different species or subspecies of marine life. After free listing, individuals will be asked to identify (name) a large set of photographs derived from the available literature on tropical south pacific marine life (e.g., Allen & Steene 1999). After these tasks, each person will be asked to tell what they know about each organism on a master list, which will be compiled from all previous free lists (unless the list grows too long) and the photo-identification task. Once the informants' initial comments about the organism have been exhausted, my probes will become increasingly more specific and will focus on three areas: (1) behavior (if applicable) of the organism, (2) human use (e.g., harvest season) and important concerns (e.g., venomous), and (3) relation to local ecology (other organisms). Some examples of the kinds of 'behavioral questions' I will ask are: Where is this animal/plant found? Does it live in groups? Does it reproduce (if so, how? lay eggs?)? Are there males and females of this organism? Does it sleep? (if so, when?). Some examples of 'human use' questions are: Do people harvest this plant/animal? Is it dangerous, poisonous, or venomous? Is it edible? What happens if you eat it? What happens if it bites/stings you? When was the last time you saw one of these? How many have you seen (or how many do you see per week/month/year?)? What should one do if this organism is encountered? Are there taboos on this organism? Some examples of questions about relations to local ecology are: What does it eat? What eats it? Does it have any effects on other animals/plants? How? What other animals/plants affect it? How? Because these interviews are intended to bootstrap up my understanding of Fijian local knowledge, I will gradually be revising and refining the interview as I go along—this basic methodological approach builds on that used by Medin & Atran in their work on folkbiology. This initial inquiry will be used to develop the structured instruments described below.

For constructing some of the structured interview tasks below, I will attempt compile as comprehensible a set of photographs-matched-to-Fijian-names (for marine plants and animals) as possible. For any organisms that were not matched with the available photographs, or were inconsistent or ambiguous across informants, I will organize a 'photo competition' in which individuals will be awarded prizes for the best photographs of each organism on the 'unmatched list.' A few digital cameras with underwater housings will be made available for general use.[3] In combination with a laptop

[3] Experienced fieldworkers know that this 'photo competition' idea may fail miserably. Note, however, that the data from the semi-structured interviews should be more than sufficient to construct the structured tasks.

computer, I will be able to both print photos in the field and integrate them into our computer-based data collection instruments for use in the structured interview tasks. This expanded set of photograph-name matches will allow me to create different instruments suitable for "experts" and "novices" (e.g., children), if the need arises.

Second, using the information obtained from the semi-structured interviews, I will create a series of structured data-collection instruments aimed at various topics related to the biology and ecology of marine life with the goal of producing data matrices suitable for quantitative analysis (e.g., Cultural Consensus Modeling). Without doing the initial semi-structured interviews, it is not possible to precisely specify these instruments, but I can describe the form they will most likely take. *Recognition task:* Using a fixed set of 35-45 marine animal photographs, individuals will be asked to identify the animal in each photo (being as specific as possible). *Categorization Pile sorts:* individuals will be asked to sort the photos in as many piles as they want according to "what goes with what by nature" (following Medin et. al. 2002; Medin & Atran forthcoming). Informants will be asked to explain their piles. Then, after recording the pile assignments, informants will be asked if any of the piles can be subdivided in a meaningful way. We will continue subdividing the piles until the informant is satisfied that no more meaningful subdivisions can be made. Then, I will return to the original piles, and ask the informant if any of the piles can be combined in a meaningful way. At each stage, I will ask the informant to explain why piles can be broken down or combined. In this way, a taxonomic tree can be coded for each individual. By replicating the techniques used by Medin and Atran with Itza Maya, university students and Menominee, I will not only provide a measure of cultural knowledge suitable for analysis within my own sample of children and adults, but I will also be able to address whether the general patterns of categorization that have been shown for land vertebrates and trees can be applied to marine life. For example, categorizations of invertebrates do not show these same generic-species level of categorization (degree of specificity) seen in vertebrates, but little work has been done on populations that have substantial economic reliance on harvesting invertebrates. *Questionnaires*: Several questionnaire instruments will be developed that involve showing each individual a series of 30 to 40 photographs of plants and animals. For each photograph, individuals will be asked a series of either yes/no,[4] multiple-choice or fill-in-the-blank questions. For example, for animals I will likely ask such things as: (1) Is this animal edible? (2) Is this animal poisonous (will you get sick if you eat it)? Is this animal's bite venomous? When is the best time of day to fish/hunt for this animal? (3) What animal most frequently eats this animal? (fill-in); (4) This animal should not be eaten by (a) anyone (b) all women, (c) menstruating women, or (d) people from the 'land phratry.' Individuals' answers will be coded numerically and represented in a 3-D matrix (individuals-photos-questions), to allow for easy manipulation and analysis.

For another mixed set of plants and animals (approximately 40), I will lay out the photographs alongside a single 'target photo' and ask the participant to pick out all the organisms that affect the target, are affected by the target, or in which there are mutual effects. In each case, the informants will be asked how this effect occurs and whether it is positive or negative. This will be repeated until all the photos have been in the target position, and I will also ask the same questions vis-à-vis humans. This will be coded into a square matrix (photos as rows and columns, +1 when row item affects column item positively, -1 for row item affects column item negatively, and 0 for no effect). Such a matrix provides one measure of each individual's knowledge of ecological relationships and can be used to compare individuals.

After 20 adults have been sampled using the above-described instruments, I will run each data set through a Cultural Consensus Analysis (Romney et. al. 1986, 1987; Garro 1986), and depending on the results, I will assign the subsequent application of the instruments to one of two Tracks. Interview instruments that show "first factor solutions" (high consensus) will be assigned to Track I, while those with medium or low consensus will be assigned to Track II. Because Track I instruments don't capture very much intracultural variation, I cannot use them in combination with the Cultural Network data to track the flow of cultural learning (how this will be done is explained below). However, such high consensus instruments are ideal for studying the ontogeny of cultural knowledge/consensus. Thus, I will use Track I instruments with a large sample of children and adolescents of all ages to explore the ontogenetic emergence of adult levels of cultural competence (see next section). Track II instruments

[4] For yes/no questions, the question presentation will be varied to control for any "yes" or "no" biases in answering under uncertainty.

will be applied to a large sample of adults and integrated with the CIN analysis—here the high variance provides us with the statistical power necessary to pin down the pathways of cultural learning.

In addition to exploring local knowledge and the organization of that knowledge, I will initiate some exploratory work on how people deal with novel circumstances and make inferences using their local knowledge. To this end, I will ask informants to extend their knowledge by giving them 'what if scenarios' and seeing how they respond. The first technique is to stimulate people with ten different unfamiliar fish and marine mammal species. These start with a familiar context that may be relevant to the unfamiliar species. For example, "suppose you were out fishing around mid-day in May and you caught five fish in your net that looked like this [show a photo of an unfamiliar fish species]; each was 2 feet long and about 10 inches wide (show visually)." After presenting the basic scenario, I will begin with open-ended questions, giving the informant time to respond, and gradually narrow the focus. For example, one might begin with "What would you think? What would you do? Would you keep it or throw it back? Would you eat it? How would you prepare it? Would you ask anyone for advice about it? What fish from around here does this remind you of? Besides the answers the informant gives, I will pay careful attention to any questions they ask about the situation or fish. A second technique will be to give informants a familiar species in a novel circumstance. For example: "Suppose you catch a *fish-type* [common edible fish] that is [unexpectedly] covered with large green and yellow bumps, and has a milky white coloration on its eye. Following the same general-to-specific question pyramid, I would ask such things as: What would you do? Would you touch it? Throw it back? Eat it? Feed it to the pigs? What if, later that day, you caught another *fish-type* with only two small (barely noticeable) greenish yellow bumps? Using data from these probes, structured data-gathering instruments will be developed similar to those described above that will allow me to assess whether the pattern of inductive inferences in such novel circumstances bares any relationship to the details of the distribution of knowledge or to the cultural information networks.

Measuring Status, Status Knowledge and the Psychology of Status

Prior ethnographic work in Fijian villages indicates that social and economic life is dominated by a social ranking that is explicitly assigned by sex, age, and clan membership—although Toren (1990) shows that, under some circumstances, these three factors create predictable ambiguities. In addition, however, this work also suggests that other sources of status related to specialized cultural knowledge, success in church activities and skill/ability undercuts and influences social ranking, and may produce competing hierarchies (Sahlins 1962, Toren 1990, 1999, Thompson 1940). One central objective of these methods is to understand individuals' conceptions of status (or statuses) and measure individuals' mental representations of status rankings, with the ultimate goal of analyzing how status influences the pathways of cultural transmission. Here, I describe both observational and interview techniques for measuring different forms of status, as they exist in individuals' minds and as they emerge through interaction in daily life.

Conveniently, daily life in Fijian villages provides several straightforward ways to measure at least one kind of status by direct observation. First, at the level of the household and extended household, individuals seat themselves along the 'major axis' of the dining mat according to relative status (by age, sex and other considerations; Toren 1990). Thus, during frequent time allocation visits (see below for details), the ordinal positions of all individuals along the dining mat's major axis will be recorded. Similarly, during kava drinking ceremonies, which occur almost daily (depending on the village), individuals seat themselves according to relative social rank in relation to the *tanoa* (kava mixing vessel), which marks the division between higher and lower status individuals. According to explicit Fijian descriptions, seating position is only determined by age, sex, avoidances and clan rank, but I and other researchers (Toren 1990) suspect other factors may have important influences. When time allocation leads us (my assistants and I) to a kava ceremony, we will sketch who is sitting where, and the position of the *tanoa*. If possible, we will place discreet markers at intervals along the walls of the main kava drinking areas to assist us in measuring interval distances—actual physical distance, not just relative position, carries meaning in this context. Third, we will attend occasional village feasts and meetings, where similar seating arrangements express social rank in larger social groups, and can be similarly measured.

Using the data from the kava ceremonies in regression models, I can estimate the relative importance (as regression coefficients) of age, sex, and clan rank, as well as other variables like fishing skill, medicinal knowledge, education, etc. in predicting seating position (measures of fishing skill, etc.

are detailed below). Fixed-effects regression models are particularly useful in this regard as they allow one to control for the fact that somewhat different individuals are likely to be present at each kava ceremony. This approach will yield estimates of the relative importance of these variables *as they arise from daily interaction*.

By comparison, to get individual-level representations of the relative social rankings, we will deploy an interview-based method rooted in the same social context. Using a set of 15 small photographs of individuals from the village and a large floor plan of the typical kava drinking area (with the tanoa appropriately positioned), we will ask interviewees to place each of the photos on the floor plan (made to scale) according to where they think the individuals would sit for kava drinking. We will clarify whether their arrangement is where the individuals *should* sit, or where they *would* sit, if these are different (and we'll elicit both if they are different—although, I suspect they won't differ). Once arranged, we will use a grid system to quickly record the positions as 2-D continuous variables. We will also ask the interviewee to explain their arrangement. This will be repeated for 8 sets of 15 photographs, containing a total of 40 different individuals. For *each interviewee*, using fixed effects regressions, I will be able to calculate the relative importance of the same set of variables (age, sex, skill, etc.) in predicting the seating position of each individual, controlling for the other individuals (other photos). This means that every person who does the task will likely generate somewhat different beta weights (regression coefficients for sex, age, clan, etc.), thus yielding a distribution of these weights. Analyzing this distribution will allow me to address questions such as: Do women or adolescents have different weights than older men? Do people from different clans have different weights? Is there a convergence in weights with age? (Children will also perform this task). Note that 'different weights' implies a somewhat different mental model of social ranking. These individual-level results will also be compared with the weights assigned to the same variables as they arise naturally from social interaction (measured above).

Using the same technique in a separate set of interviews, we will explore how different individuals deal with ambiguous situations in social ranking. For example, the available ethnography suggests that social situations involving women from the chiefly lineage and non-chiefly men create status-related ambiguities (about who sits where). Using specially chosen sets of photographs, such an ambiguity can be highlighted and studied by putting a chiefly woman of very high status into a set of photos with various non-chiefly men who have been previously shown to produce a reliable social ranking among themselves. Using different sets of photographs will allow us to systematically disentangle the mixed effects of clan, age, sex and other potential factors such as wealth, skill or knowledge. Other ambiguities, which will no doubt arise during the fieldwork, can be isolated and examined with a parallel approach.

To gather data on other status rankings that may crosscut and compete with the hyper-cognized social ranking discussed above, a random sample of 40 individuals (adults and children) will be asked to free list important activities that require skills, knowledge or specialized abilities, and then rank those activities according to their (1) importance to the community and (2) difficulty (and perhaps other aspects). For each of these activity domains (e.g., spear-fishing), we will ask a large sample of individuals to free list the individuals from the village that they think are the most skilled or knowledgeable in each of these activities. Informants will then rank their list from most skilled to least skilled. For example, depending on the responses to the first free listing task, we may elicit rankings such as the most skilled rugby players, the most knowledgeable about local history, curing illness, gods, spirits and *mana*, the most educated, the wealthiest, and the best farmers, fishers, musicians, and storytellers. For each interviewee, I will generate a single 'prestige ranking' that aggregates the individual's rankings across all their lists—the same names will likely appear on multiple lists.

In order to understand how people think about status, and to develop structured interview instruments, I will begin with 30 semi-structured interviews on the general topic of status, social rank, prestige, deference and influence. As before, I will begin with open-ended questions and, after exhausting the informant's spontaneous responses, my probes will become increasingly more specific (often following up from the informant's initial statements). Here I list a series of questions to give readers a sense of what I have in mind: What makes someone worthy of respect/honor? How do people feel around such people (what emotion)? How does one become influential in this village? Describe the characteristics of a chief. Describe the characteristics of a commoner. How should commoners behave around members of the chiefly lineage? How should members of the chiefly lineage behave around commoners? Do chiefs differ from commoners? Can a commoner become a chief, or a member of the

chiefly lineage? Can members of the chiefly lineage and commoners marry? Is a person very skilled at curing diseases (or building houses, etc.) particularly worthy of respect or deference? What is mana? Where does it come from? How can a person get more mana? Are some *mataquali* (lineages) more important/influential than other *mataquali*? (Why? Can you rank them?) Can a person switch *mataquali*? If so, how? Can a foreigner join a *mataquali*?

Following the same approach described above for measuring marine ecological knowledge, I will use the data and experience gained from these semi-structured interviews to develop a series of precise instruments to gather systematic data from a large sample of participants on status-related social relations. As above, for each instrument, an initial sample of adults will be analyzed using Cultural Consensus Modeling (CCM). If a low or medium amount of consensus is achieved, I will assign the instrument to Track I—analyze it with CIN data to establish cultural pathways. If high consensus is achieved, the instrument will be assigned to Track II—apply interview instruments to children and plot the trajectory to adult cultural competence.

Measuring Similarity

Because the degree to which a learner judges another person to be similar to himself may affect how likely (or how much) the individual is to use the person as cultural model (i.e., someone he would learn from), we will measure individuals' assessments of the degree of similarity between themselves and others. Using a complete set of photographs for the village, each participant will be asked to pick out the individuals who are most similar (in overall similarity) to himself. Participants will then rank the *selected* photos from the most similar to the least similar. Finally, participants will be asked to explain their choices and rankings. Using these data, regression analyses will be used to assess what, if any, observable variables (e.g., relative age, lineage, height, etc.) predict each individual's similarity rankings. This measure will be integrated into the analysis below.

Measuring Cultural Information Networks

Using social network methods, my goal is to figure out who in the local population do individuals pay attention to for the purpose of social learning (who influences, or learns from, whom): Who are they likely to observe and listen to in acquiring their knowledge, beliefs and mental models of how the world works? Because it is difficult to know *apriori* which of the potential methods for gathering this sort of network data are likely to work best, I will deploy several approaches, based on both observational and interview methods. Once collected, the networks produced by each method can be compared to one another, and assessed according to their ability to predict the distribution of cultural knowledge (as measured above using the Track II instruments).

Interview methods: Every individual in the community will be asked to perform a set of social network tasks using a complete set of photographs of every individual in the village (except children <4). Using a series of target questions, individuals will first go through the photographs and pick out all the individuals whom (for example) "*you* might go to if you had a question about fishing or fish." Having selected out these individuals, the informant will then rank order the selected individuals according to whom they would be *most likely* to go to with a fishing question—this allows me to produce a set of weighted 'directional ties.' Here is a preliminary set of additional network target questions: (1) whom might you go to if you had a question about aquatic plants? (2) whom might you go to if you had a question about *vakaturanga* (proper behavior by and towards chiefs) or *vakarokoroko* (deference)? (3) whom might you go to if you had a question about *mana*? Undoubtedly, some of these may fail, and additional questions will be added as the research progresses. We will do these interviews with as complete a range of ages as possible, including both children and adolescents. With children, we will attempt to go as young as we can, and will examine how using only photographs of other children compares to the answers derived from the complete set. Also, using only the photos of other children, these informants will pick out (1) whom they are friends with (then rank them), and (2) whom they'd most like to be friends with, but aren't (and rank them). Because of the extensive number of interviews involved here, we will begin testing these methods immediately in Summer 2003.

Time Allocation: During the field year, my assistants and I will gather 12 months of spot-check time allocation data with between 4 and 8 checks per day. Entire households, not individuals, will be spot checked, and the checker will need to determine the location of each individual from that household at the check time. Standard time allocation codes (Johnson & Johnson 1987) will be used during the preliminary fieldwork (summers 2003-05) to develop a locally appropriate set of codes. However, our particular emphasis will be on recording who each person is with, and where they are

(e.g., whose house, which room, relative seating position around dinning mat or kava bowl). With children, for example, we will record who is in the playgroup and where this is occurring. Because we will use local Fijians, as well as foreign anthropologists as spot-checkers, we will be able to examine whether 'an approaching anthropologist' has an effect on people's activities (Borgerhoff-Mulder & Caro 1985). Data will be collected using the *Psion Workabout*, and organized using Observer 4.1 software.

Using this time allocation, we will be able to generate a variety of social network measures for children and adults. For example, I will be able to generate a matrix of weighted non-directional ties simply by using the fraction of time every two individuals spent together. Or, by focusing only on 'visiting data' I can produce a matrix of directional ties based on the fraction of visits to each person over total visits and 'who visits whom'.

Research Questions, Hypotheses and Data Analysis

Before linking the above data collection to the specific hypotheses and research questions, I will first outline my general approach by dividing it into two parts. The first part focuses on the ontogeny of cultural consensus using the Track I data (high consensus instruments applied to children and adults). The second part combines the medium and low consensus data with the information networks to examine the pathways and learning processes involved in cultural transmission.

The Ontogeny of Cultural Consensus: For each Track I instrument, the individual data sets (e.g., categorization task datasets) will be grouped by age-class (4-6, 7-9, 10-12, etc.) and each age-class will be individually run through CCM. This will provide measures of fit and a consensus model for each age class. Once this is accomplished, a variety of analyses are possible. For example, the consensus model for each age-class can then be compared to the adult consensus (yielding a correlation) and plotted—age-class on the x-axis and correlation on the y-axis. The ratio of first eigenvalue to the second, or proportion of variance explained, can be added for each age-class to illustrate the trajectory of the eventual adult consensus. Similarly, the average competence value for each age-class could be plotted with the standard deviation in competence as error-bars.

By comparing the trajectories of different instruments (e.g., chief-commoner relations, or status ranking vs. ecological relationships) one can assess (1) which aspects of widely shared mental representations and cultural knowledge are acquired more, or less, rapidly, and (2) if there are 'critical periods' in which competence jumps, or if it only gradually improves. Further, by analyzing the sequence in which items on the children's consensus models converge to the adult consensus, I can assess if certain items in the instruments are 'harder to learn' than other items (or if there is no particular pattern).

Two hypotheses will help structure this exploratory inquiry. Hypothesis 1: children will develop 'basic level categories' that correspond to the generic-species relatively earlier than other ecological categories or ecological knowledge (following Atran 1998), and ecological knowledge related to these basic level categories will be learned more rapidly. This may also apply to certain aspects of social categorization and knowledge (e.g., distinguishing commoners from chiefly lineages), if these make use of folkbiology's descent-based membership and essence-based approach to induction (Gil-White 2001). Hypothesis 2: children will develop an accurate knowledge of various status rankings (both social ranking and various skill/knowledge rankings) earlier than they will understand the cultural models/rules for ranking—i.e., that is, they will only know the actual rankings (based on observing ethological patterns), and will not yet have inferred the rules/models for ranking new individuals. This is because children are 'geared-up' to rapidly learn status rankings on the basis of deference cues—this follows from both my own theoretical work on status and Toren's (1999, 1990) ethnographic observations in Fiji.

The pathways and learning processes of cultural transmission: The second portion of the analysis can best be thought of in two steps. First, using the theory discussed above and the hypotheses presented below, I will examine the variables that influence (i.e., predict) the likelihood of 'links' or 'ties' (as a dependent variable) in the measured Cultural Information Networks (CIN)—the pathways through which cultural learning flows. Second, using the CIN data as independent variables, I will analyze the degree to which an individual's mental representations and knowledge are influenced by other individuals in their community. More specifically, I will use the CIN data to predict the distribution of mental representations and knowledge measured by various Track II instruments. This

should not only allow me to assess the relative importance of other individuals on one's own cultural knowledge, but also allow me to assess how that information is processed.

Hypotheses about establishing cultural learning pathways:

(1) *Skill/knowledge and Similarity:* In selecting cultural models (who people learn from), individuals will preferentially select people who they perceive as highly skilled or knowledgeable and similar to themselves. In the *p** autologistic regression analyses described below, this hypothesis predicts that the above-described measures of perceived skill and knowledge will have positive and relatively large beta coefficients (compared to other variables). This should apply to both domain-specific rankings that relate directly to the network target question (e.g., fishing) and the individual-level aggregated 'prestige ranking' described earlier—Henrich & Gil-White have used evolutionary theory to argue that great skill in one domain increases an individual's prestige (i.e., their likelihood of being imitated) in other domains. Both 'general similarity' between the individual and the potential models will positively predict the likelihood of ties. This similarity variable can come directly from the interview-based similarity measure described above, or can be derived from a set of 'observable' variables, such as same sex, social strata (chiefly phratry vs. commoners), and ethnicity.

(2) *Age:* Individuals will prefer models who are older than themselves, but not too much older. This is because, on-average, older individuals are more experienced, and thus more likely to possess adaptive information. However, individuals who are substantially older than the learner may not have information that is relevant to the learner's current circumstances. For example, by preferentially learning from older peers, children can scaffold themselves up to increasingly complex skills. By contrast, a 5-year old imitating an old fisherman isn't likely to acquire useful information because the child hasn't the basic knowledge or physical skills to make use of the advanced techniques or knowledge. The size of the age window (the potential model's age minus the learner's age) should increase with the age of the learner—older individuals should 'worry' substantially less about the size of the age difference than children.

(3) *Access:* Because learning is influenced by an individuals' exposure and access to potential models, factors like household proximity (physical distance), lineage membership and cross-cousin relationships ('joking relationships') should positively influence the establishment of cultural network ties, while parallel cousin ('avoidance relationships') are likely to reduce the probability of a network tie (esp. in adults).

Each of these three classes of variables can be put into *p** autologistic regression models (reviewed by Anderson et. al. 1999 for social network applications) and used to predict the existence and strength of ties in the CIN's.

Hypotheses about the flow and distribution of cultural knowledge:

The idea here is to use the measures of mental representations and cultural knowledge discussed above (hereafter KM, = Knowledge Measure) from each individual's models (her/his ties in the CIN) and his/her parents, as well as measures of direct experience (e.g., with fishing) to predict an individual's KM. The theory and evidence discussed earlier predict that (1) parents will have only a small effect relative to the effect created by one's models, and (2) individuals should acquire most of their cultural knowledge from cultural learning because individual learning is too costly and inefficient—thus, 'direct experience' (estimated by age, time allocation or personal reports) will be of relatively small importance compared to the effect of one's models. These predictions can be tested by estimating a family of network autocorrelation models (Leenders 2002; Anselin 1988) related to (1).

$$x_i = const + \beta_M \underbrace{\left[\sum_{j=1}^{N} w_{ij} x_j \Big/ \sum w_{ij} \right]}_{Model\ Weighted} + \beta_p x_{iP} + \beta_e y_i + e \qquad (1)$$

Here x_i is the KM of the focal individual, x_j represents the KM's of the individual's *potential* models, and w_{ij} is the rankings that *i* assigned to individual *j* from in CIN data ($w_{ij} = 0$ if no tie exists between individual *i* and the potential model *j*. x_{iP} is the KM for *i*'s parents, which could be the individual's same-sex parent or a blend of the parents' KM's—obviously *i* must have living parents to estimate this version of (1). y_i is a measure of *i*'s experience and *e* is the uncorrelated error term. By estimating the β-parameters in equation (1), and comparing the standardized versions of those parameters, I can assess the relative importance of models (network 'learn from' ties), parents, and experience in contributing to an individual's cultural knowledge.

This model can be applied to adults and children together (with controls for developmental differences that allow the 'parent effects' to decrease with age), or applied to each separately. Further, this same equation can be estimated using a variety of measures in both the domains of ecological and social/status knowledge. This will allow me to assess how different kinds of learning processes may contribute differently to the transmission of different aspects of cultural knowledge. We may find, for example, that knowledge about ecological relationships is primarily acquired from highly skilled, more experienced peers, while knowledge about *mana* is acquired primarily from one's father.[5]

Using equation (1) as a baseline model for how individuals integrate cultural information from multiple models, I can test it against alternative hypotheses about cultural learning processes by comparing the fit of alternative models to this baseline. For example: one alternative model arises if, instead of weighting the KM of one's models according to their perceived expertise, *i* uses a conformist transmission learning algorithm that integrates information across models (network ties). This can be introduced by replacing the term labeled 'Model Weighted' with a 'take the majority' algorithm or robust estimator (both versions of conformist transmission) that takes only the individual's that *i* is tied to in the CIN as input. Thus, every individual in the network has a different set of inputs. With this switch of terms in (1), the new equation can be estimated, and the AIC (Alkaike Information Criterion), which represents a measure of 'fit' for autocorrelation models (Leenders 2002), can be used to compare the baseline model to the alternative. If the AIC's are substantially different, this analysis lends support to one of the two hypothesized models. These two models could also be compared with other alternative models, such as one that includes a conformist effect from the entire community and a Model Weighted effect.

Finally, exploring these data, I will use standard social network techniques to isolate cohesive subgroups (Wasserman & Faust 1994) and apply CCM. Remember, I initially selected the Track II data because it failed to produce a single factor solution, so it will be interesting if subgroups can be found in the network that show strong consensuses. This would mean the failure of the consensus model for the entire group resulted from the fact that different subgroups within the CIN achieved different consensuses. The subgroups emerging from the social network can be examined for any correspondence with social structural divisions such as clan, phratry, or spatial clustering.

Longer-term Plans

Beyond the five year plan laid out here, I will continue this project for as long as possible (three decades hopefully), and expand it to include other villages within the Yasawas, other parts of Fiji (such as the southern Lau), and Fijian-Indian communities on Viti Levu and Vanua Levu. Longitudinal work with the same individuals will allow me to observe the actual process through which children acquire adult level cultural competence. By reapplying the same instruments periodically to the same individuals, I can relax the above assumption that today's children will one day achieve the same consensus as today's adults. Such longitudinal data on CIN's will also allow me to assess the relative stability of social networks for both adults and children over long stretches of time—network researchers often assume the networks they elicit are fairly stable over time, but this assumption is rarely tested. Eventually, I will be able to revisit the above analyses using network data collected over decades—e.g., the relevant CIN for predicting an adults' ecological knowledge may not be his/her CIN as an adult, but their CIN from ages 9 to 15. Expanding this project to similar villages that are hundreds of miles apart is essential for exploring cultural variation across social groups. In the process, I hope to train student researchers to replicate and improve on these methods in studying other societies.

Educational and Personal Career Development

In parallel with the above-described field research program, I will develop the interdisciplinary field of Culture and Cognition. The project goals over the next five years are to (1) construct a network of Culture and Cognition researchers at several universities to share ideas, methods and students through a variety of venues, (2) foster interdisciplinary interaction and collaboration by organizing a seminar series to bring exemplary scholars to Emory (e.g., Nisbett, Atran, D'Andrade, etc.), (3) develop the infrastructure and technological resources in my Emory and Fijian labs for training students in ethnographic methods, experimental techniques and data analysis, and (4) design an interdisciplinary course curriculum for undergraduate and graduate students interested in studying Culture and Cognition.

[5] For the various forms of KM, I will use logistic forms of the network autocorrelation models.

Building a collaborative network of Culture and Cognition interdisciplinary researchers from places such as UCLA, Centre National de la Recherche Scientifique, UC Davis, the University of Pennsylvania and the University of Michigan will contribute to the emerging field in several ways. First, by bringing together the field's top researchers with graduate students and undergraduates, the conferences planned for years 3 and 5 of this grant and the ongoing seminar series will promote intellectual growth and novel lines of interdisciplinary research, as well as creating fertile ground for inter-university collaboration. Promoting both research and education, the network will provide opportunities for students to pursue research projects at a wide variety of university- and field-based labs. Besides creating a tremendous opportunity for students, this collaboration will benefit researchers by providing a larger pool of qualified research assistants. The C&C Program at the University of Michigan (in which I taught in 2000-2001) has already begun to set this up, but I plan to invigorate and expand the idea substantially. Through a website dedicated to this Culture and Cognition collaboration, we will present our ongoing research (from all participating universities) in an easily accessible manner, post research and field training opportunities for graduate, undergraduate and even motivated high school students, and provide our detailed interview protocols, experimental procedures and analytical techniques to other researchers.

Throughout our field work, my assistants and I will also give lectures in the villages and village-schools in which we work in order to teach our informants something of anthropology, social science, and our research program—at the end, we will highlight our preliminary findings. As our Fijian lab's computer technology is replaced, we will donate it to the local Fijian schools.

Infrastructure and Technology for Education and Research

By year 3 of this grant I will have two complete Culture and Cognition Laboratories. Emory University has just completed refurbishing the first lab in Atlanta. By fall 2003, with this grant and money from Emory, this lab will be stocked with 10 workstations, loaded with both theoretical modeling and data analysis software—e.g., Anthropac, UCINET (social networks), The Observer (observational data like time allocation), Nud*ist Nvivo (qualitative data management and analysis), Mplus (structural equation models with latent variables) and Stata7. These computers will be linked to a local lab server, so they can be used in experiments and data collection. This laboratory is intended to be a central place for students and faculty: (1) running pilot and control experiments related to field work, (2) testing and refining new ethnographic and experimental methods, (3) looking for hands-on training in data-analysis and computer modeling of cultural learning processes (the lab will be used as part of the "Methods and Analysis" courses designed during the curriculum part of the project), and (4) working on projects requiring specialized data analysis, modeling and research designs related to culture and cognition.

Field laboratory: The second lab will be constructed in a Fijian village. Physically, this will be a mid-sized to large Fijian house. Following the standard Fijian pattern, researchers will live and work in the 'private' section of the house, while the large front section will be used for interviews and experimental work. The area will be decorated and laid out in exactly the manner of local houses (no furniture, woven mats on the floor), in order to make interviewees as comfortable as possible. The house will be equipped with solar power. A laptop computer will be used as a server for eight *wireless* Web-Pads (flat, 10-inch square). With simple touch screens, these will be ideal for gathering structured interview and experimental data. The idea is that one interviewer could run eight individuals through a series of exercises fairly rapidly, with the data being automatically entered into the database on the laptop. In previous fieldwork, I have found that using a computer with images and graphics is actually better than standard techniques because, for people who have little or no experience with computers, simply looking at the computer screen and touching the keys is fun and interesting. When we are not using the Web-Pads for research, we will make them available to the local schoolteachers for use in their classes—Web-Pads can also run 'stand-alone.' My hope is that this 'field lab' can provide a working model that can be replicated in improved by other researchers interested in pursuing long-term research on culture and cognition.

Curriculum Development

In collaboration with other Emory faculty, I will develop two 2-course series for undergraduates and graduate students. The first undergraduate course will be a general introduction to the field, with emphasis on understanding the major empirical foundations for the theoretical developments in the field. I will be piloting this course in the Fall. The second course prepares

undergraduates for research by providing them with both methodological (interviewing and experimental techniques, etc.) and analytical tools (CCM, social networks), as well as practice in linking theory and methods. The goal of the class will be to complete a small research project, with the goal of publishing it in *The Emory Anthropologist* (Emory's undergraduate journal). Accompanying these basic courses, I will design flow charts of recommended course sequences (pulling courses from across the university) for students interested in pursuing Culture and Cognition.

For graduate students, the first course will also be a general (but more intensive) introduction to the field, with emphasis on how both theoretical and empirical developments being made in a variety of disciplines can contribute to a unified body of theory. I will be piloting this course for graduate students from anthropology and psychology in the Fall. The second course will be on research design, and will emphasize integrating interdisciplinary methods (interviews, ethological observation, experiments) with rigorous data analysis. The goal of the class will be to write a fundable research proposal—perhaps for work at one of the field sites made available through the collaborative network. As above, along with these core courses, I will design flow charts of recommended course sequences in Culture & Cognition.

Preparation and Personal Career Development

My educational, institutional and research experiences have uniquely prepared me to successfully complete this project. My initial undergraduate training in both aerospace engineering and anthropology provided a firm, though somewhat unusual, foundation for my graduate work in anthropology at UCLA, where I worked jointly with Robert Boyd and Allen Johnson on both theoretical and empirical research. My work includes both laboratory experiences at UCLA (and later Michigan) and sixteen months of fieldwork in Peru and Chile, where I used a novel combination of ethnographic and experimental methods. My research was interdisciplinary from the start, and has been published in the top journals in Economics (*American Economic Review*), Anthropology (*American Anthropologist* and *Current Anthropology*), and Biology (*Journal of Theoretical Biology*). This diversity led to post-doctoral and faculty positions at the University of Michigan, where I was part of both the Department of Organizational Behavior and the Culture & Cognition Program in Anthropology and Psychology (where I taught the core graduate seminar). After my second year at Michigan, I was offered positions at several universities in Economics, Psychology, and Anthropology. I eventually chose Anthropology at Emory because I believe it will provide an ideal environment for developing the research program that I have outlined above. I spent the last year at the Institute for Advanced Study in Berlin, where I was invited to participate in a research group on social norms with an interdisciplinary group of economists, psychologists and philosophers.

Despite this general preparation, I will need to improve my skills and knowledge in three ways. First, I must learn Fijian. Besides field-training during the summers and self-study in the winters, I plan to engage a tutor for additional practice. Second, I must improve my knowledge of tropical Pacific marine ecology. Third, I will need to further refine my knowledge of certain advanced analytical techniques, including network autocorrelation models and autologistic regression. However, given my background, past experience and the time provided by this grant, I look forward to these challenges and believe they will lay important building blocks for my future scientific career.

Schedule of Major Activities

Year	Time Frame	Major Activities
1	May 2003-Aug 2003	Prelim. Fijian field work, funded by prior NSF grant; language training
1	Aug 2003-May 2004	Course curriculum development; Emory laboratory development; organize seminar series; language training.
2	May 2004-Aug 2004	2nd Summer field work in Fiji: demographic data collection, pilot methods for Cultural Information Networks, train field assistants; language training.
2	Aug 2004-May 2005	Implement new curriculum; continue seminar series; train student research assistants; test Web-Pad system; construct database
3	May 2005-Aug 2005	3rd Summer field season: network data, basic economic data, pilot semi-structured interviews, train field assistants; language training
3	Aug 2005-Dec 2006	Culture and Cognition Conference at Emory; language training; construct DB
3-4	Jan 2006-Dec 2006	12 months of fieldwork in Fiji
5	Jan 2007-May 2008	Data analysis, manuscript writing, 2nd C&C Conference at Emory; seminar series