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Persistence of Botanical Knowledge among Tzeltal Maya Children[1]

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Anthropologists and other social scientists interested in environmental knowledge are concerned that much of this knowledge is rapidly changing or being lost (Nabhan 1998, Maffi 2001). Although the systematic depth and breadth of ethnobotanical knowledge have been well documented (e.g., Conklin 1954, Berlin, Breedlove, and Raven 1974, Berlin 1992, Posey 1999), very little research has addressed the transmission and acquisition process (Ruddle 1993, Ohmagari and Berkes 1997, Zent 1999). Furthermore, few studies have been conducted on how these processes intersect with globalization, environmental degradation, migration, and poverty.

With the benefit of retrospective data, the results of our recent study indicate that one aspect of children's ethnobotanical knowledge—the ability to name plants—has remained relatively constant in the Tzeltal Maya community of Mahosik' (Chiapas, Mexico) over the past 30 years in the face of sociopolitical, economic, and environmental change. The study replicates research on Tzeltal children's acquisition of botanical terminology conducted in the same community in 1968 (Stross 1970, 1973). Stross used a "plant trail" instrument consisting of several hundred marked plants found on a path through the village that children were asked to identify. We re-created the plant trail in Mahosik' in 1999, using a representative sample of Stross's list of plants. The follow-up provided the unique opportunity to compare Tzeltal children's plant-naming abilities 30 years ago with those of a subsequent generation.

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Children's Acquisition of Botanical Knowledge

Enculturation and cultural transmission have been a focus of anthropological research throughout the twentieth century, although intensity of interest has varied over time. Childhood acquisition of environmental knowledge has only recently become a specific topic of inquiry. Information about children's interactions with the biophysical world was often included in ethnographic monographs but tended not to be the main focus of many studies (Ruddle 1993). Furthermore, research did not often focus on how children go about learning the everyday skills and tasks necessary for survival or cultural competency (Ruddle and Chesterfield 1977, Hewlett and Cavalli-Sforza 1986). We have more information on what children and adults know than on how they come to know it. Hewlett and Cavalli-Sforza's (1986) model of cultural transmission among Aka and Ohmagari and Berkes's (1997) research on Cree women's bush skills acquisition mark a reexamination of the process of acquiring environmental knowledge. Many ethnobiological studies focus on adults while emphasizing knowledge loss or change. Research on Piaroa ethnobotanical knowledge in Venezuela (Zent 1999, 2001) and ethnobiological knowledge among Lacandón in Chiapas (Ross 2002) focuses on generational knowledge differences.

Learning processes in traditional education systems are typically experiential or participatory in nature and unlikely to occur in formal school settings. In some societies knowledge is transmitted largely through parent-child interaction, as is the case with subsistence knowledge in the Orinoco Delta (Ruddle and Chesterfield 1977). In other societies children acquire the bulk of their knowledge through independent observation, participation, or play (Lancy 1996). Children in many societies have an astounding depth of plant knowledge, as Hunn's (2002) research in Oaxaca has shown. Acquisition of cultural knowledge and skills or, more broadly, socialization has come to be viewed as an active process—a collaboration between individuals involved in teaching and learning (Rogoff 1990). Several in-depth cross-cultural studies of child development have recently been conducted in the Maya region, including studies in Tzotzil and Yucatec communities in Mexico (Greenfield, Maynard, and Childs 2000, Gaskins 1999) and in Q'eqchi' communities in Belize (Zarger 2002).

Children's ability to name local plants is a fundamental part of their general ethnobotanical knowledge, part of a system of shared knowledge and beliefs often referred to as "traditional environmental knowledge" or "indigenous knowledge." Berkes (1993:3) defines traditional environmental knowledge as "a cumulative body of knowledge and beliefs, handed down through generations by cultural transmission, about the relationship of living beings with one another and with their environment." Ethnobiologists have noted that almost no research has been conducted with children (Waxman 1999, Medin and Atran 1999). What little there is deals with the transition from "novice" to "expert" within a given domain, primarily from the perspective of developmental psychology (Johnson and Mervis 1997, Carey 1985). Many of these studies have been conducted with North American children. They provide insight into the development of cognitive abilities as children grow and gain more experience in the world, but more cross-cultural research is needed. On the basis of major findings from developmental psychology and linguistics on childhood acquisition of ethnobiological terminology, Waxman (1999:274) notes that linguistic and conceptual development are linked, supporting the establishment of hierarchical systems of knowledge.

Study Context

In the highlands of Chiapas, the Tzeltal and Tzotzil Maya, numbering approximately 800,000 (INEGI 1996), have developed an elaborate knowledge system and modes of interacting with the biophysical environment (Berlin, Breedlove, and Raven 1974, Stepp 2000). Their landscape today is very much a human landscape, with a patchy mosaic of different habitats that in most cases are human-determined.

The community of Mahosik' is located in the northwestern part of municipality of Tenejapa, one of six Tzeltal Maya municipalities in the highlands. Tenejapa, with a population of approximately 30,000, is composed almost entirely of Tzeltal Maya-speakers, 80% of whom are monolingual in Tzeltal (INEGI 1996). Mahosik' lies between 1,500 m and 900 m above sea level on a mountain slope bounded by the river that forms Tenejapa's border with the municipality of Chenalho. At the time of the original study, it had approximately 300 inhabitants, with no electricity and no vehicle access available to residents. In 1999, when the follow-up study was conducted, it had approximately 1,500 inhabitants. It is now the second-largest community in the municipality after the municipal center. Coffee and corn are the main crops. The landscape surrounding the village is a mosaic of secondary vegetation. Despite the population density in the area and the intensity of agricultural activity, a significant amount of secondary forest exists.

Apart from population growth, there have been many changes in the community since the 1960s. What was once an eight-hour walk to the municipal center has been replaced by a 20-minute drive along a primarily paved all-weather road. Large trucks frequently travel the road carrying produce to regional markets. Almost all households have electricity, and some homes also have television and refrigeration. The widespread adoption of coffee production as a cash crop has led to a vast increase in the availability of consumer goods in the community. Some coffee growers have become so successful that they have begun hiring migrant workers from neighboring Guatemala. However, most families continue to practice subsistence farming as a primary household economic activity. Land use has intensified, and clearing of forests for firewood and building materials has accelerated. Medical care options now include a health clinic staffed by government health workers in the village.

Residents of the highlands have experienced increasing social and political conflict over the past 30 years. In the 1970s, in response to land shortages in the highlands, the federal government encouraged Tzeltal and Tzotzil Maya to migrate to the lowland Lacandón region of Chiapas. Continued marginalization in the relocated communities and in the highlands provided an active base of support for the Zapatista movement that emerged in 1994. The government's reaction to the uprising has included aid programs aimed at pacification, low-intensity warfare, and militarization. There is a high degree of awareness and concern about political events in the region.

In the face of this widespread social, economic, political, and environmental change, it appears that, for the most part, children's daily activities have not fundamentally changed. They still do not travel very far from their community on a regular basis and are engaged in household subsistence activities that take them to the forest, coffee groves, and farmlands. Very young children help around the house with small chores and household tasks and are often sent off on their own or in small groups to find cultivated and noncultivated herbs, fruits, or other items needed by their mothers, aunts, or sisters in food preparation. Beginning at seven or eight years of age, there is greater division of tasks by gender. Boys tend to learn skills from their fathers and girls from their mothers. Girls gain basic competence in a few household skills beginning at age five or six, and boys accompany their fathers to the milpa or the coffee grove at seven or eight.

Stross (1970) has described the acquisition of botanical knowledge as "informal," with infants first learning Tzeltal names for the plant parts that are most often consumed and gradually associating them with plants outside the house that produce them. Some information is volunteered, some is requested by the child, and some is overheard in informal conversations. This process is linked with childhood language acquisition. The mother and siblings of a child are the most important sources of plant names and uses early in life. As children develop, they begin to learn from their fathers, other relatives, and peers.

METHODOLOGY

In the original study, Stross created a plant trail that wound through Mahosik' and asked children walking the trail with him and a Tzeltal collaborator to identify a standardized set of plants. The trail included 209 species of varying degrees of cultural significance and abundance (Stross 1970, 1973). Stross interviewed 25 children (13 girls and 9 boys) and 10 adults over the course of a year. The follow-up study was designed to be as faithful as possible to the original, using a representative sample of plants to determine what changes might have occurred in children's ability to correctly identify plants over the intervening 30 years. We interviewed 29 children between the ages of 4 and 12 (16 girls and 13 boys) individually using a plant trail consisting of a subset of the original 209 plants used by Stross.[2] The plants were limited to a representative sample of 85 in order to avoid young children's losing interest in the task. With the original plant trail, each child's interview took approximately six hours to complete, while the follow-up trail required only two hours. The representative sample was obtained by coding the original list based on cultural use and significance categories of Tzeltal botanical classification identified by Berlin, Breedlove, and Raven (1974),[3] maintaining the same proportion of each category. Every effort was made to maintain the same variation within specifics, generics, and life forms. A list of the 85 plants included in the 1999 plant trail, with Tzeltal names, scientific names, and cultural significance categories, appears in the electronic edition of this issue.

RESULTS

The results of the 1999 study are surprising given the changes that have occurred in Mahosik' in the intervening 30 years. For example, by age 9, children could correctly identify at least 50% of the plants on the trail, and by age 12 they could identify 95% of the plants, a level equal to that for the adult control group. The same was true for children in the original study, although there was no adult control group.

In the 1968 study, culturally significant plants were correctly identified more often than plants that were considered less important. Children correctly identified cultivated species the most often (70% of the time), with protected and significant species following close behind. For both cultivated and protected plants, specific as well as generic terms were often known. A similar overall pattern emerges from the aggregated responses in 1999 (fig. 1). The children who participated in our study presented a higher percentage of correctly identified plants in the cultivated and protected categories than those from the earlier study, perhaps because the interviews were much shorter. To explore the relationship between scores from the two study groups, average scores for cultural significance categories were plotted and a linear regression calculated. The results indicate the significance of the relationship between the two samples (R-square = .893).

The relationships between plant-naming ability and age for children interviewed in 1968 (fig. 2) and in 1999 (fig. 3) are remarkably similar. Each data point represents

2. This is approximately 10% of the children in Mahosik' in 1999. Eight adults were also interviewed (three men and five women) in order to provide a cultural reference point for the children's answers within the Tzeltal system of widely shared ethnobotanical knowledge.

3. The four categories include cultivated plants, species genetically and morphologically altered by human intervention; protected plants, species aided in some way by human intervention; significant plants, species that are culturally significant but receive no special treatment; and unimportant plants, species that have little cultural utility or significance.

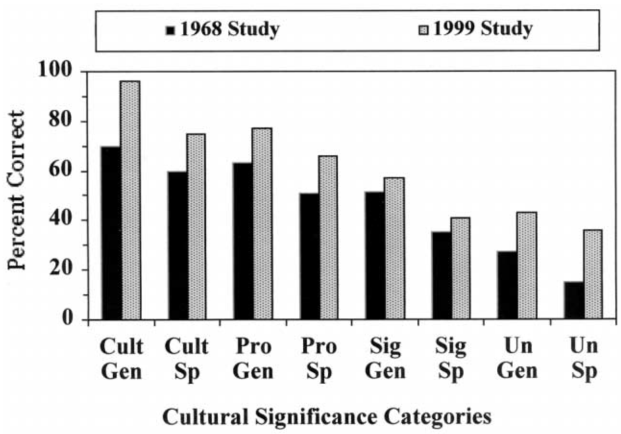

FIG. 1. *Percentage of plants identified according to cultural use and significance categories for children ages 4–12 in 1968 and 1999.* Cult, *cultivated;* Pro, *protected;* Sig, *significant;* Un, *unimportant;* Gen, *generic;* Sp, *specific.*

an aggregate (based on average score) of children's ability to name all plants on the trail for girls and boys in each age-category. The scores were calculated separately for specific and generic levels of classification because measuring the cultural difference between knowing the generic name for a plant and knowing the correct specific name is problematic. The ability to name plants is significantly correlated with age in both studies ($p < .01$ for the specific level).

Children's overall development of expertise in categorizing and naming local plants was not significantly different between the 1968 and 1999 studies. Two statistical tests were carried out to determine whether the results of the follow-up study were significantly different than those of the original study. The tests compared the average scores for each age-group in the two studies. The results of both a t-test (specific level, $t = -.620[16]$; $p > .05$ [$p = .546$, equal variances not assumed]; generic level, $t = -1.227[16]$; $p > .05$ [$p = .243$, equal variances not assumed]) and a Mann-Whitney test (specific level, $Z = -.354$; $p > .05$ [$p = .723$]; generic level, $Z = -1.060$; $p > .05$ [$p = .289$]) indicate that the differences in scores are insignificant.

From the perspective of cognitive development, the children exhibited a common pattern for novices who are beginning to master a particular domain of knowledge: overextension and underextension of categories. Studies have shown that children are more likely to overextend categories than are adults (Johnson and Mervis 1997, 1998) but that when reasoning is required to extend known categories to unfamiliar specimens or domains adults are much better at transferring existing knowledge and expertise. We found evidence of this on the plant trail in Mahosik'. For example, there were four morphologically similar ferns on the trail located in close proximity. Children who did not give the species-level name for the first fern that appeared, *Pteridium aquilinum* (*bats'il tsib*, or true fern), usually did not extend the generic name (*tsib*) to the other three ferns found nearby; because they realized that they did not know the species-level name, they said that they did not know the names at all. Adults exhibited the opposite tendency—when they realized that they did not know the specific name they extended the category of *tsib* to all four species of ferns.

DISCUSSION

Through a comparison of plant trail data collected by Stross in 1968 with data collected in 1999, we have demonstrated that little or no change has occurred in children's plant-naming ability in Mahosik'. More research needs to be conducted on how naming ability relates to general ethnobotanical knowledge and other environmental knowledge, such as knowledge of species interactions or environmental change. This is especially important because social demand for such expertise and the cultural value ascribed to environmental knowledge may in fact be changing. However, if classification and nomenclature are the foundation of ethnobotanical knowledge (Berlin 1992), they may serve as a limited proxy for understanding the dynamics of general ethnobotanical knowledge.

What is puzzling about the results of this long-term follow-up study is that in the face of what appears to be fundamental social, political, and economic change little or no change has occurred in children's ability to identify plants using their own cultural categories. The intervening 30 years have brought drastic changes to the com-

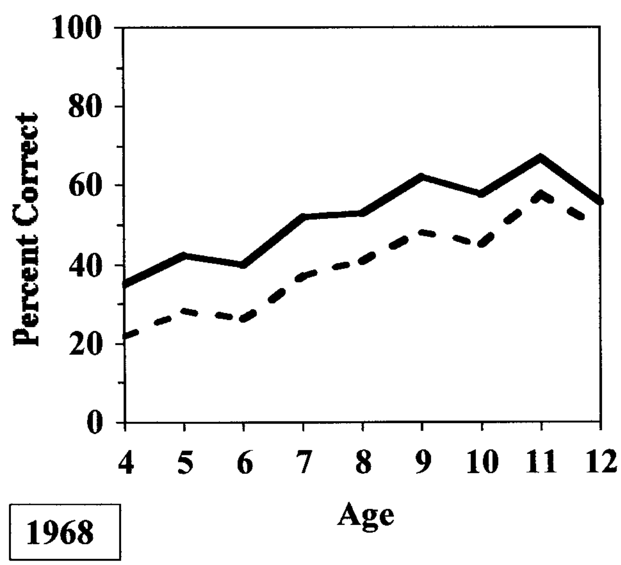

FIG. 2. *Percentage of plants identified for genus* (solid line) *and species* (dotted line) *levels for each aggregated age-group in the 1968 study* (n = *25*).

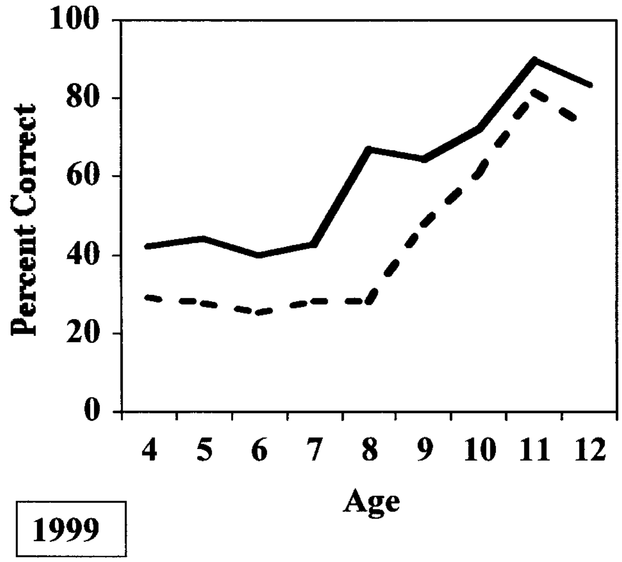

FIG. 3. *Percentage of plants identified for genus* (solid line) *and species* (dotted line) *levels for each aggregated age-group in the 1999 study (n = 37).*

munity; a water supply system has been installed, a satellite dish sits on the roof of the primary school, and there has been a fivefold population increase since 1968. What is it that has remained constant? Daily activities for most families in Mahosik' still focus on the milpa and the coffee groves. Although more children regularly attend school in 1999 than in 1968, many still do not attend every day of the week. Instead they may stay at home a few days out of the month to work or accompany their families to the fields, particularly during harvest times. In fact, children's day-to-day experiences in the local landscape may have remained relatively unchanged over the past three decades. Children spend most of their time out of school collecting food resources, playing, or working alongside family members. They learn much of what they know about their biophysical environment from their siblings, their parents, and their grandparents. It is likely that this foundational aspect of the acquisition process has not changed dramatically in the past 30 years.

The results of our study suggest that it is difficult to generalize about loss of indigenous knowledge around the globe. They also point to the need for further research on knowledge change in different local contexts. While significant change in plant-naming ability among children is not evident in Mahosik', the situation may differ in other Tzeltal Maya communities in Chiapas and elsewhere. Knowledge change or loss is very likely, given the current and potential effects of globalization as well as environmental and cultural change. But it is clear that more replicable comparative research needs to be conducted on the transmission of environmental knowledge. The fact that complete ethnofloras exist for only a small fraction of the world's population makes studies of this type difficult. We may find that environmental knowledge is resilient and mutable, persisting in some contexts while it is changed or lost in others.

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New Perspectives on Primate Evolution and Adaptation

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The study of primate evolution and morphological adaptation is vital to our understanding of the behaviour and ecology of living primates, including humans. The papers and posters on this theme presented at the winter meeting of the Primate Society of Great Britain on November 29, 2002, served as a showcase for the diversity and excellence of research on it in the U.K. and elsewhere, as well as demonstrating its relevance to more mainstream primatology. The Osman Hill Memorial Lecture, by Ian Tattersall of the American Museum of Natural History, was entitled "Becoming Human" and complemented the other presentations by conveying the behavioural differences, particularly the emergence and presence of symbolic reasoning and thought, between humans and other primates while highlighting the similarities in phylogenetic pattern between humans and other successful groups of animals, including primates. The biological similarity between humans and other primates was a theme in a further paper, by Margaret Clegg, in which interspecific variation in primate vocal tracts was examined. Clegg demonstrated that the human oral cavity and larynx are within the range of variation that would be expected for a primate of their body mass. Thus, although speech and language are vital in the definition of "being human" and Tattersall argued that language was the cultural stimulus for the evolution of symbolic thought, humans and primates appear to be morphologically very similar in the regions used to produce sound. Humans and primates were also compared in Chris Dean's presentation about the importance of tooth development rates in elucidating life-history patterns in fossil hominins. In Plio-Pleistocene hominins, including *Homo erectus*, enamel growth rates were higher than those in modern humans, indicating that their life-history patterns were different. It appears, therefore, that although modern humans are similar in many ways to other primates, crucial aspects of their biology, especially those linked to brain growth and development, have, at least in part, been causal factors in behavioural change.

The diversity evident in the primate fossil record was illustrated by the papers given by Peter Andrews and Dan Gebo, with Andrews reporting a new species of ape, assigned to the African genus *Kenyapithecus*, found in association with *Griphopithecus alpani* from the middle Miocene of Turkey and Gebo discussing Asian eosimiids, including postcranial evidence of a new species, weighing approximately 100 g, from Myanmar. Both of these papers provided important new insights into the radiation and biogeography of fossil primates. Andrews's talk, like Dean's, showed the utility of studies of enamel formation in extinct animals: enamel hypoplasia was evident in all of the fossils assigned to the new ape species but not in the associated *G. alpani* dentition, indicating a shared event that caused developmental stress in one species but not the other. The possible reasons for this were the subject of extensive debate.

Several major aspects of primate adaptation were considered at the meeting, including body size, brain energetics, and locomotion. Body size has implications for adaptation and is correlated with important biological and ecological variables, an issue that was illustrated clearly in Dan Gebo's paper on Asian eosimiids. Thus, an appreciation of the patterns of body-size change in primates is important to our understanding of the evolution of the order. Whereas Cope's Rule describes a tendency towards increasing body size over time in many animal groups, Christophe Soligo demonstrated that a gradual increase in size over time in the "archaic primate" group the plesiadapiforms was not accompanied by an equivalent trend in the primate omomyoid and