Evidence for the Precocious Acquisition of Plant Knowledge by Zapotec Children

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I will consider evidence that children in subsistence-dependent indigenous communities master great quantities of empirical knowledge about their local natural environment before 12 years of age without the benefit of formal instruction (Stross 1973). By comparison, most urban American adults are profoundly ignorant of their local floral and faunal environment (Dougherty 1979). The results of studies of ethnobotanical vocabulary acquisition by American and Tzeltal Mayan children is summarized in Table 1.

If this were simply a matter of children learning what they are taught it would be of limited significance. However, if acquisition of environmental knowledge is like first language learning, "acquisition deprivation" at a critical age may be lasting. Traditional Environmental Knowledge systems provide detailed, empirically robust images of local natural environments (Berlin 1992; Williams and Baines 1993; Berkes 1999). Such knowledge may be a necessary, though obviously not a sufficient, basis for sustainable resource management by local communities. The production and reproduction of TEK needs to be understood if TEK itself is to be conserved as a critical cultural resource for the future (Hunn 1999).

The question of the production and reproduction of TEK is also of interest to cognitive psychologists and linguists. The "modularity of mind" is the subject of much current research and theoretical speculation in these fields (Fodor 1983; Gardner 1983; Hirschfeld and Gelman 1994; Atran 1998). This research is motivated in large part by evidence that the child's precocious acquisition of syntax must entail quite specific innate species-specific language learning mechanisms. The neurological locus of such mental modules, specific in form and content, is as yet poorly known, but studies of selective aphasias due to localized brain damage indicate some tendency for modular localization of

Table 1. Acquisition of botanical terminology in three communities.

AGE	MAHOSIK', TENEJAPA, CHIAPAS (STROSS 1973)	BERKELEY, CALIFORNIA (DOUGHERTY 1979)	SAN JUAN MIXTEPEC, OAXACA (HUNN N.D.)
2.5	30+ plant names; 4 life forms applied functionally		
4-5	100 plant names applied consistently w/uses; 4 life forms; 32 generics	20 plant names; 10 applied consistently; 4 life forms; 7 generics	
6-7		7 life forms; 20 generics; 2 specifics	7 life forms; 58 generics; 12 specifics
8-10	108 plants on trail identified consistently; 4 life forms; 106 generics; 20 specifics; varietals	8 life forms; 26 generics; 4 specifics	7 life forms; 111 generics; 18 specifics
11-13	equivalent to low-end adult competence		9 life forms; 197 generics; 100 specifics; 6 varietals
adult	4 life forms; 471 generics; 237 specifics; 7 varietals (Berlin 1999)		10 life forms; 274 generics; 173 specifics; 7 varietals

certain language functions. Of particular interest is evidence for semantic localization by domain. For example, there are documented cases of the highly selective loss of (or retention of) memory for plant and/or animal names (Pinker 1994:314), which suggests the possibility that a child's acquisition of names for and associated information about plants and animals may be to some degree innately driven. Striking cross-cultural parallels in the formal scope of ethnobiological nomenclature and classification supports this view, unless we are to believe that these "universals" are adequately explained by the operation of more general learning strategies applied to the highly structured objective reality of species diversity. The "Magic Number 500" (Berlin 1992) as a central tendency for the number of basic plant and animal taxa (and of place names [Hunn 1996]) is also suggestive of content specific innate "formatting" of memory.

I believe that the evidence for the precocious acquisition of vocabulary for and knowledge of "natural kinds" (Keil 1986; Gelman and Markman 1987; Gelman and Coley 1991) may provide additional support for the view that there must be innate predispositions to acquire such knowledge. Furthermore, if learning about nature is "natural," we should consider the pedagogical implications. I will suggest in conclusion that currently fashionable curricular strat-

egies for early science education may be quite "unnatural" and thus less likely to succeed than alternatives designed to build upon a child's innate natural history learning module.

PROCEDURES

I will briefly summarize preliminary data from my Zapotec Ethnobiology project based in San Juan Mixtepec, a small town in the Sierra Sur of Oaxaca, Mexico, still largely self-supporting through subsistence agriculture based on the traditional Mesoamerican crop complex of corn, beans, and squash. The initial phase of this project was designed to document the Traditional Environmental Knowledge shared within this community and to establish the correspondence between San Juan Mixtepec TEK and the global scientific biodiversity inventory for the region (Hunn 1998). I have not systematically compared the quantity and quality of TEK among adults and children in San Juan Mixtepec. However, I have recorded large numbers of naming responses by individual consultants aged seven to 70. I plan a more systematic survey in this and neighboring towns in the near future, building on the data of my initial research.

In this brief presentation I will limit my analysis to the plant domain and to half-a-dozen individuals for whom I have extensive data. I will also limit my comparisons to counts of named plant taxa independently employed by each individual, categorized by folk taxonomic rank. I should note that counting named taxa and assessing their rank requires careful judgment. There are many ambiguities to be resolved. In particular, one must judge whether a linguistic response such as ***guièe-gùts***, literally 'yellow flower,' is in a given case used productively as a descriptive phrase or whether it qualifies as a lexeme, i.e., a semantically exocentric construction (Conklin 1962).

Naming responses were recorded in several contexts: 1) naming voucher specimens (during collection, pressing, or drying); 2) naming plants collected by consultants but not preserved (a rapid assessment technique particularly effective with children, once I had gained a basic familiarity with the local flora); 3) naming plants *in situ* during excursions through various habitats or while working in fields; and 4) review and discussion of vocabulary lists. I have so far collected 2085 voucher sets in and near San Juan Mixtepec, of which 1936 were named by one or more local consultants for a total of at least 2348 naming responses of type (1). The majority of these were named by Pedro Miguel Zurita or by Inez (28) and Justina (16) Cruz Hernández, their father Cándido (55), and/or their mother Rosalia Hernández Cruz (55). During July of 1998 and again this past September I commissioned local children to bring me plants

and to teach me their names, uses, and habitats in exchange for a token payment. Unfortunately, in several instances several children arrived simultaneously, so I could not confidently distinguish which of them knew which names. If in doubt, I attributed the name to the oldest child present. I recorded 768 such naming responses. Over half of these were by MariElena Cruz Hernandez (12), youngest daughter of Cándido and Rosalia. Lacking vouchers for these sessions, I made an initial assessment of the "accuracy" of the child's determination based on my sense of the range of admissible adult naming responses to the species in question. My strategy was similar for *in situ* identifications, though some of these were documented photographically. I have not yet tallied these, but they number in the thousands. Finally, I arranged for a series of interviews lasting 20 hours over three days with Hermilo Silva Cruz, immediate past municipal president, committed *milpero*, and literate in the local Zapotec. By briefly discussing with him the distinctive characteristics of each plant, I was able to confirm that we were speaking of the same plants.

My primary consultants for this analysis are all native speakers of Mixtepec Zapotec born and raised in San Juan. Mixtepec Zapotec is their first and dominant language; all but Rosalia are bilingual in Spanish. My two primary examples of "precocious" learning are MariElena and her niece, Lilia. The bulk of the data for MariElena was collected in the summer of 1998 when she was 12 and for Lilia in July 1998 when she was seven and in September 2000 when she was nine. I hit on the idea of offering MariElena ten pesos for each bag of plants she could bring with the understanding that she would tell me the names and uses of each. I made it clear that I did not want to pay for duplicates, but that she should bring me different plants each visit. It was late July, school vacation and time for the first weeding. MariElena would be able to collect the plants while helping her mother in the fields. The next evening I heard a soft knock on the door to our compound. It was MariElena with a plastic bag of leaves, flowers, and other botanical odds and ends. An hour later I had listed 32 plants, with uses and commentary on when and where they could be found in flower. Very little of her information appeared to be in error. The next day she brought another bag. We spread the plants out on the floor and tallied another 16, none duplicating her previous haul. Three days later she brought 19 more and her seven-year-old niece, Lilia, presented her own bag of 17. MariElena stood by as Lilia proudly named her leaves. MariElena once or twice quietly corrected her. The next day MariElena brought 26 more. The score: MariElena 97, Lilia 17, for a total of 114.

I returned in August for an additional extended visit. MariElena and I picked up where we had left off: 100 plants on the 18th, 96 more on the 19th, 25 on the 22nd, and 62 on the 23rd, at which time I had to leave to return to Seattle. During this visit the word got out that a child could earn easy money this way. Her

Table 2. Summary statistics.

	LF	G	G_0	G_+	S	S_0	S_+	V	TT	Total
Omniscent Informant	10	435	320	115	371	365	6	14	699	830
Total Voucher IDs	12	351	271	80	224	219	5	11	501	614
Hermilo	10	227	169	52	170	164	6	14	353	421
Pedro*	9	274	226	48	173	170	3	7	385	478
Cruz family*	8	239	203	36	91	89	2	4	296	350
MariElena	9	206	155	42	100	97	3	6	258	321
Miguel	9	153	132	21	54	54	0	0	186	233
Lilia§	7	112			18			0		137

* Voucher specimin identifications only.

§ Very partial returns, at seven and nine years of age

LF are life-form taxa; G_0 are monotypic generic taxa; G_+ are polytypic generic taxa; S_0 are monotypic specific taxa; S_+ are polytypic specific taxa; V are varietal taxa; TT are terminal taxa.

cousin, Miguel came around with his younger sister on the 18th with 52 plants (including many of the same plants that MariElena had already brought). He brought another 77 on the 19th, and 60 more on the 22nd. Lilia came by herself on the 18th with 60 more of her own. Finally, Cesareo, MariElena's grandfather, 84 years old, needing some ready cash, dropped in with an additional 27 plants. The grand total for two short weeks of work was 687 identifications. In naming 393 plants, MariElena used 206 distinct folk generic names, names for 258 terminal taxa, and for 321 taxa at all ranks (see Table 2).

I compare my data for MariElena, Miguel, and Lilia with my current tabulations for the San Juan Mixtepec "omniscient informant" (Werner and Fenton 1970), for the total inventory of voucher identifications, and for three adult inventories in terms of:

- the number of life-forms and supra-generic complexes (LF) recognized
- the number of folk generic taxa (G) recognized, distinguished as monotypic (G_0) or polytypic (G_+)
- the number of folk specific taxa (S) recognized, distinguished as monotypic (S_0) or polytypic(S_+)
- the number of folk varietal taxa (V) recognized
- the number of terminal taxa (TT) recognized (i.e., $G_0 + S_0 + V$)
- the number of total taxa recognized (i.e., LF + G + S + V)

These dry statistics cannot convey the depth of consultants' knowledge of each named taxon. To suggest this richness I will review in somewhat more

detail one 90 minute session with Lilia this past September (2000), during which she named and described 82 plants she had collected the afternoon before after school on a short walk in and near town. Her responses were necessarily brief given the number of plants to be discussed and the limits of a nine-year-old's attention span. In Table 2 I summarize her responses to three primary questions: ***¿Zhá lÉ guìzh rí?*** (What is the name of this plant?); ***¿Pâr-né rquiˇ rí?*** (What is it used for?); ***¿Pá ló nˇ?*** (Where is it found?).[1]

If the lifeform assignment was not implicit in the name as it is most often, I might have asked also, for example, ***¿Pé yâg-á?*** (Is it a tree/shrub?) or ***¿Pé lbÈ-w?*** (Is it a vine?). Finally, I noted my tentative Latin determinations. Lilia's mother (Inez), aunt (MariElena), grandmother (Rosalia), and great-grandmother were nearby but only offered to help if specifically requested to do so. I have bracketed their contributions. Lilia's "errors" or "inadequate" responses are marked by asterisks.

Of 82 distinct identifications, she was unable to name the plant (***nàn-d náa***, I don't know) or named it "incorrectly" in seven cases (91% correct). Three correct responses were duplications. Thus, in one short walk on one afternoon Lilia collected and correctly named 72 distinct plant species. Furthermore, she noted whether or not the plant was used,[2] and if used, for what purpose. She noted nine plants used as medicines (***rmêd-á***) and her elders contributed another three species to that list. In most cases Lilia was also able to specify for what illness the plant was used (e.g., ***pâr-né yòob ní pâr rò***, for coughs), even at times describing how the medicines are applied (e.g., ***gâz né***, we may bathe with it).

She also noted if the plant was edible (e.g., ***rôw né***, we eat it), used as fodder or forage by animals (e.g., ***rôw chˇv***, goats eat it; ***gôw nguˇd***, chickens may eat it), or was of ritual significance (e.g., ***pâr ló mdiò***, for [placing] on altars) or ornamental value (***pâr-né rgal guiè***, for giving flowers).

Lilia also characterized where most of the plants occurred in terms of habitat (e.g., ***ló nÈz***, on the trail; ***lén càrrâl***, inside the fence or in the garden; ***ró yù***, in town; ***ló gòdz***, in marshy places; ***chó quiè***, on rocks), specific locations (e.g., ***ló x-càrrâl nánít***, in grandmother's garden; ***guiˇt Ró-ctà***, below Flat Rock), or simply by pointing (e.g., ***nèc***, here; ***cˇaní***, over there).

Lilia uses plant names similarly to San Juan adults. The great majority of her naming responses are folk generic names (Hunn 1998), which in Mixtepec Zapotec routinely incorporate the life form or complex name as a prefixed element (except in many Spanish loans). She freely combines certain "nested" life forms, as is common in adult speech (e.g., ***guìzh-guiè-tˇl***, *Bidens* spp.). She adapts Spanish loanwords to the canonical syllabic forms and tonal conventions of Mixtepec Zapotec (e.g., ***guiè-jàrân***, *geranio* flower, *Pelargonium* spp.),

but uses Spanish borrowings no more frequently than is general among San Juan adults.[3] She employs the hedge, ***xín-*** (relative of, similar to) as do adults (e.g., ***xín-gòrdòlôb***, relative of *gordolobo*, *Gnaphalium* spp.), and for many of the same species. Lilia also employs trinomial nomenclature for folk specific taxa appropriately (e.g. ***guìzh-guièe-tˇl-nquiˇts***, *Bidens* spp.; ***yàg-yàaz-ngˇs***, *Baccharis heterophylla*).

Her sample of plants is biased towards herbaceous species, but this may reflect their relative ease of collection in comparison with trees and shrubs rather than any notable gaps in her repertoire. Finally, the plants collected represent a wide range of species, native and introduced as well as wild and cultivated. The 82 plants represent 79 species of 70 genera in 33 families.

ANALYSIS

Are MariElena and Lilia unusual among San Juan children their age? I have no reason to think so, though I do not have a sufficient comparative sample to assess whether their ethnobotanical mastery is typical. Lilia's younger sister (now eight) seems far less knowledgeable. However, she was raised in Pochutlá, a coastal city, and is Spanish-dominant. The limited data I have for Miguel, also age 12, suggests that there is no dramatic gender difference in the acquisition of this knowledge. Extensive ethnobotanical knowledge is everyday knowledge acquired without apparent effort at an early age by virtually everyone in town. It is only from our "civilized" perspective that it seems remarkable, since we expect such elaborate knowledge of the natural world only of professional specialists or fanatic hobbyists.

How did MariElena and Lilia learn so much at such an early age? They did not learn extensive ethnobotanical knowledge in school: the public school curriculum here is nationally standardized, and is thus not designed to local environmental conditions. Teachers are almost always temporary residents raised elsewhere in the state. Formal schooling may be authoritatively promoted as a means to escape the "ignorance and poverty" of village life, as was the essential message of the local priest's valedictory sermon to the inaugural secondary school graduating class of 1997. The notion that local primary school children might be deeply knowledgeable with respect to local ecology is nowhere recognized by the public school system (as is also true generally in the United States).

Clearly, MariElena and Lilia have learned (and continue to learn) about plants from their grandmother, mother, sisters, and aunts in the course of weed-

ing and harvesting the family fields, caring for the family's animals, tending the family garden, and running errands in search of medicinal herbs for sick relatives. They also learn a great deal at play. Children as early as five years old play at cultivating *milpa* and decorating altars. Such play is institutionalized in an ancient ritual celebrated as the *Fiesta de la Santa Cruz*, May 3rd and September 14th each year. On these days San Juan families climb to the summit of nearby *Cerro San Isidro*. Here the adults leave offerings of flowers and votive candles at an altar on the summit and at an old well said to be "the door to the house of Lightning," the Zapotec god of Lightning and Rain, *Cocijo* (pronounced ***ngùzìi*** in Mixtepec Zapotec), petitioning for life-giving rain. Meanwhile, the children "play" in a protected grove of oaks at the western end of the summit, building miniature stone houses, plowing and planting miniature corn fields, and tending pine-cone cattle, goats, and turkeys, in a celebratory enactment of the traditional *campesino* "good life."

I believe this evidence, preliminary as it is, demonstrates how "natural" it is for children of primary school age to absorb in great detail a body of local knowledge of natural history, particularly when that knowledge is constantly reinforced in the daily life of the family and community. For an urban child it is, I suppose, "natural" to master at a young age a vocabulary of machines, sports, entertainments, and social distinctions. As a consequence, however, urban children lose the chance to develop a keen awareness of the diversity of life around them, and thus, perhaps, grow up ill prepared to appreciate it and conserve it. Though we may learn as adults to appreciate the natural diversity of our surroundings, I believe that as adults such learning is neither so readily nor so deeply acquired. This was brought home to me when I met Valentín Martínez Miguel, a 70-year-old blind man, in San Juan. He lost his sight at age 18, but has since learned to write both Spanish and Zapotec in braille. I hired him to write accounts of local plants and animals. He was able to describe the appearance of many plants and animals despite being blind these past 58 years. What he had learned as a child is burned into his memory.

The currently fashionable primary school science curriculum in Seattle public schools marginalizes natural history as "rote memorization" in favor of emphasizing the "discovery" of underlying principles of the physical world. However, how can children discover underlying principles with no grasp of the fundamental diversity of nature around them? To dismiss the acquisition of a basic vocabulary for naming the "natural kinds" in a child's backyard as "rote learning," is to dismiss as of little value the child's natural foundation of environmental knowledge. Perhaps, we should devise curricula that encourage the child's built-in fascination with natural history rather than divert their attention to abstract theoretical goals pursued in an empirical vacuum.

NOTES

1. This latter question was not asked for all plants.

2. In several cases toward the end of our session she seemed to have tired, using the "no use" (***rguin-d-á***) response rather freely.

3. However, I judged her use of ***guìzh-bèjûc*** (*bejuco* vine) an "inappropriate" innovation, as I had not heard that particular combination before.

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