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Ontogenesis, Use, and Representation of Cultural Categories: A Psychological Perspective

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In 1966, I was asked to write a review of the volume emanating from the 1963 Merida Conference on transcultural studies in cognition (Greenfield, 1967). The report of that conference (Romney & D'Andrade, 1964) identified an important gap between the fields of anthropology and psychology in their approach to the transcultural study of cognition: anthropological study focuses on relatively static cognitive *products* while psychological research concentrates more on dynamic cognitive *processes*. Romney and D'Andrade, in their "Summary of Participants' Discussion," pointed out diverging assumptions on the part of the two fields: on the one hand the "assumption by anthropologists that 'cognition' is equivalent to the code held by a group of individuals" and on the other hand "the psychologists' assumption . . . that 'cognition' is equivalent to mental capacities or intellective processes" (p. 239). Indeed, after reviewing the conference as a whole, Romney and D'Andrade said that "it began to appear as though many of the issues could be reduced to one: whether the transcultural study of cognition is primarily a study of codes or of intellective processes" (p. 234).

In this chapter, I will try to close this gap, to link cognitive processes with cultural codes. Indeed, a similar mandate was put forth by Roger Brown (1964) in his concluding statement of the 1963 Merida Conference; he said there that eventually someone is going to have to nail together the mind as template—a categorical grid imposed on reality—and the mind as transformer—an active cognitive processor.

Within cognitive anthropology, the years since the conference have witnessed

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progress in this task of integrating cognitive processes—the mind as transformer—with cultural codes—the mind as a categorical template. For example, Kronenfeld (1979) has applied George Miller's (1956) magical number 7 ± 2 in conjunction with Bruner, Goodnow, and Austin's (1956) concept-attainment strategies to the analysis of decision making processes in various societies. In this work the concern is not with culturally standardized *products* but rather with culturally standardized *processes.* A paper by Berlin, Boster, and O'Neill (1979) integrates process with code in another way, by demonstrating how processes of visual perception affect a cultural system for classifying birds.

I will continue this integrated approach to the study of cognitive process and cultural product by considering several methodological and substantive approaches to understanding the dynamic processes involved in the ontogenesis, representation, and use of culturally standardized cognitive structures. A major question to which I will return at the end is the extent to which individual cognitive processes are determined by the nature of a culture's relatively standardized category systems, both linguistic and nonlinguistic.

The Ontogenesis of Cultural Codes: An Example from the Domain of Kinship

My concern here is with the developmental acquisition of specific kinds of cognitive processing constraints stemming from the acquisition of kin terms.

This particular study, which I carried out in collaboration with Carla Childs (Greenfield & Childs, 1978), examines the development of sibling terms in Zinacantan, a Maya Indian community in Chiapas, Mexico. It also presents a new methodological procedure for studying kinship knowledge. The method is a comprehension task in which the subject is given a series of kinship terms and must name a person or people to whom each term applies. This method has an advantage for developmental research in that it maximizes the display of competence concerning kinship terminology at each point in development. This is the case because comprehension generally develops before production. The child need only name particular people in his or her family to answer each question. This skill is generally acquired before the production of kinship terms. In other words, the kinship terms are given and the child replies, displaying his or her understanding of the term by naming a person to whom it applies. To give an example from English, a question might be "Who is your sister?" This question presents the kinship term "sister." The reply might be "Alice," the name of a person in the family. Kronenfeld and Gladwin (n.d.) listed eight broad questions which formal analysis of kinship systems has sought to answer. Our method involves the inverse of one of their questions, the calculation of kin terminology from the user's point of view. Instead of calculating which *kin term* applies to a given person, our procedure involves calculating which *person* is referred to by a given term. For example, the kind of calculation which Kronenfeld and Gladwin referred to would be involved in the question "What is Alice to you?" to which the answer would be "sister." Here the name of the person is given and the subject must calculate the relationship to that person. In contrast, our procedure gives the kin term and the child responds with the name of a person to whom it applies.

Our data were collected in the Zinacanteco hamlet of Nabencauk under the aegis of the Harvard Chiapas Project. Our sample consisted of 66 subjects varying along three dimensions: age, sex, and schooling; however, sex and schooling did not turn out to affect the results, so I will not say anything more about those variables. For present purposes, therefore, this was a developmental study involving the comparison of three age groups: 4- to 5-year-olds, 8- to 10-year-olds, and 13- to 18-year-olds. (Sample sizes were 13, 33, and 19 respectively.)

Before asking our subjects any questions, we obtained family trees from their mothers. These trees gave the names of all household members and showed the kinship relationships between them. We used these family trees to compose a set of questions for each subject relating to his or her nuclear family, the basic residential unit in Zinacantan. The questions that will be discussed all involved Zinacanteco sibling terms. They were of two types: egocentric and other-centered. The term *egocentric* is used here somewhat differently from the way it is used in componential analyses of kinship; *ego* refers specifically to the subject who is being questioned, not to the general reference point for the terminological system, which we call *reference point,* as will be clear later. Egocentric questions concerned the relationship of an individual participant to his or her siblings. Figure 1 presents an example. For this family tree we had composed three egocentric questions for Chepil: "What's the name of your older sister?" (Shunka); "What's the name of your younger brother?" (Petul); "What's the name of your younger sister?" (Maruch). Other-centered questions concerned a given sibling's relation to his or her siblings. Here are examples: "As for your older sister, Shunka, what's the name of her younger sister?" (Maruch); "As for your younger brother, Petul, what is the name of his older sister?" (Shunka). We asked all questions in a singular form even when a correct answer included more than one person. However, after each response we asked the subject, "Does the person have any more in this category?" For example, Shunka has two younger brothers, Chepil and Petul. If we asked "As for your older sister, Shunka, what's the name of her younger brother?" and the subject answered "Petul," we would then ask "Does she have any more younger brothers?" We would repeat this question until the subject told us that there were no more.

Our main theoretical purpose was to test out the value of componential analyses, cultural values, and Piagetian theory in accounting for the ontogenetic development of the Zinacanteco system of sibling terminology. However, in reconsidering this research for the present chapter, I realized that our results also point to the value of

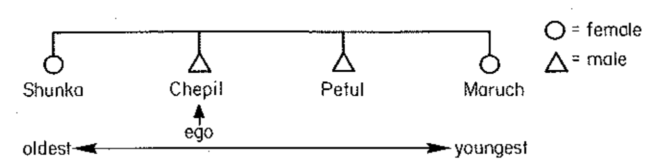

Figure 1. Sample Zinacanteco family tree showing sibling relationships.

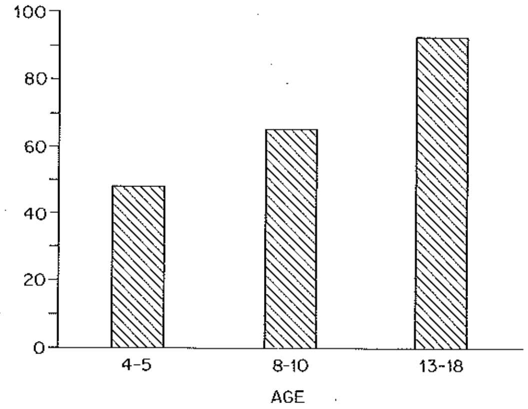

Figure 2. Percentage of questions answered correctly at different ages.

extensionist semantics for their explanation. Under such an analysis, knowledge begins with focal examples of relationships and extends outward to similar instances. In the area of kinship, this sort of analysis was first proposed by Lounsbury (1964) and further developed by Kronenfeld (1973) for kinship systems as they exist in mature adults.

Here are the results. From a developmental point of view, the most basic, although not particularly unusual, results are shown in Figure 2. This figure shows that the ability to apply sibling terms correctly is acquired gradually. It is clear that an increasing number of questions was correctly answered at each age level. The 13- through 18-year-olds approached perfect knowledge, correctly answering 94% of the questions. This information by itself does not favor any particular developmental model, but it does show that the sibling system does not arise full-blown at some point in time. Some model of progressive acquisition is required.

What does it mean to say that a componential analysis can account for development? Basically, the claim is that the conceptual components posited for the analysis guide the learning process. This claim can be tested through the patterning of errors.

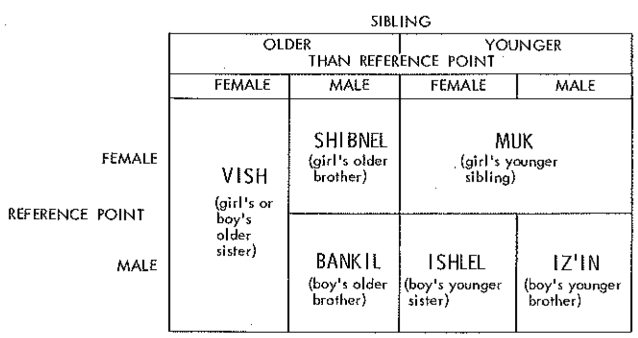

Figure 3. Three-dimensional componential analysis of Zinacanteco sibling terms.

In this regard there are three different componential analyses, each with its particular developmental implications. I will start with two traditional analyses of Zinacanteco sibling terms of reference, both developed by Collier (1969). The first, shown in Figure 3, is based on three dimensions: sex of reference point (which would be sex of ego in componential analysis terminology), sex of sibling, and age of sibling relative to reference point. That is to say, a Zinacanteco speaker would use a different word to describe a sibling depending on whether the *speaker* is male or female and whether the *sibling* is male or female, younger or older. The distinction in two of the semantic components of the dimensions are, however, incompletely realized, as the figure shows. Sex of reference point is not distinguished in the term for older sister, *vish,* which is the same for both male and female reference points. Sex of sibling is not distinguished in naming a female's younger sibling. The basic term *muk* applies to younger siblings, both boys and girls. It can, however, be modified to specify sex by the addition of the Tzotzil word for boy or girl. If these three semantic components, or dimensions, guide the acquisition process, then one would expect the child's comprehension of the terms at different stages to reflect the gradual acquisition of the three semantic components. The second way in which semantic components should be reflected in the acquisition process is that componentially more complex terms would be learned before componentially simpler ones. For example, *bankil* (boy's older brother) and *shibnel* (girl's older brother) are componentially more complex than *vish* (older sister) because the latter does not involve the component of sex of reference point, whereas the former two terms do.

Let us now turn to Collier's second componential analysis (Figure 4). This analysis is based on reciprocity and relative age. The relative age dimension is the same as in the three-dimensional analysis that we saw before, but the two sex dimensions have been replaced by a single reciprocity component. The idea of reciprocity is embodied in the example. Shibnel and *ishlel* are a reciprocal pair of terms because if you are my *shibnel,* I am your *ishlel.* This model substitutes one relational component, reciprocity, for two categorical components, sex of reference point and sex of sibling. Since all sibling terms now have the same number of components, this model reduces them to the same componential complexity. Hence our prediction from this model is that all terms would develop at the same rate and that error patterns would reflect the components of relative age and reciprocity.

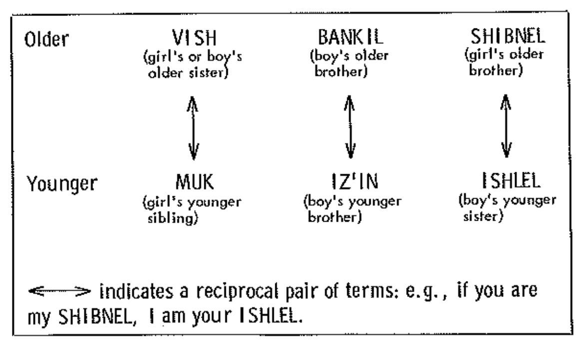

Figure 4. Two-dimensional componential analysis of Zinacanteco sibling terms.

The third type of componential analysis comes from Haviland and Clark (1974). Their analysis combines the two already presented and also adds a relational feature: that siblings have common parents. For the present purposes, it is not necessary to go into the details of Haviland and Clark's model. Suffice it to note that the predictions based on relative complexity would be the same as for the first model.

Evaluation of the models with respect to actual findings produced some interesting contrasts. (In order to hold category size constant, this data analysis is based on questions for which there is only one correct answer, i.e., one family member falling into a particular category. The effects of category size will be considered separately in the memory analysis to be reported later.) Our first finding regarding the patterning of errors is that, overall, no term is more difficult than another. This result goes against the complexity predictions of the first componential analysis of Collier and against that of Haviland and Clark. The result is in accord with the complexity predictions from Collier's second model. At this point then, Collier's first model and Haviland and Clark's model are eliminated, and we shall proceed with further consideration only of Collier's second model.

Let us further analyze Collier's second model. The developmental implications of this model are that children would use the older/younger dimension and the reciprocal relation between pairs of terms in order to learn the system. Let us proceed now to look at errors of commission in order to see whether the components hypothesized by this model mediate the learning process. Errors of commission are of particular interest because they can be used to see whether the participants of various ages have analyzed sibling terms into various components. A pattern in errors of commission reveals the existence of a concept, as opposed to knowledge of specific examples. (Nevertheless, keep in mind the fact that only 11% of all errors were errors of commission; the majority of errors by far were errors of omission.) Table I groups errors of commission according to which semantic component is maintained. Let us consider specifically those semantic components presumed by Collier's second model, the model which our results thus far indicate is the most promising for developmental explanation. To understand what maintaining common parentage, maintaining right sex, and so on, mean in this table, consider this example: If the experimenter asks a boy "What is your older brother's name?" and the boy responds with the name of his younger brother, his wrong answer is not totally wrong; it maintains the sex—male—of the correct answer and stays in the same reciprocal pair—older brother and younger brother. If he responds by naming his older sister, he maintains relative age of the correct answer, but not sex or the reciprocal pair. The only semantic component consistently maintained by the youngest children was common parentage. That is, they infrequently named people outside their sibling group in answer to sibling questions. But this component is not even part of Collier's second model. One could say, however, that this model was just taking the sibling system in isolation and that if it had been considered as part of a larger componential analysis, then common parentage would certainly have been included.

Table I. Errors of Commission at Different Ages[a]

	Maintain common parentage	Maintain right sex	Maintain relative age	Stay within reciprocal pair	Number of questions
Age 4–5	75%	46%	38%	23%	20
Age 8–10	94%	80%	16%	30%	55
Age 13–18	100%	79%	21%	14%	14
					89

[a]The percentages do not add up to 100 because each one represents a binary split of the complete data for a particular age group. The small number of errors that referred to people outside the sibling group were not included on the age, sex, and reciprocity analyses, because we sometimes did not know who these people were.

Let us, nonetheless, proceed to more telling facts. It can be seen that the middle and oldest age groups maintained the attribute of sex as well as common parentage. Neither relative age nor reciprocal pairs were maintained by any age group. But the maintenance of reciprocal pairs in errors of commission would be required at some point in development by the model now under consideration. There is additional evidence in our data that reciprocity is not used in learning the sibling system; this evidence is fully presented in an article by Greenfield and Childs (1978). The important point is that the analysis of errors of commission does not show the semantic addition of components required by any of the three models. Children seem to be acquiring comprehension of the sibling system of terminology by learning how to label individual relationships between particular people rather than by use of conceptual components. These individual relationships can be thought of as focal instances. Here is one piece of evidence that focal instances are critical in the developmental acquisition of kinships terms.

Let us first consider a point that was mentioned before: the fact that 75% of all errors maintained common parentage. This result means (1) that most errors did not extend beyond the nuclear family and (2) that most errors stayed within the correct generation. This first characteristic agrees with the Kronenfeld (1973) analysis of Fanti kin terms, which showed that nuclear family terms are extended outward to apply to relatives outside the nuclear family. This result seems to indicate that children do not start their acquisition of kin terms by discriminating nuclear family from others. In a way, others are nonexistent. What the children do is simply learn to identify members of the nuclear family. Common parentage is a core common to all sibling terms and this core seems to be learned first.

What is the significance of the second characteristic, that errors do not cross generations? It does not imply that children are learning the component of generation. The children named people in their own generation, yet limited themselves to that generation within the nuclear family. If generation were acquired as a generalized component, this component could be maintained while naming cousins outside the nuclear family; but this type of error was made very rarely.

Another point that emerges from Table I relates to a cultural emphasis in Zinacantan. In that culture, relative age is a salient social characteristic. Comparing age with sex, one could say that within families in general, not just the Zinacantecos, relative age would have more behavioral significance for sibling relationships and roles than does sex. Yet it can be seen from the table that the attribute of sex is preserved before the attribute of relative age. This result seems to indicate that cultural and behavioral salience is not a factor in developmental acquisition. On the other hand, our finding is in accord with Piaget's view that absolute attributes are learned before relational ones. Sex is a categorical attribute. Age is a relative or relational attribute. On the other hand, common parentage, the first components to be acquired as a component, is also relational, and this result contradicts Piaget. Thus, the results are mixed with respect to Piaget's idea that absolute attributes should be acquired before relational ones. What is suggested, however, is that the core concept of sibling is acquired before the various sibling relationships are differentiated.

There is also some additional evidence showing how the developmental acquisition of sibling terms moves outward from focal instances. The particular focal instances are those predicted by Piagetian analysis (1928): that the child will be able to apply terms first in response to egocentric questions. These are questions concerning the relationship of the subject to his siblings, for example, "What is the name of your older sister?" Only later should the child be able to answer questions concerning relations between two siblings apart from self, for example, a question to Chepil in the family shown in Figure 1: "As for Maruch, what is the name of her older sister?" The final stage, according to Piaget, involves the child's ability to see himself or herself from the point of view of another person. The child must reverse perspectives. The following question–answer pair, again addressed to Chepil in Figure 1, requires a reversal of perspective: "As for Maruch, who is her younger brother?" (me). Figure 5 shows this developmental progression from being able to answer questions where the subject is the reference point to being able to answer questions with other reference points; it also shows the still greater difficulty of other-centered questions about relations to ego. These are basically questions where the answer is me. What this graph shows is that, among the youngest children, we have a situation where the child can name, for example, her older brother but cannot answer a question about

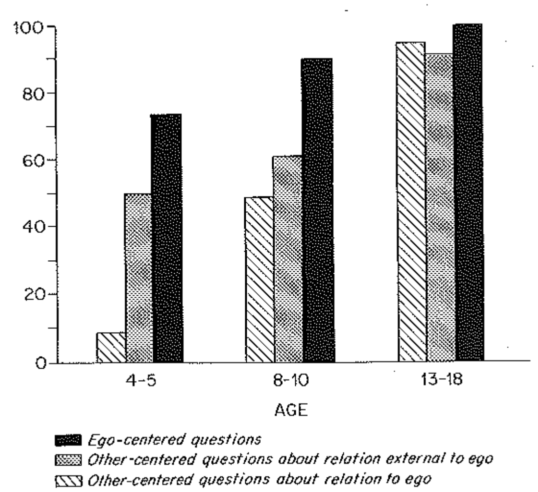

Figure 5. Percentage of questions concerning different types of example answered correctly at different ages.

her older brother's older brother. Nor can she name herself as her older brother's younger sister. For the 4- and 5-year-olds we see a neat progression: they answer most of the egocentric questions; a lower percentage of other-centered questions, involving a relationship totally external to ego; and, finally, very few questions which involve taking another person's perspective on self. Figure 5 shows that this ordering of difficulty of the questions is maintained for children in the middle age range, although their performance with each type is better than that of the youngest children. It is only with the 13- to 18-year-olds, however, who can answer virtually any type of question, that the gap between question types closes. The evidence indicates that knowledge moves outward from one particular focal relationship, the relationship of other people to oneself. The important theoretical point is that no characteristic of sibling terms *per se* predicts error patterns as well as the nature of the example on which the child is being questioned. In concrete terms, this means that whether a child is being questioned about a *vish* or *shibnel* does not affect the difficulty of the question while the sibling system is in the process of development. What does matter, though, is whether you are asking the child about *his/her shibnel* or someone else's.

It is interesting to consider why Haviland and Clark (1974) would find their componential analysis explanatory in the case of English kin terms, whereas we did not in the case of Zinacantan kin terms. The answer lies not in the difference between the two languages or between the two cultures but rather in the task itself. Haviland and Clark were asking for definitions, whereas we were asking for the application of kin terms. *Development in the application of kin terms is intrinsically different from definitional development.* Indeed, a closer look at their results indicates that there is no conflict with our data. Haviland and Clark, as well as Danziger (1957), found an early stage in the definition of kin terms before semantic components appeared. At this point, the child could name examples of terms but could not define them. In essence, our task required naming rather than definition, and our results suggest that children learn kin terms as labels for specific relations before the labels themselves are organized into the conceptual components necessary to formulate definitions. Development in the application of kin terms differs in another respect from development of kin term definitions. Whereas Piaget (1928) found that very young children define brother as "boy," using an absolute attribute, errors of commission in our task show that, when applying sibling terms within their own family, children do *not* think that a brother can be any boy whatsoever. A brother must be a sibling. Nelson (1973) has found that a new word is first used to refer to something in a particular *functional* relationship to the child but that generalization to new instances will occur on the basis of perceptual attributes. If we consider definition a form of generalization, Nelson's conceptualization would account for the findings of Piaget (1928) and Haviland and Clark (1974) that the earliest *definitions* of kin terms refer to perceptual attributes like sex (for example, defining brother as a boy). However, earliest *application* of the term involves referents that are of functional importance to the child, that is, siblings (cf. Cazden, this volume).

This difference between the ability to *define* and the ability to *use* a term shows that we must be careful in taking conscious conceptualization as an index of behavioral categorization. (This difference should have been taken into account by Colby, 1979, when he proposed that written material be used to study behavioral roles in a culture. Certainly there will be a relationship between more conscious knowledge of roles, as it appears in verbal texts, and the less conscious way in which roles are actualized in behavior. But this relationship needs explicit study. Here the emerging area of metacognition, e.g., Flavell & Wellman, 1977, in developmental psychology is of relevance. This is the area of investigation in which conscious knowledge *about* cognitive process and *about* behavior is studied in itself apart from the development of the cognition or behavior themselves.) In general, it has been found that knowledge of behavior or cognition lags behind the behavior or cognition itself. Thus one is likely to underestimate the complexity of a category system by relying exclusively on verbal descriptions of it.

Using Sibling Terms: The Role of Memory Development

It is productive to use our sibling data to illustrate how the development of kin term usage is affected by the development of the cognitive process of memory. Here I will be considering the interaction of a cognitive processing constraint with the cultural system itself. Because larger families require the child to remember more individual relations, we were able to utilize the variability of Zinacanteco family size as a natural experiment and to study the role of memory factors in our kinship task. To demonstrate the influence of this factor, we compared responses to questions for which there is but a single correct answer (the body of data discussed up to this point) with responses to questions for which a correct answer involves naming more than one person. If memory is a factor and if sibling terms can be used to access items in memory, then the more members there are in the category being recalled, the greater the probability will be of recalling at least one member. The slopes of the lines in Figure 6 show that this is the case for every age group except the oldest, for whom there is a ceiling effect. At the same time, comparison of the graph for the

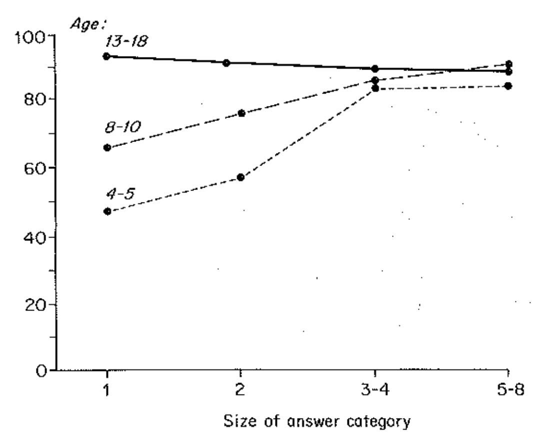

Figure 6. Percentage of questions eliciting at least one correct answer as a function of category size for children of different ages.

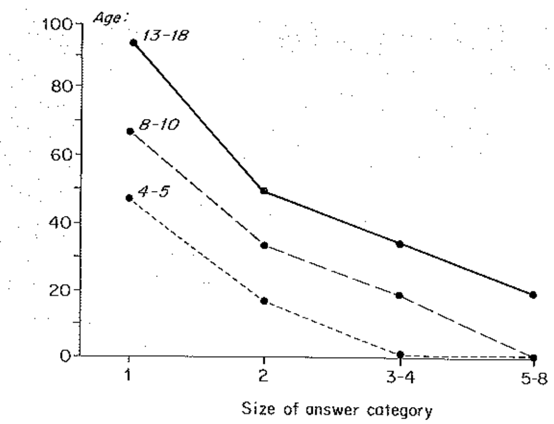

Figure 7. Percentage of questions completely answered by children of different ages as a function of category size.

different age groups shows the progressive development of memory with age. More specifically, the youngest children are as likely to produce at least one correct answer as the older children for kin categories containing three or more members in the household but not for the smaller categories, those containing one or two members. For those categories, the probability of producing at least one correct answer increases with age. The difference in the lines' slopes indicates that the constraining effects of memory decline with age.

These results can also be looked at another way: they demonstrate the influence of the terminological system on memory. That is to say, the probability of recalling one correct answer would increase with size of the category only if the category referred to by a particular sibling term were an organizing factor in memory. Category would not help or hinder performance if a particular sibling's name could not be retrieved in terms of the particular relationship being asked about. This result also shows that sibling terminology is an organizing factor in children's memory.

Another memory skill that is called for when there is more than one sibling in an answer category is the ability to make a list. This skill requires not only retrieval of data but *ordered* retrieval, so that one can remember which items have already been retrieved and which have not. The larger the answer category, the longer the list and the more difficult it should be to retrieve the complete list. Figure 7 shows that this is indeed the case. The downward sloping lines from left to right show that the probability that a question will be completely answered declines as the size of the required list gets larger. The different heights of the three graph lines show that, in general, the ability to construct lists of any given size becomes progressively greater as age increases. The only deviation from this pattern is due to a floor factor for the youngest children such that they are not able to generate any complete list for categories containing three or more members. This type of analysis illustrates a method for studying the developmental interaction of a cognitive constraint, memory, with a culturally prescribed cognitive system, sibling terminology.

Representing Cultural Categories: The Role of Cognitive Development and Task Structure

There is yet another sort of cognitive analysis of culturally standardized categories. We can consider the representation of examplars of culturally prescribed categories, analyzing how this representation is constrained by cognitive development on the side of the organism and by task structure on the side of the environment. Recent concern with the internal structure of categories (e.g., Berlin & Kay, 1969; Berlin *et al.*, 1979; Rosch, 1973) has considered intension—the category's definition—only indirectly through the study of extension—its exemplars. In the study I will now describe, Childs and I (Greenfield & Childs, 1977) approached the internal structure of categories through the direct study of intension in a nonverbal representational task.

The categories in question are two patterns woven in Zinacantan. We examined the difference between concrete exemplars of the two categories and their representation by native Zinacantecos. To examine the constraining factors in the representation of these patterns, it was necessary to introduce a new method for investigating visual representation of a cultural object.

Note the categories themselves. Figure 8 shows two exemplars of each of the two categories. The top pair is the pattern used for the male pancho called a *pok' k'u*ul.* The bottom one shows two examples of the pattern used for the female shawl called a *pok' mocebal.* Each variant of a given pattern has certain features in common. The male pattern is essentially the repeated pattern of a red stripe followed by a broader white stripe. The female pattern, in contrast, also involves red and white alternation, but the red stripe is actually a complex unit consisting of three red stripes separated by two white stripes. The task, shown in Figure 9, involved placing sticks in a frame in order to form striped patterns. For the part of the experiment concerned with the woven patterns, the subject placed sticks in a frame in order to make first a *pok' k'u*ul* then a *pok' mocebal.* Both articles of clothing were continuously present during the task, and the relevant one was always pointed out to the subject.

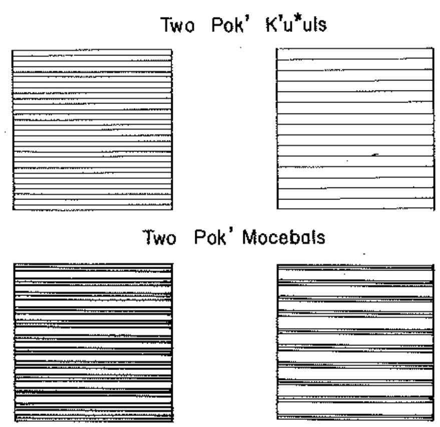

Figure 8. Categories of Zinacanteco woven patterns. Black lines represent red stripes; white spaces represent white stripes.

Figure 9. Experimental setup for pattern representation task.

An interesting phenomenon concerned how cognitive development constrains the representation of these two categories of woven pattern. As in the kinship study, we had 4- and 5-year-olds, 8- to 10-year-olds, and 13- to 18-year-olds. Most of the youngest children had not reached the stage where they could represent both patterns as a simple alternation. None could differentiate the two patterns. Most of the 8- to 10-year-olds could represent the patterns in one way or another. Nevertheless only one child in this age group differentiated between the patterns. The modal strategy, used by six children, was to represent both patterns as a regular alternation of red and white. Thus the female pattern containing three differentiated parts or elements became identical with the two-part male pattern. It is clear that the general failure to differentiate the two patterns stemmed from failure to differentiate the elements within the more complex pattern. The tendency of this age group to simplify the more complex patterns was also manifest in pattern continuation tasks in which the experimenters started a novel pattern and the task of the child was to continue it. The same progressive differentiation of parts in representing complex patterns has been found in the development of patterning tasks in a variety of cultures. Hence, our results show evidence of highly generalized constraints on cognitive development.

More interesting, though, are the constraints imposed by the differing behavioral roles in relation to the two patterns. The two behavioral roles with which we were concerned were (1) weaving the patterns, using them, and viewing them and

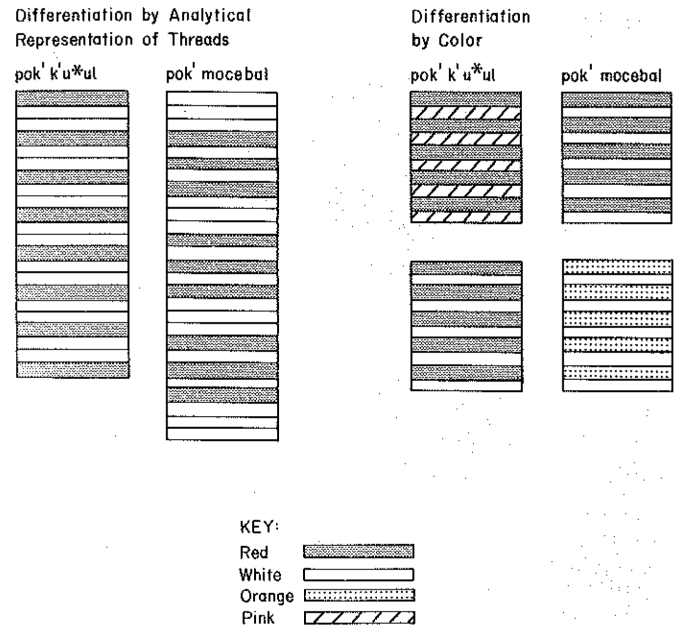

Figure 10. Zinacanteco ways of representing two woven patterns.

(2) simply using the patterns and looking at them. Figure 10 shows two strategies for representing the patterns. The crucial feature of the representational strategy on the left is maintaining the configuration of stripes in the two patterns, including the thin white stripes in the female pattern. This type of representation was more than twice as frequent among weavers, represented by the girls in our oldest groups, as opposed to nonweavers, represented by the oldest boys. This comparison refers to subjects who had never attended school. This type of analytic representation is what one would expect from people who are involved in the actual construction of patterns, as weavers must be.

This strategy becomes more interesting, however, when we compare it with a strategy used by the nonweaving boys of a similar age, shown on the right side of Figure 10. Essentially about a third of the oldest boys used color to differentiate the male and female patterns. Zinacanteco boys are clothes conscious too, but this type of representation shows that they consider a different aspect of the pattern significant. When the male garment is seen from a distance, the thin stripes seem to disappear and the pattern looks like a solid pink or light red color; therefore, the *pok' k'u*ul* gives the impression of being more red or more pink than the *pok' mocebal* even though the threads in the two garments are exactly the same color. None of the girls (weavers) used color to differentiate the two woven patterns.

The girls' attention to the structural detail of the pattern contrasts with the boys' representation of a difference in superficial appearance, a difference nonetheless important in making the distinction between male and female Zinacanteco clothing.

The role requirements of Zinacanteco women in relation to clothing are different. Girls need to know and use the detailed analytical aspects of the patterns more than boys do, and so they are more apt to choose those aspects when representing them. Thus we found that behavioral role, specifically the task in which a pattern category is embedded, affects the salience of different attributes of that pattern.

Which attributes will be highlighted on the verbal level is also a function of a particular task environment. Frake (1962) pointed out a relevant example a long time ago. At a party where two aunts are present, most people would refer to one as "my mother's sister" and the other as "my father's sister." If only one aunt were present in the same setting, however, it is more than likely that one would use the simple term *aunt*. The former terms make the feature side-of-family salient, whereas the term *aunt* does not.

We have found very similar phenomena in the developmental study of communication (Greenfield & Dent, 1980). In this study the task was to explain to another person how to combine some simple objects (beads in a cup or a series of cups) in a situation where the second person cannot see what the first is doing but has the same materials. We found that attributes are coded verbally when they are necessary to make discriminations relevant to the task, but not otherwise. For example, when a 6-year-old or a 10-year-old child explained how to seriate a sequence of cups of different sizes and different colors, the word *cup* was rarely used. Instead, the cups were identified by their color. In this situation, the word *cup* does not distinguish among alternatives required to carry out the task. On the other hand, color words do. Olson (1970) has integrated this notion into a general theory of semantics. He posited "that words designate, signal or specify an intended referent relative to the set of alternatives from which it must be differentiated" (p. 264). Olson cited Brown's (1958) idea that objects are usually named at the level of generality which allows them to be differentiated from other objects of contrasting function. Thus, the fact that we use the term *ball* more often than *baseball* or *sphere* reflects the nature of potential alternative referents: not usually golfballs or cubes but rather bats, rackets, kites, or skateboards. Thus the very choice of a label reflects the set of alternatives potentially in a given context. In putting forth this idea of relative salience, I am not trying to denigrate absolute bases for salience in the perceptual system; I only want to point out that these absolute factors can be modified through task structures which selectively render particular distinctions functional for a particular task. This could be an important concept in further elucidating the relation between perceptual categories and linguistic encoding.

Our study of pattern representation indicates that the task relevance of categories affects the salience of their features and that this differential salience can be manifest in nonverbal representation, as other studies have shown for verbal representation.

Cognitive Effects of Superordinate Category Labels

We now turn from the cognitive causes to the cognitive effects of a culturally standard category system. My topic now is the cognitive implications of superordi-

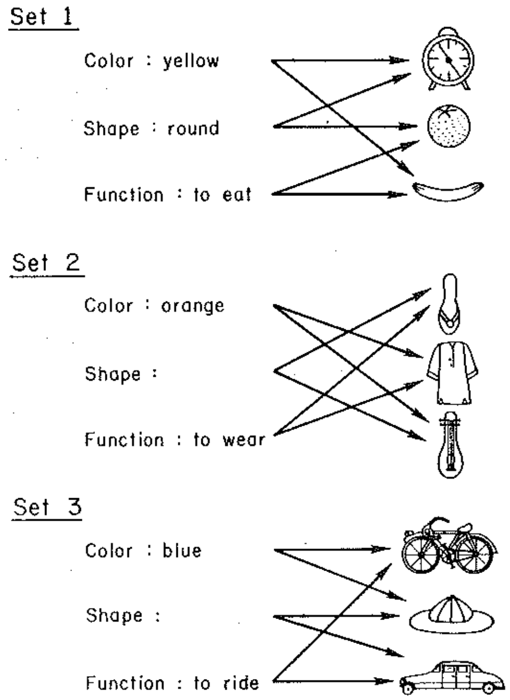

Figure 11. Diagram of stimuli in grouping experiment.

nate labels in a hierarchically organized terminological system. Here I shall be drawing on a study which was carried out in Senegal and involved a grouping task (Greenfield, Reich, & Olver, 1966). This study was done with Wolof children from three different milieus in Senegal. One group had neither schooling nor urban influence; the setting was a traditional Wolof village. The second milieu was the same traditional rural milieu plus schooling. The third milieu was school plus urban influence. These children attended public school in Dakar, the country's capital. The children in each milieu represented three grade levels or age groups: first, third, and sixth grade and for the unschooled groups, the age equivalents 6 and 7, 8 and 9, and 11 to 13. The materials for the grouping experiment consisted of three sets of three pictures each. In each set it was possible to form a pair on the basis of color, form, or function of the objects pictured, as Figure 11 shows. Children were asked to show the experimenter two pictures out of each set of three that were most alike. They were then asked the reason for their choice. After they had gone through this procedure once, the three displays were exhibited a second time with the instructions to show the experimenter two other pictures that were alike in a threesome. Again the question "why?" was asked. At the end the children were asked to identify the pictures. Pretests had been conducted in order to ensure that the objects pictured would be equally familiar in urban and rural environments. Figure 11 shows the different ways the pictures could be grouped. Thus, in Set 1, the clock and the banana could be grouped together by color; the orange and the clock could be grouped together as

round; the banana and the orange could be grouped together because both are to eat or both are fruit. Although the school children were learning French in school, the results to be reported were based on testing in Wolof, the children's first language.

There has been much controversy about the place of superordinate words in conceptual thought. In this experiment, superordinate words are words like *color* or *shape,* as opposed to specific color words like *blue* or specific shape words, *round* or *square.* The Wolof language, in contrast to French or English, has neither the word *color* nor the word *shape.* We found in our grouping task that lack of the word *color* did not hinder color groupings from being formed. In fact, unschooled Wolof children used color more than any other attribute to make the groupings. Are there, then, any cognitive implications of the absence of superordinate words? First, we found that use of superordinate words increases with age among the children who attend school. This sort of finding is in itself nothing new. The same trend has been observed before in the development of children's vocabularies (Brown, 1958). *It becomes interesting only when one realizes that such development takes place among the unschooled Wolofs only to the extent that French words are assimilated to their Wolof language because these words do not exist in Wolof.*

But these facts still do not answer the question of whether this terminological development or its absence has extralinguistic cognitive consequences. Let us now consider Figure 12. If this hierarchical organization corresponds to the type of structure generated by the subject in order to deal with the task, then his or her use of the superordinate words *color* or *shape* should indicate that the person is at the top of the hierarchy and has access to the entire hierarchy. We would predict, then, that he or she would be able to supply more than one kind of attribute if pressed. For the person is plainly contrasting, say, color with shape or with use. By the same reasoning his or her use of shape names or color names alone (for example "round" or "yellow") would mean that he or she was operating one level lower in the hierarchy. The person would then be cut off from the top of the hierarchy and its connections with other branches and would be less likely to operate in branches other than the one in which he or she was already located. A concept is defined as much by what it excludes as by what it includes, that is, by its contrast class. The concept of color, therefore, comes into being with the appearance of an opposing idea, and this opposing concept cannot exist on the level of specific color names. *Round* contrasts only with other shapes; *yellow* only with other colors. If this reasoning is correct then we would expect that if a child ever used an abstract word like *color* or *shape* he or she would vary his or choice of grouping attributes when asked to make a first and second

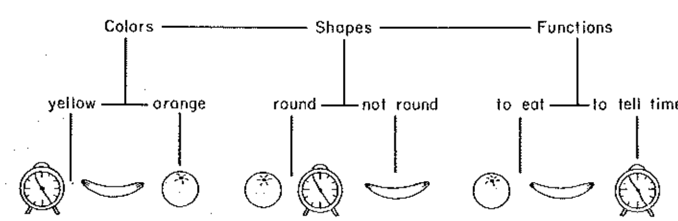

Figure 12. Possible hierarchical organization of first set of pictures.

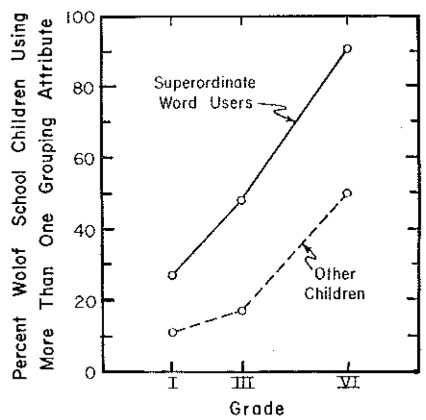

Figure 13. Percentage of Wolof school children using more than one grouping attribute.

choice of pairs for each of three sets of pictures. If he or she used only concrete words like yellow, then we would expect the person to form nothing but color grouping in all six tasks. The results presented in Figure 13 indicate that there is an important association between the use of superordinate words like *color* or *shape* and the use of a variety of attribute types for grouping. The results are presented separately for each grade level, so that it is clear that this relationship holds when all other factors such as knowledge of French and school grade are held constant. Thus if a Wolof child used a superordinate word, his or her chances of grouping by a variety of attributes are twice as great as those of a child who utilizes no superordinate vocabulary in this task. Recall that when a Wolof child uses the word *color,* it is a French word that he or she is introducing into a Wolof linguistic context. In 1958, Roger Brown hypothesized that superordinate class words are basically a luxury for people who do not have to deal with concrete phenomena. Our findings show, however, that superordinate words can be used to integrate different domains of words and objects into hierarchical structures. Our results show an association between the hierarchical depth of a taxonomic structure and flexibility in category use (cf. Bain, 1980).

Open and Closed Category Systems

Finally, let us consider the learning and developmental consequences of an aspect of culturally standardized category systems that has not been considered by cognitive or other branches of anthropology. That is the question of an open versus closed category system. The concern here is once more with categories of woven patterns, and I will use this domain to illustrate what I mean by an open or closed system. The Zinacantecos have a closed system in the sense that there are discrete, finite, and, as it happens, very few categories of patterns in the culture; furthermore, this pattern set is not meant to be added to. In contrast, many other peoples, including other Maya groups for whom weaving is important, place a premium on pattern innovation. In these cultures, the domain of pattern categories is an open system with a constantly increasing or changing inventory of patterns.

In one study, Childs and Greenfield (1980) investigated how Zinacantecos learn to weave. Our findings concerning this learning process may well be a consequence of the closed quality of the system of woven patterns. In the instructional process, we found an emphasis on modeling and observation, which yielded basically errorless learning. That is to say, instructional intervention was done selectively in such a way that whenever the learner reached a part of the process where she was having difficulty, the teacher intervened by either helping or totally taking over, in the latter case providing a model for observation. This type of selective intervention not only provided a model for the girl, but also prevented her from making errors. This kind of instruction is in sharp contrast with methods of teaching and learning which depend more on trial and error. Our hypothesis (Greenfield & Lave, 1982) is that trial-and-error learning becomes functional when it is used in connection with an open system of product categories, such as patterns in weaving (cf. Schubert, this volume). The essence of trial and error is that the learner learns by experimenting. In the process of experimenting, the learner makes mistakes, but also may make discoveries, for example, may invent a new pattern. At the present time, I have reports from two cultures in which weaving is important and in which pattern innovation is not only permitted, but also very much valued. One of these cultures, studied by Lisa Aronson (personal communication, 1978), is the Ibo town of Akwete in eastern Nigeria. The other is, like the Zinacantecos, a Maya group, but one located in the highlands of Guatemala and studied by James and Maria Loucky (personal communication, 1978). Both sets of investigators report that girls learn to weave through a process of trial and error. Initially little miniature looms are set up, and the young girls are given odd leftover scraps of material or grass to weave with. Later when they start weaving real items on a real loom, they are basically left alone. That is to say, there is no teacher hovering over the learner, waiting to intervene at the slightest sign of an error. The only people around are siblings, who give advice but generally do not know how to weave themselves. Hence, the evidence thus far indicates a correlation between instructional method and whether the category system relating to a cultural product is an open or closed one. *Errorless learning based on observation and selective intervention by a teacher seems to go with a closed system or product categories, while trial-and-error learning based on experimentation seems to go with open systems of product categories in which innovation is valued.*

Conclusions

In conclusion, I would like to pull together the diverse threads of this chapter. First, I have tried to present models for the developmental acquisition of culturally standardized category systems by focusing on two such systems, kinship and weaving patterns, and two aspects of the system, one linguistic and one nonlinguistic. Kinship was investigated on the linguistic level, whereas patterns were investigated in terms of their visual representation. The first finding emerging from the study of kinship was that extensional semantics—adding the Piagetian notion of decentering to identify focal instances—presents a good model of the development of sibling-term comprehension in Zinacantan. The second finding from the kinship study had to do with the influence of memory development on the application of sibling terminology. In the domain of pattern representation, another cognitive developmental factor—differentiation—played a role. That study also demonstrated the influence of a social factor—the task for which a category will be used—on the internal structure of a category. The next topic was an investigation of the cognitive consequences of a formal aspect of a category system, degree of depth in a hierarchically organized structure. Here I found that the presence of a superordinate level not only integrated what would otherwise be separate taxonomic structures, but also facilitated the flexible use of alternative modes of categorization. Finally, I looked at the relationship between culturally standardized category systems and methods of socialization, looking specifically at the relationship between the openness of category systems and methods by which the system is taught. Here my tentative conclusion was that closed category systems are associated with errorless methods of learning and teaching and are more dependent on observation and modeling, whereas open systems are taught with trial-and-error methods, leading to innovation as well as error.

For each of these topics I have tried to describe empirical techniques which could be applied by cognitive anthropologists to substantially broaden their inquiry into the effects of environmental and cognitive processing constraints on culturally standardized cognitive structures. My hope is that these methods and concepts will prove useful in the future, furthering not only research, but also productive interchange between anthropology and psychology (cf. Okun & Fisk, this volume).

In terms of the relationship between the individual, language, and society, it is clear that the mere existence of a culturally standardized category system, whether represented verbally or nonverbally, does not determine the use to which it is put by an individual. Factors of cognitive development influence its use at different points in time, as was clear with both our kinship task, a verbal one, and our pattern representation task, essentially nonverbal. These cognitive developmental constraints appear to have a stronger influence than the culturally specific form of the category system itself. Thus, in our kinship study, egocentrism influenced the pattern of development more than did the structure of Zinacanteco sibling terminology. Potentially universal factors of cognitive development emerge more readily than do culture-specific ones. For example, the growth of memory, an apparently universal phenomenon, played a role in the kinship task, but the culturally important discrimination of relative age did not seem to.

The flexibility of culturally standard categories to individual needs was also revealed. The study of weaving patterns showed that the same categories will be represented in quite different ways within a given culture depending on roles relative to those categories. Thus, although it could be claimed that the Zinacantecos have a single system of pattern categories, weavers represent them quite differently, on the average, than do nonweavers. Here, differentiated social roles within a society moderate the influence of uniform cultural products. The other direction of influence, from static category system to dynamic psychological process, was shown in the work on hierarchical category depth. There the presence of superordinate terms, available in some languages but not others, affected the flexibility of categorization processes.

Finally, I identified differences between societies in terms of whether a category system is open or closed. One might conclude that closed category systems stamp their impression on the members of a culture more than open ones do. For in the

latter, cultural products are not merely taught to individuals, they are also created by them. Thus, the dynamic cognitive processes of the developing individual moderate and modulate the influence of static cultural products, while at the same time being influenced by them (cf. Nadin, this volume).

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