CHAPTER 13

On Culture and Equivalence: II

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The very idea of culture recognizes a selectivity and an orchestration in the use of human capacities, and it would seem likely that with each unique cultural pattern would go a certain set of biases in representing the world. In some settings survival may depend on skills in exploiting the immediate "natural" environment, resulting in the elaboration of supporting enactive and ikonic representation. Other, more technically elaborated cultures may be more specialized in symbolic representation, giving more emphasis to the manipulation of such arbitrary systems as machines, money, and the like. The cognitive growth of the child should reflect the emphases evolved by his culture, yet obviously there are "universals" in cognitive development that derive from shared human potentialities and communalities in the human plight. It is anything but clear how these two sides interact.

At a fundamental level, cultural biases ought to affect what is called alike and different, for the act of rendering dissimilar things equivalent yields the categories with which each culture and individual cuts up its world. Equivalence judgments become the stuff of cultural world view.

The Mexican children of the preceding chapter offer some insights into the relationship between culture and equivalence. Their behavior leads to the conclusion that urban culture breeds categories whose structure and content are characterized by abstractness, in the sense that they transcend the particular attributes of individual category members. However, it is still uncertain whether *all* rural traditional milieus may be lumped together against *all* modern urban milieus

with respect to the types of equivalence judgments fostered by each. The studies to be reported here serve to test the generality of the urban-rural contrast in cognitive styles described in the last chapter. They do so by extending the study of equivalence grouping to two very different corners of the earth, Alaska and Senegal.

The results of Reich's work among the Alaskan Eskimos and Greenfield's studies of the Wolofs in Senegal should not only elucidate this matter; they should also begin to solve an additional puzzle: *which* factors embedded in a given cultural milieu make a difference in the development of cognitive equivalences? And what aspects of equivalence judgments are touched by these influences? Finally, these studies can tell us something about the psychological nature of equivalence groupings themselves, for instance, about the relation between grouping structure and grouping content.

Our comparative test will be facilitated if we start with the Eskimos, for Reich's study utilizes virtually the same procedure used in the Mexican work reported in the last chapter and in Olver's American experiment reported in Chapter 3.

THE ESKIMOS

One possible beginning would be a detailed anthropological description of the Alaskan Eskimo's cultural background. However, most of the relevant features for cognitive growth are unsure. In fact, the similarity of results in Mexico City and Boston, Massachusetts, and the dissimilarity of both from a small Mexican village give us reason to suspect that modern urban environments everywhere may produce a certain style of equivalence judgments, and that this influence may transcend national and other differences in cultural content. Therefore, the most relevant question we can ask is, to what extent have the Eskimos made the transition from their traditional rural society to the modern urban milieu of Anchorage, where this study was conducted?

Since the first contact with white explorers and whaling ships in the nineteenth century, there has been a gradual disintegration of traditional Eskimo ways of life and an acculturation into the world of the white American, still only partially accomplished. World War II resulted in an accelerated rate of change for the Eskimo, as for all Alaska, so that the Eskimos of today are increasingly oriented toward the white American economy and institutions. Their aspirations toward fuller participation in the white society are frustrated, however, by a lack of adequate training and education, and by a

shortage of jobs. They are exposed to disappointment and prejudice at a time when many of the traditional sources of individual security and social cohesion have disappeared.

The children who participated in this study, then, have a real Eskimo heritage, though they are in a transitional phase of acculturation. Their grandparents lived most of their lives in Eskimo villages, engaged in the traditional subsistence activities. Their parents were born in villages, spoke Eskimo as their native language, though all were subject to the upheavals of the past twenty years that led families to move to larger towns and even to cities like Anchorage in the hope of participating in the greater abundance they see existing in the white American society. Although most of the children studied were born in a village, their reference culture, like that of their parents, is the white American one. Most telling in this regard is the fact that all the children feel pressured to speak English and to get as much education as possible—the two best avenues to fuller participation in the white American society in the eyes of the Eskimo.

In fact, the white and Eskimo children who participated in the study had identical or very similar educational backgrounds, at least in terms of curriculum and standards of performance. The sixteen white children attended a public elementary school serving a lower-middle-class neighborhood in Anchorage. The twenty Eskimo children came from two sources: half were pupils in the same Anchorage elementary school that the white children attended; the other half were patients in the Alaska Native Health Service Hospital in Anchorage and were enrolled in the elementary division of the hospital school.

The Eskimo children were separated into a younger and an older group, with age ten as the dividing line. Matching white groups posed a problem. The Eskimo children in a given school grade are on the average older than the white children in that grade; and although the majority of the latter will fall within a two-year age span, the Eskimo children will vary considerably more in age. We chose to follow the pattern in the Alaskan schools. The Eskimo children in both the younger and older groups are on the average older than the white children with whom they will be compared. Although the grade placement for each of the matching groups is roughly equivalent, the age range is greater for the Eskimo children in both groups. In short, the younger Eskimo group averages 9.7 years as compared to 8.5 years for the younger white children; 12.0 and 10.6 are the comparable ages for the Eskimo and white older children. The mean

grade placement for both younger groups is around 2.5; for the older children, 4.3.[1]

A comparison of the children's performance on the Goldstein-Scheerer Cube Test supports the division of the children into these four groups. This test is primarily a nonverbal task requiring an analysis of spatial relationships. The child must copy a design with four blocks. He is shown from one to four representations of each design, each successive representation giving greater assistance with the analysis and reconstruction of the pattern the child is to form with the blocks. The child is given a score of four if he correctly constructs the design when shown the first representation—a small-scale version of the pattern; a score of three if he achieves the pattern when shown the second representation—the same size as the first but with the addition of black lines indicating the division of the four blocks that compose the design; a score of two for correct construction given the third representation—a scale representation of the design; and a score of one, if correct construction is achieved with the fourth representation—a scale version with lines dividing the pattern. Ten designs are presented to each child; this procedure allows for a "perfect" score of forty points.

The performances of the two younger groups and of the two older were almost identical—around twenty-eight for the former, and just thirty-five for the latter. In terms of at least one highly respected test of nonverbal intelligence, our younger and older pairs of groups are properly equated.

THE EXPERIMENT PROPER

All the children were given the task of telling how different objects are alike. The testing procedure was a modification of the equivalence task described in Chapters 3 and 12, which used objects commonplace on the Alaskan scene. The child was first presented with a pair, for example, gloves and *mukluks*,[2] and asked, "How are gloves and *mukluks* alike?" Then another object, a parka, was added to the array and the child was asked, "How is parka different from gloves and *mukluks*?" and then, "How are gloves, mukluks, and parka all alike?" This procedure was continued until eight items in the array were

[1] For details see Lee C. Reich, A Cross-Cultural Study of Cognitive Functioning. Doctoral dissertation, Harvard University, (in preparation).

[2] *Mukluks* are Eskimo boots made of furs and skins, widely used by residents of Alaska.

presented. A contrasting item was given at the end of the array, and the child was asked only how it differed from all the others. Two arrays were used:

Apple-orange, potato, meat, milk, water, air, germs, (stone).
Gloves-mukluks, sweater, parka, blanket, stove, fire, sun, (ice).

To ensure that the words had the same meanings for all the children and to achieve a standardized translation by the interpreter, appropriate objects were presented for the first six items in the array and were named as the questions were asked. The objects remained on the table as successive items were introduced. The child was free to handle them and to point and demonstrate his meaning as he wished. No attempt was made to represent the last items in each array (air and germs, fire and sun).

An initial attempt was made to administer one array to each Eskimo child through an interpreter speaking the dialect of the child's village, in order to compare the performance of Eskimo children when using English and when using their native language. But the majority of the Eskimo children showed a striking inability or reluctance to speak Eskimo. Although all the children included in the study were of full Eskimo descent, as nearly as could be determined, half denied that they spoke Eskimo and maintained that they understood "only a little bit" when their parents spoke Eskimo to friends and relatives. Other children were shy and disconcerted by the request to speak Eskimo to the interpreter. If a child was either unable or unwilling to respond in Eskimo, the entire series was presented in English, as it was for all the white subjects. The responses of the few Eskimo children who would respond to the task in Eskimo are included in the following analyses, since the comparison of their performance on the arrays administered in English and on those in Eskimo showed no difference.

For children in modern urban settings—notably near Boston and in Mexico City—the development of equivalence groupings involves a change in both structure and content. According to the findings reported in Chapters 3 and 12, the young child forms complexive groupings that need share no common attribute. The conceptual content of his groupings tends to be perceptual; similarities are based on visible or tangible attributes like color or shape. The older urban child constructs superordinate groupings whose members have one or more attributes in common, whereas the grouping strategy of the rural Mexican child hardly changes as he grows older. The older urban American and Mexican children switch from groupings based on perceptual attributes to those based on the functional or nominal

properties of things, whereas the rural children, who start out less perceptually oriented than the urban, develop in the opposite direction, toward more (and better) perceptual observations on which to base equivalence judgments.

If this dichotomy between modern urban and traditional rural is a useful one, then we would expect not only our white but also our Eskimo children to follow the urban pattern. In order to test this hypothesis, the children's answers were categorized roughly as before (Chapters 3 and 12). The main types of grouping structure were (1) *superordinate,* explicitly based on one or more attributes common to all the items included, and (2) *complexive,* based on several different attributes, none common to all items. For a detailed description of the subtypes of superordinate structure, see page 74. It suffices for the analysis of the present data to describe the various forms of complexive grouping.

Collections. In a collection, the items are grouped according to contrasting attributes. A different attribute is mentioned for each item, although there may be some implicit relationship among the attributes selected. For example, an eight-year-old said, "An orange has spots all over it and it's orange. An apple is green, and sometimes it turns red, and a potato is kinda brownish."

Edge Matchings. Edge matching may be described as a chain of linked pairs. One item is related to another, the second is then related to a third on the basis of a different attribute, and so on. An eight-year-old Eskimo said, "Orange and apple are alike 'cause they're fruits. The potato and the orange have these little dents [pointing]. The fish and potato are brown. The milk is like the potato because the inside of the potato is white. The milk and water are alike because they are like drinking stuff." There is little consistency in the attributes through which the pairs are linked.

Key Rings. In a key ring one item is taken as a nucleus, and the grouping is formed by relating the other items to it. One child used this construction. "You get to put water in there [pointing to the can of condensed milk] to make milk and you got to wash them [all the other items]."

Associations. In an association two or more items are linked, and their relationship is extended to include other items in the group. "You eat them. You eat the water when you stir it in something. Like you put water in pancakes or something and the water dissolves."

Multiple Groupings. In a multiple grouping two or more subgroupings are formed. One Eskimo child handled apple, orange, potato, and fish by saying, "These two are round [apple and orange] and

these two aren't." When milk, water, and air had been added to the array, she grouped them by saying, "You can't see the air and those all have colors."

The conceptual content of the groupings was divided according to the type of attribute on which the equivalence judgment was based. As in Chapters 3 and 12, attributes were classified as perceptible, functional, or nominal. All answers fell into the following categories:

Perceptible. The items are grouped on the basis of phenomenal qualities. Three kinds of intrinsic qualities accounted for most of the "perceptible" responses:

1. **Color**
   Specific: "They are red."
   General: "They have colors."

2. **Shape.**
   Geometric: "They are round."
   Size: "This is almost as big as these."

3. **Material.**
   General: "These are fur."
   Detail: "They have seeds."

There were also a few responses based on perceptible attributes extrinsic to the object, such as location in time or space.

Functional. Equivalence is based on the use or function of the items, either what they do or what can be done to them. Reference in the first or second person to someone performing or receiving an action signals the presence of a *personal* functional attribute. "We eat them," or "They help us grow," or "They keep your body warm" are all examples of personal functional reasons. When no reference is made to personal involvement in the action, or when the reference is in the third person, the attribute is considered an *impersonal* functional one; for example, "They grow," or "They keep people from starving," or "They can be eaten."

Nominal. The items are grouped by using the conventional name that exists in the language. ("The apple and the orange are both fruit.") Note that this type of grouping gives no additional information about the items; it tells only what other things are potential members of the group. It is thus partially redundant. Nominal groupings, however, are usually implicitly functional insofar as common names generally reflect the common uses of objects.

EQUIVALENCE IN ANCHORAGE

In terms of structure, the developmental trends of Eskimo and white children are alike: the proportion of superordinate groupings increases and that of complexes decreases with age (Figure 1). The older children of both groups not only form significantly fewer complexes, but also such complexes as remain tend to be the varieties that involve the connection of longer strings of items, such as associations and multiple groups. Collections, involving as many attributes as items, and edge matchings consisting of overlapping pairs, are formed by the younger children of both cultural groups, but not at all by the older white children and rarely by older Eskimos. These trends are in perfect accord with the pattern found in Brookline, Massachusetts (Chapter 3), in Mexico City and to a lesser extent in a small Mestizo village (Chapter 12).

If we turn from developmental trends to absolute proportions, a quantitative difference between the two Anchorage groups emerges. Superordinates at both age levels are significantly less frequent for the Eskimos than for the white children. This result is not astonishing if these children are in fact breaking away from a traditional milieu that emphasizes concrete uniqueness at the expense of abstract equivalence. Figure 1 indicates that the Eskimos may attain the same level of superordination, but later.

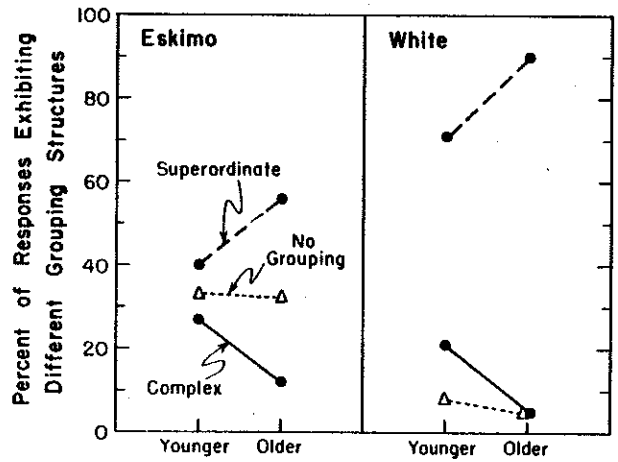

Figure 1. Percent of responses exhibiting different grouping structures given by Alaskan children.

There is one additional difference in the patterning of Eskimo and white groupings with respect to structure. The Eskimos often see neither a complexive nor a superordinate connection among the items; rather they see no connection at all. The resulting refusals to group (Figure 1) often included a specific reference to the differences among the items. For example, one Eskimo boy said, "The same about them is nothing. They have another taste. The milk has a different taste from the orange, the apple, potato, and fish. That's all." The opposition between difference and equivalence was sometimes directly manifest in a type of response employing hypothetical similarities. A good example of these "if" responses is the reasoning of the boy who pointed to the apple and said, "If they both [apple and orange] had this color, they would have been the same." When the potato was added to the array he said, "The only way they could be alike is if this [potato] was a fruit." The impression gained from reading these protocols is that these children do not readily change their point of view in order to resolve a contrast into a similarity. They contrast items within an attribute dimension but do not move to a more general level or shift to another attribute. In the "if" responses the children seemed to be groping toward a superordinate structure but could not quite bring it off technically. They transformed one object to negate the contrast rather than selecting a new single attribute as a basis for equivalence. Among the Eskimo this maneuver was unique to the few who were high in no-grouping responses of all sorts, and it was never used by a white child, either in Anchorage or in Brookline.

One of the problems Eskimo children face in acquiring the techniques of equivalence grouping is overcoming the embeddedness of objects in a particular setting in order first to abstract one attribute and then shift to another point of view. Thus, to an extent, the Eskimos appear to share with the village Mexicans of the previous chapter a remnant of a traditional heritage with its emphasis on the concrete individuality of things.

This picture of the structure of equivalence in Alaska hides one fact: that the Eskimos did not answer or said that they did not know the answer much more frequently than did the white children. The Eskimo children often seemed to withdraw from the situation; and a study of Eskimo culture indicates that passive retreat into silence is the standard way of dealing with tense or unpleasant situations and is consequently a characteristic Eskimo reponse to threatening interactions with the white world. Nevertheless, all the indications were that this response was specific to the task and *not* a reaction

to the general testing situation with its unfamiliar white tester, for the Eskimo children had done as well on the Goldstein-Scheerer test as the white children. It would appear that certain Eskimo children have particular difficulty in acquiring the techniques of verbal abstraction valued by the white culture. Their responses illustrate tendencies that perhaps influence the cognitive development of other Eskimo children as well.

Turning now to the content of equivalence groupings, we see that both white and Eskimo children follow the pattern first observed in Brookline, Massachusetts, and later in Mexico City: there is an increasing tendency to pose a similarity judgment on a common function served by objects or on the way they are classified in language (Table 1). The main difference between the Alaskan groups in the developmental picture presented in Table 1 is that the drop in perceptible attributes occurs later for the Eskimo than for the white children. Olver's Brookline data, plus the results in Anchorage, indicate that the sharp drop in the use of perceptible attributes comes in the second or third grade for most American children, in the fifth grade for Eskimo children. Nevertheless, the final proportions of perceptible, functional, and nominal attributes are approximately equal for both groups of children.

The decline in the use of perceptible attributes by Eskimo children is because of a diminution in color reasons. Seven in ten of the younger Eskimos made at least one grouping based on color. No older Eskimos made such groupings, and only a single child in the other groups did so. Yet form and material were used about equally often by all four groups of children. There is evidence that color is especially preferred by the younger Eskimo children, at least in terms of their verbal reasons. They produce two unique responses: grouping items simply because "they have colors" and using "if" responses focused on color, such as, "If this had white, they'd all be the same color.

TABLE 1
Percentage of Reasons of Different Types Given by Alaskan Children

	Eskimo		White	
	Younger	Older	Younger	Older
Perceptible	50%	10%	20%	14%
Functional	34%	71%	73%	77%
Nominal	4%	5%	7%	9%
Refusal to group	11%	14%	1%	0%
Number of reasons	105	111	104	107

Neither the generalized color response nor the "if' color responses have been observed, even in younger white children in Anchorage or in the Olver and Hornsby study (Chapter 3) in the United States.

As the Eskimo children grow older, they seem less caught by the vivid colors of objects, although they continue to notice them and may group on the basis of other perceptible attributes such as form and material. Likely as not, the white children go through the same sequence, but earlier. This conjecture is consistent with other studies dealing with use of perceptible attributes—color, form, and material. Brian and Goodenough (1929) report that children from ages three to six prefer color over form, but that form responses increase with age. And Hornsby (Rigney, 1962) finds that although first-grade children use form almost as often as color, their color groupings drop out by the third grade and form groupings persist until the sixth grade.

Why do younger Eskimos use color at an age when the white children by and large no longer do so? It may be, as Bruner suggests, that color requires fewer transformations than shape for the following reason: (Rigney, 1962, p. 72):

> In forming color equivalence groupings, the subject need attend to only a single dimension—that of hue. Form, however, permits of variation along a multitude of dimensions—height, length, width, number of sides, curvature, regularity or irregularity and so on.

In terms of the number of possible dimensions, function would be closer to shape than to color. In this view, the special status of color would derive from its psychological (if not physical) unidimensionality and the consequent fact that it requires a single step—selection of hue—to be utilized as an equivalence base in this experiment.

The utility of ordering kinds of attributes in terms of the complexity of the transformations they require is borne out by the results of another investigation done by Reich with the same groups of Eskimo and white children. This experiment suggests, however, that transformational complexity affects verbal equivalence more than nonverbal grouping behavior, at least in certain situations. Children were given an "animal sorting task" in which they were to pick out from an array of forty-four animals "those that go together" and then to explain the reason for their groupings. The species represented incuded dogs, cows, lions, seals, bears, sheep, chickens, and whales. Possibilities existed for within-species groupings as well as for more inclusive groups based on habitat or function. Eskimo and white children, regardless of age, do not differ in their nonverbal response to this array. Animals of a single species were almost always placed together. Size

or content of the children's groupings did not differ. However, equivalence rules verbalized by the younger Eskimos stand in marked contrast to the reasons for grouping given by the other children. When the older Eskimo and white children gave reasons they named the animals, saying, for example, "These are cows." Although the younger Eskimos could also identify the animals on request, when giving reasons they described physical properties of the items they had grouped, saying, for example, "They are red," or "They have the same black fins," or "They are standing up." As true criteria these perceptible attributes would have dictated the inclusion into the group of other animals, but such cross-species groupings based on essentially irrelevant perceptible attributes were extremely rare. In effect, the younger Eskimos were "explaining" their groupings in terms of prominent attributes rather than formulating an equivalence rule that summarized the similarities within the group as well as distinguishing it from others.

If we judge from the results of the first experiment, the explicit formulation of such an equivalence rule was beyond the means of the younger children, for the verbalization of a nominal grouping rule requires a symbolic transformation—the step from criterial attribute or attributes to class name. As far as behavioral sorting is concerned however, the array was ideally suited to species grouping, for each species was embedded in the most relevant possible context—animals of *other* species. If it is true that for members of traditional societies concept formation proceeds by differences more than by similarities, then species concepts would be formulated in terms of features that distinguish a given species from other species. No transformation from criterial attributes to class name is necessary if grouping proceeds by differentiation among classes on the same level of generaility and not by superordinate generalization. However, when a concept is defined in terms of what it is *not*—that is, its contrast set—rather than in positive terms, it can be brought into play only in a particular context.

The importance of this point will become even more salient when we look at concept formation in Senegal. When the shift from perceptible to functional attributes does come for Eskimo children, the form it assumes is different than for other American children, whether in Anchorage or Brookline. They do not express the function of things in terms of their personal interaction with them nearly so often as do most American children (Table 2). Eskimo children are more likely to refer to function in an impersonal manner, saying for example, "They are to eat," rather than "We eat them." This result had

TABLE 2
Percentage of Functional Attributes that are Personal and Impersonal

	Eskimo		White	
	Younger	Older	Younger	Older
Personal	38%	41%	85%	78%
Impersonal	62%	59%	15%	22%
Number of functional attributes	38	79	76	82

been expected in the light of an analysis of Eskimo culture, for, despite an emphasis on self-reliance, its value system contains ideals of cooperation and the subordination of the individual to the group.

Recall that according to Olver and Hornsby's suggestion in Chapter 3, one's self forms the stable reference point that promotes the change from a complexive grouping structure based on shifting attributes to a superordinate structure based on a single constant attribute. Thus, egocentric functionalism was seen as prerequisite to both superordinate structure and impersonal functionalism. But the development of the Eskimo children indicates that the structure of equivalence groupings is independent of its egocentric content and that egocentrism is not the universal stage postulated by Western psychologists such as Piaget (1930) and Vygotsky (1962).

On the other hand, one tentative conclusion is that specific cultural content has its largest effect on the most specific aspects of grouping strategies. Thus the *type* of structure and the type of attribute are not affected by a specific cultural value, but such a value may determine the form a given type of attribute will take.

Thus, in the example at hand, the ideal relation between individual and group seems to determine whether functional attributes will have a predominantly personal or impersonal content. Another result substantiates this same conclusion: the functional responses of the Eskimo and the white children to the array of ingestible objects varied in content according to the relevant life experiences presumably undergone by each group. The white children refer to health, whereas the Eskimo children are concerned with survival. The white children see the objects as being alike because, "They help us grow," or, "They are good for you." The Eskimos group the items because, "They keep people from starving," "They are all for our existence," or "They keep us living."

In sum, let it be noted that, in Anchorage, the over-all development of equivalence for Eskimo children and for white children is quite

similar. With growth both groups of children show a decrease in complexive grouping and an increase in superordinate constructions. This change in grouping structure involves, for both cultural groups, a corresponding change in attention from perceptible to functional properties. How this transition occurs differs in the two cultures. The Eskimo children go beyond immediate perceptual vividness to the objects themselves, their uses and functions, without intervening themselves for reference in the manner of the white children. In each case the pattern is consonant with the cultures in which the children have grown up.

EQUIVALENCE GROUPING IN SENEGAL

The conservation results obtained with Wolof children in Senegal and presented in Chapter 11 would lead one to expect that the cultural variation thus far observed among school children in the United States, Mexico, and Alaska would be overshadowed in magnitude by those obtained from children who have not attended school. If the rural-urban difference can be conceived as variation along an abstract-concrete dimension, then the relevance of school in an oral culture becomes impressively clear. At least one psychologist (Vygotsky, 1961) has noted that the written word *ipso facto* presents a new and higher level of abstraction over the spoken word, abstract in the sense of being removed from the bit of concrete reality to which it points. The spoken word stands for something; the written word stands for the spoken word that stands for something. The anthropologist Malinowski (1930) has pointed out that written language is more abstract than oral language in yet another respect: its meaning is comparatively self-contained, independent of the situational context to which it refers. Bruner (1965) extends this kind of analysis to the intrinsic nature of "learning in school" [p. 1009]:

> The change in the instruction of children in more complex societies is twofold. First of all, there is knowledge and skill in the culture far in excess of what any one individual knows. And so increasingly, there develops an economical technique of instructing the young based heavily on *telling* out of context rather than *showing* in context. . . . School imposes indirect demands that may be one of the most important departures from indigenous practice. It takes learning, as we have noted, out of the context of immediate action just by dint of putting it into a school. In school, moreover, one must "follow the lesson," which means one must learn to follow either the abstraction of written speech—abstract in the sense that it is divorced from the concrete situation to which the speech might originally have been

related—or the abstraction of language delivered orally but out of the context of an on-going action. Both of these are highly abstract uses of language.

Let us start, then, with an experiment carried out only with children who had not gone to school, children possessing an exclusively oral tradition (except for rudiments of Arabic culture transmitted by the Moslem religious school.) These Senegalese children came from the same Wolof bush village of Taiba N'Diaye as the participants in the conservation studies of Chapter 11. Thirty children participated in the experiment. There were ten six- and seven-year-olds, ten eight-year-olds, six ten-year-olds, and four fourteen- to sixteen-year-olds.

The experiment was analogous to Hornsby's free grouping experiment (Chapter 3). Ten objects found in the African market in Dakar were laid out on a table. Each child was asked to indicate those that were alike. He was then asked to give a reason for his choice. The exact instructions literally translated were:

> Won ma yi chi niro. (Show me those in here that are alike).
> Lu nyu niro? ([In] what are they alike?)

The array included four articles of clothing, four round objects, and four red things, so groupings by function, form, and color were possible. There was a sandal, a blouse, a pair of shorts, and a scarf—all to wear. The round objects consisted of an onion, a ball of indigo dye, a glass bead, and a rubber ball. Finally, the ball, the scarf, a plastic drinking cup, and a pencil were all predominantly red.

Naturally, a child could also make groupings unforeseen by the experimenter. The attribute bases for such groups could be discerned through an examination of the child's reasons. Indeed, this experiment allows us to look at equivalence grouping as manifest in both linguistic and nonlinguistic behavior. That is, we compare the child's reasons for grouping and his selection of objects.

Not all arrays of equivalent things reflect a superordinate or "true" concept. Superordinate groupings result from correctly applying a rule. This rule states the criterial attribute(s) that distinguish members of the group from certain other things in the domain. In logical terms, this rule defines the *intensive* properties of a class. If the concept is truly abstract, in the sense that the defining property is superordinate to and removed from its exemplars, irrelevant attributes of particular objects will not affect the grouping. Objects will be classed solely according to the stated criterial attribute. In line with ideas presented by Brown (1958) and Bruner, Goodnow, and Austin, (1956), we may say that the presence of a "true" or superordinate

concept is indicated by the correct recognition of its particular instances. The universe of such instances constitutes the *extension* of a concept. As Inhelder and Piaget (1964) point out, intension logically implies extension, and vice versa. This is so because a statement of criterial attributes defines, *deductively,* the universe of exemplars, whereas the enumeration of the universe implies its common properties through induction. In a "true" concept, then, intension (criterial properties) and extension (domain of exemplars) are perfectly coordinated, so that one defines the other (Inhelder and Piaget, 1964).

Let us now look at our results with unschooled Wolof children in terms of these criteria of superordinate structure, criteria derived directly from the definition of superordinate employed in Chapters 3, 12, and the earlier part of this chapter. Recall that the experimental array comprised three groups of four objects each. One group could be generated by the application of a color rule, the second by a shape rule, and the third by a function rule. How many children chose as if following one or another of these rules, grouping, say, all the red objects, all the round objects, or all the articles of clothing? The number of times a superordinate rule is fulfilled increases steadily with age (Figure 2) much as in Hornsbys free grouping experiment (Chapter 3). As in that experiment, this growth parallels a shift away from choosing pairs of objects as groups. Among the youngest children, 60 percent formed pairs; in the oldest group, they were nonexistent.

Can unschooled children say what the attribute is that they are

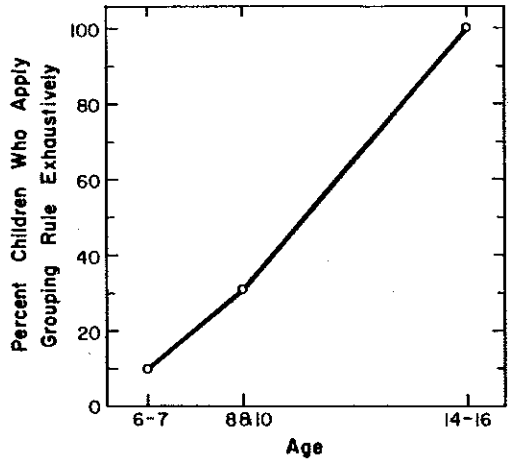

Figure 2. Percentage of bush unschooled children who apply grouping rule exhaustively.

using? In fact, a majority of children at every age are quite capable of expressing attributes relevant to the objects chosen. There are none of the shifting attributes that characterize the complexive structures described by Hornsby in a similar free grouping task. No matter how many objects are chosen, the number of attributes specified never exceeds one. Thus Wolof children attain the superordinate ideal of a single common attribute earlier than do the Massachusetts school children seen by Hornsbyl However, this precocious development of structure goes hand in hand with a premature closure of content. For all practical purposes children at all ages base their groupings exclusively on the attribute of color. The percentage of subjects using color attributes as a basis for grouping were, respectively:

70% of six- and seven-year-olds
40% of eight-year-olds
80% of ten- to sixteen-year-olds.

The only other type of attribute to be named with any frequency by these children is typified by the following reason: "They have the same manufacture." This justification seemed to mean that the objects so grouped were man-made, as opposed to the natural objects in the array like the onion and possibly the ball of indigo dye. In all the instances where this type of reason was offered, however, all or most of the objects chosen were in fact red.

The change in grouping structure with age consists primarily, then, in learning to apply the color rule systematically. In fact, the exhaustive groupings chronicled in Figure 2 always consisted of red objects, never round objects or things to wear. To put it another way, extensive properties are developing until they meet intensive definition, thus achieving the status of a "true" superordinate.

These results lead to the tentative, if astonishing, conclusion that Vygotsky's complexive stage may not be a "natural" maturational development, but rather an "error of growth" brought forth by the demands of certain environments, notably the school. It may be that such environments demand the diversification of classificatory bases and that initially this multiplicity of types of attribute entails that inefficient grouping structure called complexive. The complex may thus be a necessary step preliminary to the ultimate accomplishment of equivalence groupings based on a *variety* of criterial attributes.

An affective attribute served as a basis for grouping only once: its form was, "They are pretty." It has often been claimed by psychologists as well as by anthropologists (e.g., Werner, 1948; Durkheim and Mauss, 1963) that traditional peoples use irrational affective reactions as a conceptual link between things. These results indicate

that this is not necessarily the case. Indeed, it is possible that a bit of Western individualism might be requisite to using a personal feeling as a classificatory basis. This conclusion is harmonious with the Eskimo children's reticence about putting personal reference into their reasons. Although Hornsby's Massachusetts children do not base groupings on affective ties any more frequently than did these Wolof children, they do frequently utilize their own reactions as links between things through the medium of egocentric reasons, in which the child relates the items to his personal world. At an earlier stage, these American children often use sentential or thematic forms of grouping in which items are linked in highly personal and imaginative, if not logical, ways, (Rigney, 1962). Neither thematic nor egocentric reasons are ever offered by these unschooled Wolof children. In sum, the content of the unschooled Wolof children's reasons is no more affective and much less personal than that of American children.

We have already assessed the extensive aspect of grouping structure in terms of nonverbal criteria, and we have seen that as these unschooled Wolof children grow older, they act more and more as if they were applying a superordinate rule. Consider now another criterion of superordinate structure, one that yields a verbal index of extension parallel to our nonverbal one. In order to receive credit for linguistic superordination the child must explicitly state that there is an attribute common to each member of the group. Superordinates may be either general (e.g., "They are round,") or itemized (e.g., "This one is round; this one is round; this one is round."). The fulfillment of this criterion means (1) that the extension of a grouping has been symbolized by verbal means and (2) that its intensive properties have been stated to remain constant throughout its membership. Because in our present experiment the vast majority of children at all ages conform to the second criterion, the symbolic expression of extensive properties is the only variable tapped by count of superordinate language structure. In contrast to our nonverbal measure, however, this is a purely formal index of extension, for it is independent of the particular objects chosen, of the attribute stated, and of the fit between criterion and objects. Unlike our operational index, this formal measure of extensive superordinate structure does not show an increase with age. The percentage of reasons[3] expressed in superordinate language structure was as follows:

50 percent of six- and seven-year-olds
40 percent of eight-year-olds

[3] No child contributed more than one reason. Ninety percent or the 30 children in the experiment did supply a justification for their grouping.

67 percent of ten-year-olds
25 percent of fourteen- to sixteen-year-olds.

This finding is of special interest in light of the fact that certainly the Eskimo and other American children, and very likely the Mexican children as well, did show an increase in the frequency of this superordinate linguistic structure.

At a concrete level of description, what this difference in the development of grouping structure means is that, whereas the older American child would typically select all items sharing attribute X and would say either, "They are all X," or "This is X; this is X; this is X" the older unschooled Wolof child would also pick all the X items, but would give a one-word reason, "X" or "X-ness," leaving the enumeration of the objects sharing attribute X to be communicated by his previous nonverbal behavior. This difference in the forms of superordination is precisely what our initial analysis of the role of the school would have led us to expect. In the context of the grouping situation, an explicit statement of the criterial attribute plus a choice of all those objects containing the attribute provide a logically perfect definition of the concept in terms of the correspondence of intensive and extensive properties. An explicit statement of the link between attribute and each object selected is unnecessary. In the absence of the stimulus situation, however, the extensive definition must be formulated verbally. This is exactly what the school experience forces on all pupils—the ability to operate intellectually *in the absence of a concrete situational context.* One might say that classification among children who do not go to school remains partially enactive rather than becoming totally symbolized in words. This, however, would distort the situation; for the unschooled bush children learn to symbolize all that information not carried by the situation but needed to define the concept. They easily express their criterial attribute; it is only that they do not symbolize when the information would be redundant. Thus they select objects to form a group and state the criterial attribute. More inspection tells one whether or not all the items share the attribute; it is superflous to say so.

Unfortunately, this one experiment is not sufficient to demonstrate that the school is the critical factor separating these results from those obtained in Massachusetts and Alaska. Many other variables like culture and language were radically different from the other experiments. Therefore, let us turn to another grouping experiment. Its design was such that the effects due entirely to schooling could be isolated. This was possible because the participants included groups of bush school children whose background differs from that

of the unschooled children only in terms of formal education. In fact, this experiment utilized the same groups of Wolof children who participated in the main conservation study of Chapter 11. Consequently, three degrees of urbanization and education were represented, and the effects not only of school but also of the city could be assessed, while native language and ethnic background were held constant.

More precisely, the Wolof children who participated in this study came from three milieus:

Neither Schooling nor Urban Influence. The setting was again Taiba N'Diaye, a traditional Wolof village of about a thousand people. Children at three age levels participated in the study. There were twenty-two six- and seven-year-olds, twenty eight- and nine-year-olds, and eleven eleven-, twelve-, and thirteen-year-olds. A group of five adults were included later.

The Same Traditional Rural Milieu Plus Schooling. Most of the third and sixth-grade children lived in the same village, but unlike the first group they attended the village school. The first-grade children attended a school in Méouane, a similar Wolof village. These three grades approximated on the average the age levels of the three groups from the first milieu. Twenty-four first-grade children, twenty-two third-grade children, and eleven sixth-grade children were questioned in Wolof, their native language. Twelve sixth-grade children went through the experiment in French, the language they were speaking and studying in school.

Schooling Plus Urban Influence. These children attended public school in Dakar. There were groups from the first, third, and sixth grades. The curricula were in principle identical with those followed in the bush schools. The experiment was conducted in Wolof with twenty-three first-grade children, twenty-two third-grade children, and twenty sixth-grade children. Another group of twenty sixth-grade children did the experiment in French. Almost all these children participated in the screening experiment of Chapter 11.

The materials consisted of three sets of three pictures each. In each set it was possible to form a pair based on the color, form, or function of the objects pictured. The three sets, displayed successively, were so arranged that no type of pair appeared twice in the same position. The children were asked to show the experimenter the two pictures out of each set of three that were most alike. They were then asked the reason for their choice.

As in the conservation experiment reported in Chapter 9, the unschooled children did not respond to the question, "Why *do you*

say these two are most alike?" but had to be asked, "Why *are* they most alike?" (This question was also used in the first grouping experiment reported.) Evidently they did not distinguish between an opinion and the object of an opinion. Thus they failed implicitly to acknowledge the possibility of other points of view or of opinions about similarities and differences. Perhaps this singleness of point of view is related to the use of only a single attribute—color—noted in the last experiment.

The three picture displays and their presumptive attributes are represented in Figure 3. The color pairs consist of two drawings that have one dominant color in common but are otherwise in different colors. The shape pairs are an approximate match with respect to the dominant outline.

Before the experiment the children played with some toys, tiny models of household objects. They "showed" the experimenter "what you do" with various objects until they seemed sufficiently relaxed

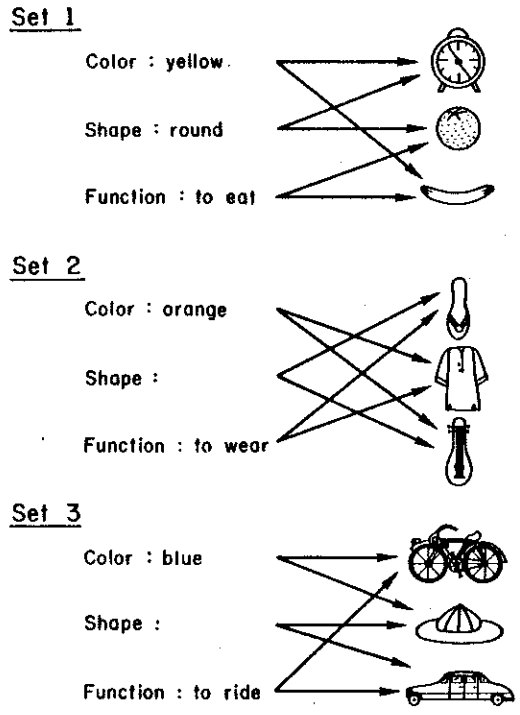

Figure 3. The three picture displays with their attributes. *Set 1*—clock, orange, banana; *Set 2*—sandal, *bubu* (Wolof robe), guitar; *Set 3*—bicycle, helmet, car.

to begin. After the first run-through of the experiment proper, the three displays were exhibited a second time with instructions to show the experimenter "two others" that were alike in each threesome. Again the question "Why?" was asked. At the end, the children were requested 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). The children also named the various colors that appeared in the pictures.

All the results that follow are based on the first-choice grouping for each set of pictures (unless otherwise stated). Thus, on the average, each child contributed three groupings and three reasons to the data. Only thirty-one out of the total 212 subjects gave fewer than three reasons.

Let us first look at the difference that school makes with respect to grouping structure, in order to see whether the results of the first experiment are confirmed under more carefully controlled conditions of comparison.

Because the nature of this grouping task was limited to the formation of pairs, we cannot use exactly the same measure of the extension rule of a superordinate concept. But let us go back to the definition of a superordinate rule. For one thing, it is supposed to distinguish members of a group from nonmembers—in this case, the selected pair from the remaining picture. Many of the children justified their choices on the basis of the color white. The background color white was actually present on all three pictures of each set. Obviously, then, "whiteness" did not constitute satisfactory grounds for forming a pair. One would have to include all three pictures in order for the extension of the group to correspond to its intensive definition. Therefore, if the color white was used to justify the inclusion of a pair of pictures, some "noisy" attributes must have entered into the selection, and a rule clearly not "superordinate" must have been used. With age this response pattern disappears in both groups of bush children, declining from a maximum of 16 percent of all reasons given by the youngest unschooled children and 10 percent of those given by the youngest school children. In Dakar this kind of reason never was observed. Olver and Hornsby identified a parallel (although more sophisticated) strategy of illogical overgeneralization in Massachusetts—"hyperordination." It reaches its maximum at a later moment in development but also finally drops out with age.

Another major nonsuperordinate strategy also declines with age among all Wolof children—object naming. Thus automobile and hat would be paired because, "This is an automobile, this is a hat."

Clearly, there is no single and superordinate criterion. Object naming, absent in the first experiment, where it was not a matter of dealing with problematical pictures, is the closest the unschooled children come to forming complexive groupings. Such a complex would be in the nature of a collection. This kind of reason constitutes between 11 and 16 percent of all reasons given by the youngest children. It disappears by the sixth grade among school children and by adulthood among unschooled Wolofs. We take these findings as indices of the growth of superordinate rules with age, school or no school.

Unschooled children, including the oldest among them, could not identify the pictures as well as even the first-grade school children of both bush and city. This relative failure to recognize pictures, despite familiarity with the objects pictured, is interesting in itself. An analysis of the relative difficulty of the various drawings indicates that it is in large measure the two-dimensional conventions for representing three dimensions that are unfamiliar and cause difficulty. One striking aspect of picture recognition is the speed with which school produces an effect. On the average, children who have been attending a bush school for only a few months fail to recognize only 1.8 out of nine pictures. In sharp contrast, the unschooled children of similar age average almost twice as many errors. Errors do not, moreover, decrease at all in the oldest unschooled group. Remember that all these children inhabit the same milieu, except for school, so that their familiarity with the objects pictured is precisely the same.

It may be that this failure to recognize the pictures is related to a change in the usual figure-ground organization. The entire card may be seen as "figure," causing the white background to become relatively salient and to be used as an attribute for grouping. It is interesting that the city children, the only ones who would have had an opportunity to see drawings before starting school, never use the background as a basis for grouping, even in the first grade. Note also that, whereas the first-grade bush school children have a modal recognition rate of eight out of nine, and progress to nine out of nine by third grade, the modal number of pictures to be identified in the city is nine from the first grade on. These findings suggest that for city children learning about looking at drawings takes place before they start school.

As for superordinate language structures, the results (Figure 4) are clear for the school children. First, note that in Dakar the pattern described by Olver holds: superordinate structure increases sharply in frequency as children move from the first to the third to the sixth grade. The rural school children follow the same pattern: superordination increases with age, although the absolute proportion is less at all ages. The developmental pattern of the rural children who have not gone to school is what we found before. For this last group of children superordinates start out in a proportion roughly the same as that of the school children, but do not increase with age.

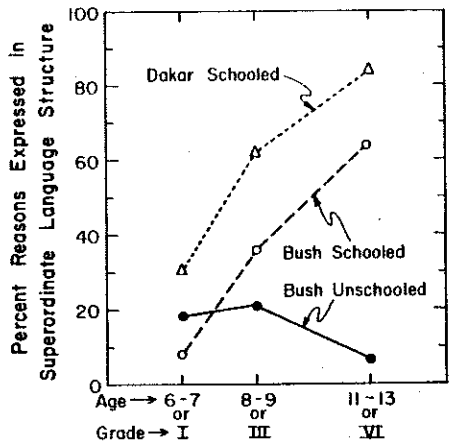

Figure 4. Percentage of grouping reasons expressed in superordinate language structure.

As in Mexico, groups inhabiting different milieus start out alike and become more different with age. Only the unschooled adult group yields ambiguous results; there is a sudden rise in superordinate grammatical frames to 40 percent of all reasons. The results from this one group are less to be trusted than the others, however, for its members, by force of circumstance, were self-selected. In fact, further analysis indicates that the five adults in this group used more than twice as many French words as any other unschooled group. The possible importance of this fact for an explicit verbalization of extensive grouping structure will be clear in a moment. The adult group also differed from the others in that it was composed entirely of men.

Up to now we have been lumping together both types of superordinate language structures, the general ("They are X" or "These X") and the itemized ("This one is X; this one is X, etc.," or "This X; this X, etc."). The general type of structure is of special interest, nevertheless, because it is farther removed from the situation at hand. A statement of the form, "They are all X," can apply to a group composed of any number of objects. It implies that every object shares

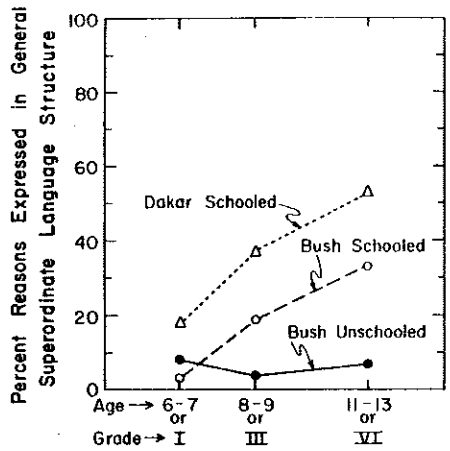

Figure 5. Percentage of grouping reasons expressed in general superordinate language structure.

the attribute. In contrast, an itemized statement applies to a group of a certain number of items. One must know how many objects were in the group before knowing whether the grouping was based on a principle superordinate to all the individual items. This type of superordinate is less abstract in that it does not transcend the individual members of the group. Figure 5 shows that the general type of superordinate structure becomes more frequent among the school children as they grow older. Again, the unschooled children are at the same point at age six or seven but do not change in this respect with age. Note that only one group, that of the oldest city school children, reaches a point at which the general type of superordinate frame accounts for more than 50 percent of their grouping reasons.

Let us now switch from the structure to the content of these children's equivalence groupings. The attributes used by the Wolof school children as the basis for their groupings are precisely what we would expect on the basis of our American, Mexican, and Alaskan results. City school children show developmental trends in the direction of more functional and nominal concepts as they progress from the first to the third to the sixth grades (Figure 6). Bush school children, on the other hand, show practically no development of functional groupings, and nominal groupings are nonexistent. As in the rural Mexican village, the proportion of perceptual groupings increases with age, from 70 percent to 84 percent.

If, however, we break down the perceptible attributes into color and form, it becomes clear that talking about an increase in perceptual groupings masks what is really happening—color pairs are decreasing as form pairs increase (Figure 6). This decrease in the use of color is similar to the pattern found by Hornsby in Massachusetts children and by Reich in Eskimo children.

In order to put these results into perspective, let us turn to the unschooled children. Here the pattern is dramatically opposite and exactly what we found before: color groups increase with age; the use of form and functional attributes is virtually nonexistent at any age; nominal attributes are completely nonexistent (Figure 6). This holds true whether we look for consistent pairing strategies or for explicit grouping criteria. The frequency of noncolor pairs never rises above chance. Note that an adult group has been added to our usual groups of children in order to find out whether color really is the end point in the development of the conceptual content of Wolof

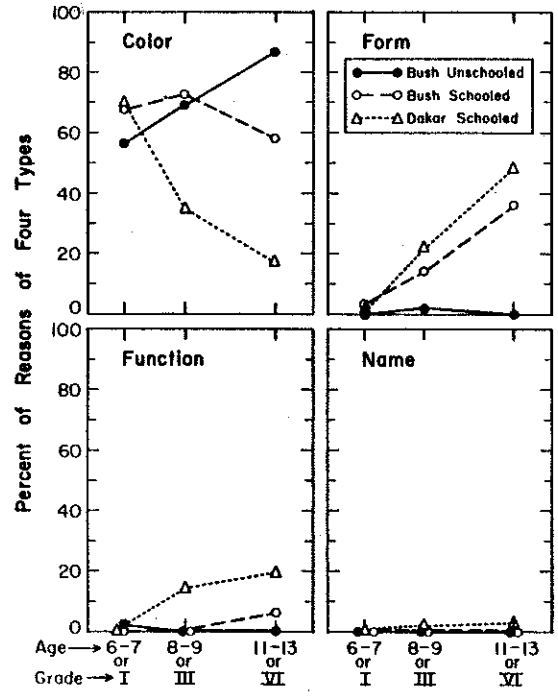

Figure 6. Percentage of grouping reasons of four types: color, form, function, and name.

equivalence groups, at least under arbitrary experimental conditions. The only difference between children and adults, however, is that the adults are better at doing the same thing. They are "better" in two main ways at making color groups. First, they are more consistent in their use of color both in grouping and in explaining. Thus all their pairs are color pairs and all their reasons refer to color. This "improvement" could also be considered an increase in intellectual rigidity and a decrease in group variability. Such a uniformity of response contrasts sharply with the end result of the schooling process, as we have seen. If anything, as school children grow older they agree less with one another on the kind of attributes to be used for grouping. This state of affairs seems as it should be. After all, there is no "right" answer; and it is generally to be hoped that school broadens rather than narrows the options of cognitive functioning.

The other way in which adults are "better" at making color groups is that their choice of pictures is perfectly correlated with their color reasons, a condition that does not hold for the children. This state of affairs reflects the gradual elimination of the use of "white" and "black," color attributes that do not distinguish any pair of pictures from the remaining one. It also reflects the elimination of perceptual errors in color matching. These errors will be taken up later as they relate to the linguistic structuring of color peculiar to the Wolof language. In any case we have here a similarity with rural Mexican children: conceptual development is in the direction of finer and finer perceptual discriminations.

Lest it be thought that unschooled Wolofs merely prefer color but are able to use other types of attributes, the second run-through of the experiment refutes this argument. The types of attribute do not change a whit, even though a different pair of pictures must be chosen. Also, these children failed to make a single functional grouping, despite the fact that they were given some practice in identifying functional attributes in the preliminary play phase. Although the school curriculum does contain specific training in the classification of various objects according to different attributes, the fact remains that without this or some other aspect of the school experience this cognitive ability fails to develop among Wolof children. Furthermore, the first functional groupings made by the school children occasionally manifest a shifting complexive nature, taking the form of a collection of dissimilar functions. Finally, in this second experiment "collections" of different colors occurred three times among the unschooled children. This phenomenon was not observed at all in the object-grouping experiment, where the children were more at home with the array

of stimuli. All the indications are that these complexes represent a more elementary way of grouping with a *particular* kind of attribute. Thus, at the age where the unschooled children's color complexes have all but disappeared, the first functional complex is formed by the school children and the school children, presumably earlier at home with color and shape than with function, form fewer perceptual complexes than functional ones. In short, the unschooled children seem to lack even the complexive precursor of more mature functional groupings.

Price-Williams (1962), working with Tiv chidren in Nigeria, found a very different pattern of concept formation. According to his results, school does not affect the kinds of attributes used to classify an array of plants; both school children and those who had not been to school classified the items into edible and inedible groups. Thus unschooled children clearly used a functional grouping rule. Perhaps this difference between the Tiv and the Wolof is a function of the appropriateness of the contrast set utilized in the experimental situation. One may recall that an appropriate contrast set allowed younger Eskimo children to make species groupings in the animal sorting task even though they could not verbalize this classificatory principle. Things may be alike because they are different from some other specifiable thing or things as well as because they share a common feature; but groupings formed in this way are in a sense more discriminations than generalizations. In Price-Williams' experiment, edible plants were placed in their appropriate context: they occurred in an array of different kinds of plants. The Senegalese procedures, by contrast, utilized totally arbitrary contexts. For example, things to eat were contrasted with a clock in the first set of pictures. In order to make a functional grouping in this situation, one would have to define the concept more in terms of a higher-order similarity than in opposition to a category on the same level of generality. When this kind of thinking occurs, the conceptual content of a grouping begins to be independent of the context in which it is placed. The "appropriate" context for a difference, unlike a similarity, is always clearly present in the form of the contrast case. Consequently, it is not surprising that Mexican children often could not see functional similarities among an isolated group of things, although they could formulate functional differences for the very same items. The important role of the contrast case in concept formation is also emphasized by Wallach (1958) in his treatment of psychological similarity.

To sum up what has emerged so far concerning the relations of school and city to the development of the structure and content of

concepts: the explicit symbolic representation of the extensive structural properties of superordinates seems to depend on school for its developmental elaboration, whereas grouping operations that are clearly superordinate, given the action context in which they occur, increase with age in all the Wolof milieus sampled. In terms of content, bush children who do not go to school end up with nothing but color-oriented concepts; all school children move away from an initial reliance on color, the bush children mainly toward form, the city children towards form and function.

Certain facts concerning the relation between the structure and content of equivalence groupings begin to emerge. Contrary to Olver and Hornsby's original conclusion (Chapter 3), structures that are clearly superordinate, given the context in which they are formed, do not depend on a changeover from "shifting" perceptible to "stable" functional attributes. For one thing, the perceptible attributes of the unschooled Wolof child, unlike those of Western children, are not shifting at all but are quite extraordinarily fixed. If, however, we are to talk about the representation of a superordinate structure that can stand somewhat out of the context in which it was formed, then we still find that its growth is associated with a shift away from at least certain kinds of perceptible attribute and towards conceptual content that can be utilized in a variety of contexts.

LANGUAGE AND EQUIVALENCE

If at this point we pursue the interpretation of results further, we are restricted to considering the general factors of school and urban environment, when in fact we have information on another cultural variable that is often supposed to be crucial in cognitive development—language. Language at the highest level of generality can be divided into two components, a semantic and a syntactic. Most experiments attempting to relate language to thought have emphasized the semantic side, in the style of Benjamin Lee Whorf (1956). Here the linguistic variable is the richness of the lexicon available in a language for representing a given domain. Implicitly, but not explicitly, these experiments deal with the vocabulary of any one language *at a single level of generality*—its words rather than any structural relation among them.

In the view of linguistic relativity developed by Whorf as early as 1935, language is seen as a system of categories that both incorporates and perpetuates a particular world view. On the lexical level, every language codes certain domains of experience in more detail

than others. It has been suggested that when a given language symbolizes a phenomenon in a single word, it is readily available as a classifying principle to speakers of that language. Although any familiar experience can be coded in any language through the simple expedient of a periphrase, experiences that must be expressed in this way are supposed to be less available to speakers of the language (Brown, 1958). The Wolof-French bilingualism in Senegal and the design of our experimental procedure enabled us to try out this view with respect to the principles of classification, that is, the types of attribute used in equivalence grouping by monolingual Wolof, bilingual Wolof, and monolingual French children.

A second kind of semantic variable is more structural. It deals with the *number of levels of generality* that can be encoded by the lexicon of a given language for a particular domain. The relation of this kind of semantic variable to concept formation was also investigated.

Finally, there are the syntactic properties of language to relate to the logical structure of thought. Hitherto the crosscultural study of the relation between syntax and thought has been sorely neglected, although a recent paper (McNeill, 1965) suggests that there is reason to believe that the lexical encoding of events is only a special (and perhaps trivial) case of grammatical encoding. Sapir (1921) may have been the earliest to think explicitly and clearly about the manner in which syntax can shape thought (see Chapter 2). Our research makes a first attempt to relate grammatical and conceptual structure.

For purposes of comparison with the monolingual and bilingual Wolof children, groups of nursery-school, kindergarten, first-grade, and sixth-grade children from predominantly French schools in Dakar were included in the experiment. These children all spoke French as their first language and the great majority were French nationals whose families were living in Dakar. In order to examine the interaction of systems of linguistic categorization as it occurs in bilingual children, the same experiment was done in French with additional groups of sixth-grade Wolof children. These sixth-graders were matched with those who had been through the experiment in Wolof.

Consider first the Whorfian-type of hypotheses that would be derived from a comparison of the Wolof and French lexicons. Only words at a single level of generality—the most specific—will be considered at this point. In Wolof it is impossible to make explicit the three color groupings possible in the picture-grouping experiment without the use of French words. Specifically, in the last set of three

pictures, the French word *bleu* (blue) must be used if one is to specify the basis of grouping by naming the color. In the second set, the use of color involves contrasting a pair of predominantly orange pictures with a predominantly red one. The Wolof language codes both colors with a single word (*honka*), so that verbalizing the basis of the grouping by means of the Wolof word would not be as satisfactory as using the French word *orange*, for it would not contrast the pair with the third member of the set. For the first set of three pictures, Wolof does as well with coding the relevant colors as French, although yellow, the color involved in forming the color pair, is not as codable by Wolof according to the criterion (suggested by Brown [1958]) of agreement between speakers of the language. In fact, the same word is sometimes used to name both yellow and orange, the "contrasting" color of the third picture in the triad. This description of the lexical situation is based both on preliminary linguistic investigation and on the actual results of the experiment under consideration.

Let us pass over a comparison of the coding of shapes by the French and Wolof languages, for the relative strength of the two languages is much less clear, and this comparison is not necessary for present purposes. With regard to functional grouping, both easily find ways of saying, "These things are to eat, to wear, to ride in." One cannot say that Wolof is superior to French in this regard, but unlike the color case, it is not clearly inferior in its ability to code at least those aspects of function demanded by the functional groups in this experiment.

From this description of the two languages, one would at the very least expect monlingual (unschooled) Wolofs to be more functionally oriented in the content of their groupings than bilinguals (schooled Wolofs) and that both these groups would form more functional groups than would monolingual French children in a situation of forced choice, where one type of attribute must be used at the expense of others.

We have already seen that the experimental results in no way justify this kind of Whorfian thinking; in fact, the results are unambiguously opposite: our monolingual Wolofs (the bush unschooled groups) are incapable both of operationally forming functional pairs (above a chance level of frequency) and of verbally expressing the functional basis of such groups.

It only remains to present the results from the monolingual French children to complete this picture (Figure 7). Indeed, their perfor-

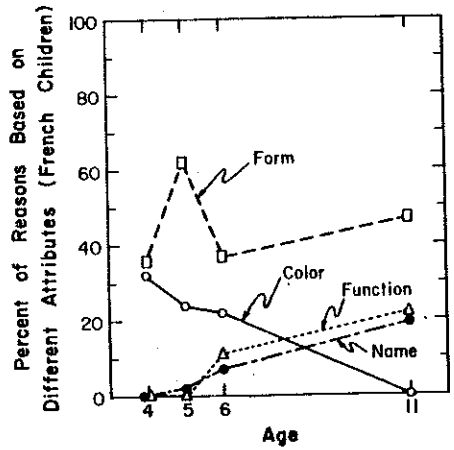

Figure 7. Percentage of grouping reasons based on different attributes (French children).

mance is in line with our modern-urban-versus-traditional-rural hypothesis, and it appears unrelated to lexical considerations. Far from being more color-oriented than the Wolofs, they are much less so from the very outset. The preceding lexical analysis is offered, however, because it is of importance to discard this type of linguistic thinking once and for all.

We have seen that lexical structure does not determine the class of attribute or domain that is selected as a basis for equivalence. Once a domain is selected, however, we may still ask whether lexical structure is related to the particular conceptual cuts that are made within that domain. For example, the Wolofs have few color words, yet this fact does not stop monolingual Wolofs from relying almost exclusively upon color in the formation of equivalence groups. Does this scarcity of words, however, cause them to make less accurate distinctions when they make their color classifications?

It is quite a straightforward matter to identify errors in color discrimination that can be directly related to lexical structuring. For example, the second set of pictures consists of two predominantly orange pictures and one predominantly red one. The orange colors are in fact identical. An error was counted when a child who claimed to be grouping according to color would select one orange and one red picture as being *most* similar. This choice was clearly wrong

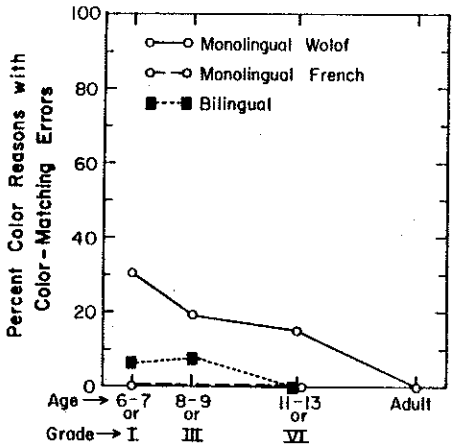

Figure 8. Percentage of monolingual Wolof, monolingual French, and bilingual children showing color-matching errors.

from an objective point of view, for he could have chosen the two orange ones that were of identical color.[4] Similar errors occurred with the other sets of pictures. In the first set, an orange and a yellow picture would be paired instead of the two yellow ones, and the child would say it was because they were "yellow." In the third set of pictures a different type of perceptual error occurred. Instead of matching the two blue pictures for their color, some children would pair a red one with another one containing a little bit of maroon. In Wolof blue is very codable, but it is the French word *bleu* that is universally used, even by unschooled bush people! On the other hand, both red and maroon are coded by the same word, *honka*.

If these errors of discrimination are due to lexical coding, Wolof monolinguals should make them most frequently, Wolof bilinguals next most frequently, and French monolinguals not at all. Figure 8 presents the frequency of the errors among those children who say they are grouping by color. The results are exactly as predicted. At every age bilinguals commit these errors less frequently than do Wolof monolinguals, and they never occur among French monolinguals of similar age. (It must be mentioned, however, that the third type

[4] Note that this is nonlinguistic evidence of the influence of language on thought and so avoids the circularity of the original demonstrations by Whorf. In other words, just calling both orange and red by a single name would not in itself constitute evidence that the two colors would be more poorly discriminated than if there were a separate word for each.

of error described above did occur once among the French preschool children.)

One characteristic of these errors is that by absolute standards they are infrequent, even in those groups of children where they occur most often. There are never more than three color discrimination errors in any single group af children. These relatively rare mistakes are not a major conceptual feature in the total context of Wolof equivalence grouping. We begin to wonder whether the lexical features of language should be assigned as large a role in thought as has been claimed by Whorf and even others who have spoken of covariation rather than determinism.

Of great theoretical interest is the fact that these perceptual errors decrease with age until at last they are completely eliminated in all groups. It appears that age brings increasingly accurate perceptual discriminations. This would appear to be a universal trend (cf., Chapter 12), even when the lexicon of a culture hinders rather than facilitates such discrimination. We may conclude that with age the constraints of reality increasingly overcome language if one opposes the other.

Thus the role of language in terms of specific lexical considerations does not appear to be great, although its domain of operation now seems fairly clear. Factors other than the lexicon determine the bases or dimensions of equivalence, but a specific lexicon may influence the "band width" of the individual categories that constitute a given dimension.

Let us turn now from the role of labels *per se* to the role of a set of hierarchically organized labels, that is, to the role of lexical richness defined in structural terms. There has been much controversy about the place of superordinate words in conceptual thought. The Wolof language, in contrast to French (and to English), has neither the word "color" nor the word "shape." It is clear from the results reported above that the lack of the word "color" does not hinder color groupings from being formed. Does the absence of the general word, however, mean that the Wolofs have no general concept of color? And if not, of what consequence is this seemingly grievous deficit?

First, it is clear that the use of these general words increases with age among the children who attend school. Only 35 percent of the Wolof first-graders employ superordinate words, in sharp contrast to 68 percent of those Wolof sixth-graders questioned in Wolof and 81 percent of those questioned in French. 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 a development only takes place among the unschooled Wolofs to the extent that French words are assimilated into their language, for these words do not exist in Wolof (at least in the perceptual domains relevant to the conceptual content of this experiment). Among the schooled Wolofs, moreover, this development of superordinate words means that French words such as *couleur* (color) and *forme* (form) are being introduced into a Wolof narrative.

But these results still do not answer the question of whether this lexical development (or its absence) has extralinguistic consequences. Consider, therefore, the following diagram:

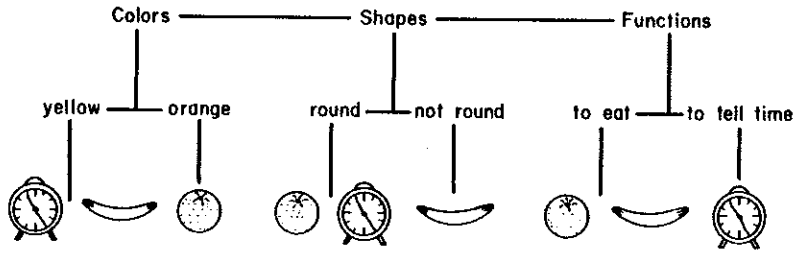

Figure 9. Possible hierarchical organization of first set of pictures.

If this hierarchical organization corresponds to the type of structure generated by the subject in order to deal with the task, then his 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. One would predict, then, that he would be able to supply more than one kind of attribute if pressed. For he is plainly contrasting, say, color with shape or with use. By the same reasoning his use of shape names or color names alone (e.g., "round," "yellow") would mean that he was operating one level lower in the hierarchy. He would be "cut off" from the top of the hierarchy and its connections with other branches. He would therefore be less likely to operate in branches other than the one in which he was. A concept (a consciously or explicitly recognized 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" is related only to other shapes, "yellow" only to other colors.

If this reasoning is correct, then one would expect that, if a subject ever used an abstract word like "color" or "shape," he would vary his choice of grouping attributes when asked to make a first and second choice of pairs for each of the three sets of pictures. But if he used only a concrete word like "yellow," then one would expect him to form nothing but color groupings in all six tasks. The results presented in Figure 10 do indeed indicate that there is an important association between the use of superordinate words like "color" and "shape" and the number of different types of attribute used for grouping. The results are presented separately for each school group, so it is clear that this relationship holds when all other factors such as their knowledge of French and their school grade are held constant. Thus if a Wolof child uses a superordinate word, his chances of grouping by a variety of attributes are twice as great as those of a child who utilizes no superordinate vocabulary. One is reminded that when a Wolof child uses the word "color," it is the French word that he is introducing into a Wolof linguistic context.

The relationship becomes very weak when the experiment is done in French with Wolof sixth-graders: when the children use superordinate words, 65 percent of them use more than one type of attribute; when they do not use any of these words, 50 percent of them use more than one attribute. The difference is comparatively small. The adverse effect on this relationship of doing the experiment in French with Wolof sixth-graders becomes especially interesting when we com-

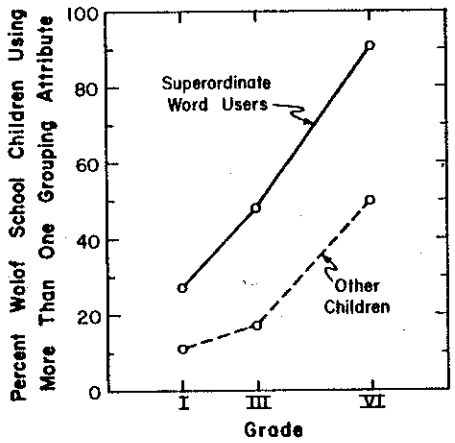

Figure 10. Percentage of Wolof school children using more than one grouping attribute.

pare the results obtained with the French children, who also did the experiment in French. We see from Table 3 that the relationship between the use of superordinate words and the ability to shift from one kind of grouping attribute to another is stronger than that obtained not only with the Wolof school children doing the experiment in French, but also with those doing it in Wolof. If a French child uses the abstract top-of-the-hierarchy labels, he is almost certain to vary his basis of grouping at least once. The contrast between the two groups reveals that access to the pure conceptual hierarchy as diagramed is indicated by the use of abstract terms only if the linguistic terms have been thoroughly mastered in all their semantic implications. When the procedure is such that the Wolof children are obliged to speak French, their use of superordinate language seems to have a forced character and indicates little about hierarchical structure and where they are in that structure. Table 3 shows that general superordinate words more frequently imply a corresponding hierarchical structure when the French superordinates are spontaneous interjections in a Wolof context.

The reasons for color preference among the unschooled Wolofs will be discussed shortly. What needs emphasis at this point is that the basis of equivalence is not an either/or phenomenon, as so much experimentation has assumed. It is, rather, a matter of adding new bases to old and of *integrating them in a hierarchically organized structure*. Everybody is more or less limited in the range of classificatory bases available to him. It is not that one person uses color and another, shape. Rather, one can use color, the other can use shape *and* color. It is the structure of the lexicon and not simply its list of terms that is crucial.

Superordinate class words are not just a luxury for people who do not have to deal with concrete phenomena, as Roger Brown (1958) hypothesizes. In a way quite different from that envisaged by Whorf in the lexical version of his hypothesis, we seem to have found an important correspondence between linguistic and conceptual structure. It relates, however, not to words in isolation but to their depth of hierarchical embedding both in the language and in thought. This correspondence has to do not with quantitative richness of vocabulary in different domains or with "accessibility" but with the presence or absence of words of a higher order that can be used to integrate different domains of words and objects into hierarchical structures. No matter how rich the vocabulary available to describe a given domain, it is of limited use as an instrument of thought if it is not organized into a hierarchy that can be activated as a whole.

Let us consider now the grammatical aspect of language and its relation to conceptual thought. Our focus switches from semantics to syntactics on the linguistic side, and from content to structure on the conceptual side. Remember that superordinate structure is not the same as the use of a general or superordinate word. The attribute that organizes a superordinate group may be general or specific, but it must be shared by every member of the group in question. Superordinate language structure, moreover, demands that the connection between attribute and group members be explicitly stated. Thus "They are all the same color" would have the same structural status as "They are all red." In terms of this structural criterion we have seen that all the children studied in Senegal conform to the usual developmental trend except the unschooled Wolof group. At this point a set of purely grammatical criteria will be introduced in order to test connections between conceptual and grammatical organization.

On the grammatical side, three stages of symbolic reference may be distinguished. The first is the ostensive mode: mere pointing at the object of reference. The second, the labeling mode, involves a verbal tag. The simplest type of label does nothing more than symbolize the pointing operation in a word—"this," "here." The next type of label is one step removed from this operation: it specifies what is being pointed at; "yellow" and "round" are examples of this way of labeling. The third mode is sentential placement. Here the label is integrated into a complete sentence; for example, "This is yellow," or "This is round." In the present experiment these three modes were defined as follows and the definitions applied to grouping reasons:

1. *Pointing*—no verbal response.
2. *Labeling*—tag only; no verb in utterance. Either or both types of label described above could be used. For example, "This," "Yellow," and "This yellow" would all fall in this category.
3. *Sentential placement*—complete sentence. Such a sentence would consist of one or both types of label described above plus a verb. "They are long" and "This one is round" are examples of reasons in the sentential mode.

The results of this analysis are presented in Table 4. Among French monolinguals, pointing is nonexistent even among first-graders. The ostensive mode, however, occupies a definite position in the reasons of all the youngest Wolof groups, especially the unschooled, but disappears in all groups with advancing age. The other differences set the unschooled children apart from all the school children. In the unschooled groups labeling increases with age. The use of the sentential mode stays at a constantly low level, although there is some

TABLE 3
Percentage of Children Using and Not Using Superordinate Words in Grouping Who Employ One or More Than One Basis for Grouping

	Superordinate Word Users				Other Children			
	Wolof in Wolof		French in French		Wolof in Wolof		French in French	
Use one attribute	24	42%	2	9%	49	80%	12	75%
More than one attribute	33	58	19	91	12	20	4	25
		100%		100%		100%		100%
Number	57		21		61		16	

TABLE 4
Percentage of Reasons Couched in Different Grammatical Modes

	Monolingual Wolof				Bilingual Wolof				Monolingual French	
	6–7	8–9	11–13	Adult	Gr. I	Gr. III	Gr. VI (in Wolof)	Gr. VI (in French)	Gr. I	Gr. VI
Pointing	24%	21%	0%	0	7%	2%	0%	0%	0%	0%
Labeling	64	58	90	62	86	57	31	4	33	12
Sentential	12	21	10	38	7	42	69	96	67	88
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
No. of reasons	50	48	30	13	119	129	93	96	46	59

rise in the adult group. By contrast, in all the school groups, both Wolof-French bilingual and French monolingual, labeling gives way to sentential placement with age and increased schooling. The most dramatic contrast is between Wolof school children and those not in school, with virtually no overlap in the distributions of the oldest children. Some ninety-seven percent of the eleven- to thirteen-year-old monolinguals' reasons are simple labels; ninety percent of the reasons formulated by the Wolof sixth-graders doing the experiment in French take the form of complete sentences.

Similarly, Deutsch (1965) finds that lower-class New York children, although weak in some usages of language, succeed perfectly well in utilizing its labeling function. And John (1963) shows that these lower-class children can label the elements in a picture as well as middle-class children, but they cannot integrate the labels into a coherent verbal description nearly so well. This is just one of a number of the parallel differences between schooled and unschooled Wolof children and between lower-class (or "culturally deprived") and middle-class children that were noted.

These results, using purely grammatical criteria, reveal larger differences between the groups who know French and those who do not than did the first, more semantic verbal measure of grouping structure. Is there, however, any direct relation between grammatical and conceptual structure? According to theory a child can frame an explicit superordinate structure (general or itemized) in either the labeling or sentential mode. An example of a general superordinate language structure in the labeling mode would be "These—round." Expressed sententially, this structure would be "These" (or "They") are round." An itemized superordinate in labeling form might be "This—round; this—round." An example of the same structure expressed in the sentential mode would be "This" (or "It") is round; "This" (or "It") is round." Obviously, a limitless variety of nonsuperordinate structures may be expressed either as labels or as complete sentences. It is valid, then, to ask whether the use of a particular mode of reference is associated with a particular conceptual structure. The answer is a strong affirmative for both schooled and unschooled Wolof children. When a school child frames a reason in the sentential mode, the probability that he will form a superordinate structure of either type is on the average almost three times as great as when he uses simple labeling. For an unschooled child, this same probability of a superordinate structure is almost six times as great when his reasons are sentences rather than labels.

For a school child, moreover, the probability that a superordinate

structure will be in a general (rather than an itemized) form is more than four times as great when a grouping reason is expressed in the sentential mode. In the unschooled groups, the number of reasons falling into these categories is very small. If, however, all four unschooled groups are combined, the relationship does hold: superordinate reasons expressed as labels take the general form about half as often as do those expressed as complete sentences.

All these findings concerning the relations between linguistic and conceptual variables contribute important modifications to the picture of culture and equivalence that emerged from the last section. At that point, large differences in conceptual development seemed due to schooling (rather than to the degree of urbanization or to Wolof culture in general). Now, however, schooling has essentially been held constant, whereas linguistic factors have been varied. The positive results produced by this strategy lead to the hypothesis that the school is acting on grouping operations through the training embodied in the written language. This hypothesis has a good theoretical basis. The written language, as Vygotsky (1961) points out, provides an occasion in which one must deploy language out of the immediate referential context. Writing virtually forces a remoteness of reference on the language user; consequently he cannot use simple pointing as an aid, nor can be count on a labeling that depends on the present context to make clear what his label refers to. Writing, then, is a training in the use of linguistic contexts that are independent of the immediate referents. Thus the embedding of a label in a sentence structure indicates that it is less tied to its situational context and more related to its linguistic context. The implications of this fact for the manipulation of concepts are great: linguistic contexts can be turned upside-down more easily than real ones can. Indeed, the linguistic independence of context achieved by certain grammatical modes appears to favor the development of the more self-contained, superordinate structure used by the school children.

For that matter, all of the semantic and syntactic features that have been discussed in relation to concept formation—a rich and hierarchically organized vocabulary, as well as the syntactical embedding of labels—become necessary when one must communicate out of the context of immediate reference. It is precisely in this respect that written language differs from the spoken. The school itself provides an opportunity to use language out of context—even spoken language—for to a very high degree, what one talks about there are things not immediately present. Thus we make no claims that the French language is unique in being able to produce the conceptual

effects described above. According to our interpretation, any written language used out of a concrete context should produce these same cognitive results.

The linguistic variables enumerated above are linked in the behavior of these subjects with an earlier accuracy in perceptual discriminations, a more diversified conceptual content in terms of classificatory bases, and a structural representation that is relatively generalized and self-contained (that is, possessing a communication value outside the situation in which it takes form). Thus far the evidence is purely correlational, however. To what extent is language a causative agent in the language–thought relations under discussion? A comparison of the performances of the Wolof sixth-graders doing the picture-grouping experiment in French with those of their classmates who were given the same experiment in Wolof should reveal what effects of school are directly related to the influence of the French language.[5]

We cannot judge whether conducting the experiment in French rather than in Wolof would promote an even earlier accuracy in color discrimination, as no younger children took the experiment in French. But we can test the effect of using French on the growth of superordinate language structures and on the diversification of content, the conceptual variables that correlate with the use of sentences and abstract words. But these conceptual features also correlate with the amount of schooling, as the last section (pp. 283 ff.) made clear. Now we will make sure that the learning of a second (written and spoken) language is the key factor in schooling, as far as forming concepts is concerned. Does instruction in spoken and written French make the difference?

It turns out that all the trends in content (Figure 11) and structure (Figure 12) related to schooling (and described in the last section) are intensified when the experiment is done in French. This generalization holds for both bush and city children. Thus color is less used by the sixth-grade children who are interrogated in French than by those of the same class and school being questioned in Wolof. Correlatively, shape and function are more frequently used when the sixth-graders speak French (in the latter case only among children in the city). As for nominal classes, French appears to make their use not only increase among the city children but also appear for the very first time among the bush children. The effect of French appears even larger with respect to structure, if we look at the general type

[5] The effect of inserting French words in a Wolof or French context was explored in connection with superordinate terms, but this is a somewhat different problem.

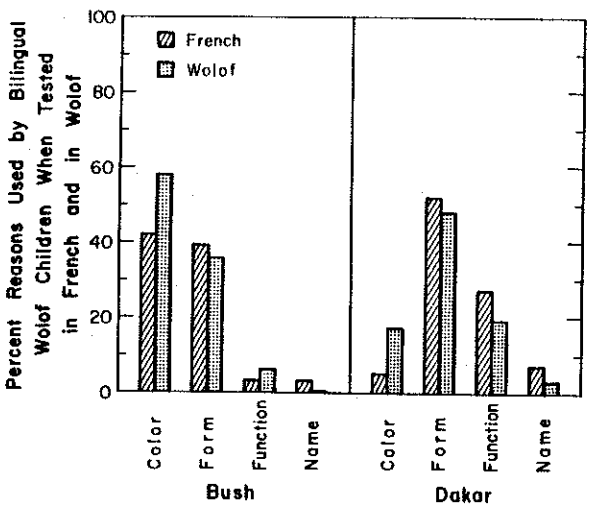

Figure 11. Percentage of four types of grouping reason used by bilingual Wolof children when tested in French and Wolof.

of superordinate linguistic structure (Figure 12). (In contrast, the use of the French language is not associated with a greater frequency of itemized superordinate frames.) This difference between results when the same experiment is done in Wolof and in French may also indicate that what is learned in one language is less than perfectly "translatable" into another.

As for the French children, the two categories of attribute that show a developmental increase are exactly as in the United States and Mexico: functional and nominal. Let us now compare these French children with their Wolof counterparts in Dakar (Figure 7). These two groups of children are following identical curricula in school, and they are both from the same city. The only difference is in the depth and extent of the French language and culture that they command. It is notable that there is no difference between the Wolof and French children in the development of functional attributes; even from a quantitative viewpoint, the final result is almost precisely the same. The French children show considerably more development of nominal equivalence, however. In the context of so much over-all similarity, this difference assumes a special significance, for the creation of a nominal class is unique in requiring a symbolic transformation that makes the leap from a criterial attribute to class name. This leap is symbolic and redundant; it adds no new information about the stimuli not carried by a functional reason. It makes sense that a purely linguistic response (that is, one without referential implications) should be most susceptible to linguistic differences between groups. This point becomes even more intriguing when we consider that the most "universal" or primary grouping attribute, color, is the one requiring the least symbolic transformation in order to be represented—namely, pointing. In fact, nothing but this action of pointing is required to communicate a color similarity. And recall that the unschooled children did point more often in our experiment. Color differs even from form in this respect, for an image is needed to simultanize the continuous tracing action necessary to represent shape.

In terms of the general type of superordinate grammatical frame, there is no difference between the sixth-grade Wolof children using French and the French children. By the sixth grade sixty-four percent of the French children's reasons fall in this category, exactly the proportion observed among the sixth-grade bush children questioned in French (Figure 12). These French children, however, form far fewer of the itemized type of frame (twelve percent of all reasons) than the Wolof children doing the experiment in French either in the bush (twenty-five percent of all reasons) or in Dakar (twenty-two percent). And their total proportion of superordinates is correspondingly less. Evidently, speaking French hinders itemized superordinates

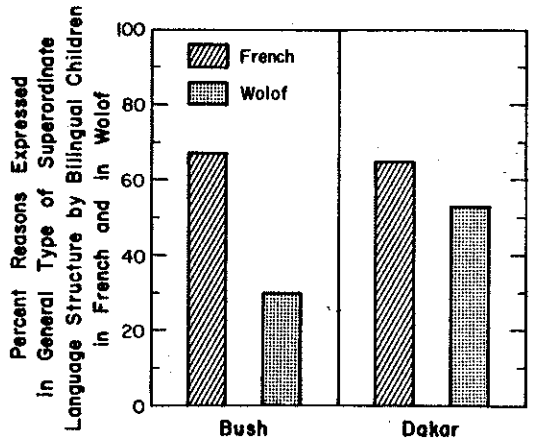

Figure 12. Percentage of grouping reasons expressed in general type of superordinate language structure by bilingual Wolof children when tested in French and Wolof.

while it facilitates general ones, for sixth-grade Wolof children doing the experiment in Wolof form more of these (31 percent of all reasons in both groups) than do any of the groups questioned in French. Thus the use of the French language per se (that is, when all other variables are held constant) augments the frequency of only the most abstract type of structure. Furthermore, the use (rather than the amount of knowledge) seems to be the crucial variable, for the Wolof bilinguals speaking French fare as well in this respect as do the French monolinguals.

Let us take up this same matter in terms of grammatical mode of reference. Table 4 indicates that complete sentences are formulated more readily in French than in Wolof, when there is precisely the same situational context.

Moreover, the use rather than the knowledge of French appears to be the relevant variable, for Wolof bilinguals are highly similar to French monolinguals as far as frequency of using the sentential mode is concerned. But what is the relationship between using French, grammatical mode of reference, and conceptual structure? Labeling reasons are scarce among the Wolof children questioned in French (Table 4), but it is probably meaningful that not a single one expresses a superordinate language structure. In sharp contrast, eighty-two percent of the reasons expressed in the sentential mode have a superordinate structure. Taking these sentential superordinates alone, we find that seventy-four percent of them are in general form—virtually the same proportion as found among the sixth-grade children questioned in Wolof when they use the sentential mode. This similarity introduces the interesting possibility that French augments the production of general superordinates by causing labels to be embedded in sentential structures. Thus the differences in the frequency of general superordinate linguistic structures between the bilingual groups using Wolof and those using French disappear, if one considers only those reasons that are couched in sentential form.

CONCLUSION

What has been found in this chapter supports the picture that emerged from a comparison of urban and rural children in Mexico—but it also goes beyond it. For in Senegal, we have discovered a difference between rural children and urban children which parallels that found in Mexico; and, besides, city-living Eskimos are much like urban children studied elsewhere. But though the rural-urban

difference is small, it is similar in nature to a larger difference that separates children who have been to school and those who have not. The difference in both cases is most compactly described as a difference between abstractness and concreteness. We believe that the difference between the city child and the rural child derives from a differential exposure to problem solving and communication in situations that are not supported by context—as is the case with, for example, most reading and writing, the use of monetary exchange, and schooling. Rural life, it appears, is somewhat less conducive to the development of abstraction.

But what is most striking is the extension of this difference when we compare schooled and unschooled children. Schooling appears to be the single most powerful factor we have found in the stimulation of abstraction.

Our Eskimo data indicate that the "egocentric functionalism" of Western children is not a necessary stage in the development of the idea of equivalence. Similarly, the sorting behavior of unschooled Wolof children reveals that a supposedly "universal" stage in conceptual development, complexive grouping, is less than universal and may be produced by school learning. Complexive grouping may be the first result of the development of a semantic hierarchy of greater depth that permits more flexibility with respect to the bases used in making equivalence judgments. Complexive structure is thus probably more closely linked with the semantic or content side of grouping than with the syntactic side. In fact, neither complexes nor functional attributes are a necessary preliminary to the systematic application of a superordinate rule. What is of such great interest to us is that unschooled children, because they show so little variability in their equivalence behavior (things are always alike in terms of shared color), need not develop explicit forms of superordinate grouping. School children, newly equipped with an enriched hierarchy of possibilities for grouping, must become explicit if they are not to be confused by the changing possibilities that present themselves for forming equivalence groups.

Bush children who do not go to school rely on color attributes at every stage of development; school children, in contrast, move away from an initial reliance on color—the bush children mainly toward form, the city children toward form and function. Thus the school appears to favor the growth of a certain type of perceptual equivalence, namely, equivalence based on form. This result is analogous to the finding in Chapter 11 that the first result of schooling is to "perceptualize" a child's approach to conservation. It must be

stressed, however, that in both conservation and concept formation this perceptual development is basically a conceptual one. Likely as not, this development is also closely tied to language. By conceptual we mean that school is teaching European habits of perceptual *analysis*. An analysis into parts is plainly crucial to concepts based on the multidimensional attribute of form, whereas unitary global perception could suffice for color grouping. Similarly, the breaking up of innate shape constancies into their component parts of retinal image and angle of view is basic if one is to understand two-dimensional conventions for three-dimensional representation. And we have seen that schooling is required for recognizing objects represented in this way, although not necessarily for dealing with less analytic pictorial representations.

Because the Senegalese school is barely richer in perceptual stimuli than is the world outside, we must look elsewhere for an explanation of the effect of schooling on perceptual analysis. In Chapter 2, (p. 40) it was suggested that because one of the universal design features of language is discreteness, that is, a discontinuity of material on all levels from sound to meaning, "analysis and synthesis are literally *forced* upon anyone who would speak human language. Language, then, breaks up the natural unity of the perceptual world—or at least imposes another structure on it." But there is more to the matter than just being a language speaker—all children are that. Where there is difference is in how language is used and what opportunities are provided for different uses. Here again, school is important. For it is the school children who have the greater opportunity to practice language in contexts that do not carry the meaning for them automatically, who are forced thereby to use sentences to the full. They are the ones who, moreover, are led by the nature of school lessons to translate their experience and actions into words and sentences that will satisfy a teacher—and thereby learn to reorganize experience and action to conform to the requirements of language. Even in conservation experiments (Chapter 11), furthermore, children who did not show conservation were in fact responding to perceptual inequalities, but it was mainly the school children among them who could isolate particular perceptible features and describe them in language.

Now, if perceptual analysis is necessary, then language is crucial as an analytic tool. Where perceptual analysis is not necessary, as in color perception, language is much less important. This formulation is quite different from the Whorfian notion of perception that places the whole burden of explanation on lexical representation and none on the domain being represented. Thus we have seen that color categorizations may be made precisely because they do not demand any

linguistic representation at all, whereas nominal classification develops last because it is totally dependent on symbolic representation and transformation. A lexicon at the lowest level of generality is therefore superfluous in determining the content domain of equivalence groupings. But it can affect the perceptual analysis of a given domain, that is, the way in which the domain is subdivided into categories. The fineness of lexical coding can in this way affect the accuracy of perceptual discriminations, at least in children, as our data on color-matching errors indicate.

Language can also act as a synthetic device, once it has broken up the world into pieces. Whereas a lexicon at a single level of generality analyzes a given domain into component parts, a lexicon at higher levels synthesizes various domains into unified hierarchical structures.

Not only do linguistic representations have the properties of analysis and synthesis, they also have a potential for self-containment and isolation from context. As with analysis and synthesis, however, this property is not always exploited to the fullest in linguistic performance and therefore cannot be utilized for the symbolic manipulation of experience. It is this feature of linguistic performance that the Senegalese school seems to develop and utilize for the growth of superordinate conceptual structures that are both generalized and context-independent. One must bear in mind that both unschooled Wolofs and those who have had schooling have the linguistic *competence* to form sentences, but their *performances* with respect to this variable are quite different. What makes the difference is that the school children are trained not only in the context-free use of language, but in the written form of language, and in a second language at that—French, which probably has more "abstract" capacity inherent in it than Wolof. At least, bilingual Wolof children perform more abstractly in French than in their native tongue.

In the end we place great stress on the role of linguistic variables in conceptual growth, at the same time rejecting almost completely Whorf's simple notions about the relation between language and reality.

Looking at cross-cultural differences and cognitive growth from another point of view, Heinz Werner (1948) remarked that:

> Development among primitive people is characterized on the one hand by precocity and, on the other, by a relatively early arrest of the process of intellectual growth (p. 27).

This is an accurate formulation with respect to the difference between the performance of school children and those who have not

been to a Western-style school in the present experiments. The unschooled children early hit on stable rules of color equivalence. School children are perfectly capable of grouping according to color, but they go on to other things. Their progress is therefore sometimes marred by "errors of growth." In conservation behavior, too, we saw this "early arrest of the process of intellectual growth" in the unschooled children. And so the differences between those in school and those out increase with age. This has also been a persistent observation concerning the differences between "culturally deprived" and other American children (Deutsch, 1965; John, 1963). Thus it seems that the conceptual development of lower-class American children resembles that of the unschooled Wolof children in this regard. If so, then early intellectual stabilization signifies that full cognitive skill is not being attained. In short, it appears that some environments "push" cognitive growth *longer* than do others.

With respect to the growth of representation, what turns out to be virtually impossible for the unschooled Wolofs are cognitive accomplishments that can be carried out *only* by symbolic means, for instance, nominal equivalence and superordinate language structures. To at least some degree school alters both the ikonic and enactive modes of representation by insisting that they be placed in some confrontation with the symbolic mode. So it may be that modern technical societies demand of their members a fundamental cognitive change as their capacities change with biological growth; whereas traditional nontechnical societies demand only the perfection and elaboration of first ways of looking at the world.

CHAPTER 14

An Overview

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We come finally to some closing observations that may bring our enterprise into proper perspective. Our objective has not been to constructed a "finished" theory of cognitive growth or to attain a set of final conclusions concerning the growth of mind. Rather, we have set out to forge a working point of view about growth and to test it in the light of systematic observations of children growing up in different settings.

We have, I believe, achieved this objective. For those who find labels useful the view of growth set forth in the preceding thirteen chapters may be called *instrumental conceptualism*. In brief, it is a view that is organized around two central tenets concerning the nature of knowing. The first is that our knowledge of the world is based on a constructed model of reality, a model that can only partially and intermittently be tested against input. Much of the structure of our cognitive models is quite remote from any direct test, and that rests on what might be called an axiomatic base—our ideas of cause and effect, of the continuity of space and time, of invariances in experience, and so on. It seems not unlikely (no stronger phrase than that is justified) that some of this axiomatic structure informing our models of reality is already given in the innate nature of our three techniques for representing or "modeling" reality: action, imagery, and symbolism. That is, the physical requirements of adaptive action "force" us to conceive of the world in a particular way, a way that is constrained by the nature of our own neuromuscular system. So, too, are we constrained by the primitive properties of visual, auditory, and haptic space in our effort to represent our knowledge in terms of imagery. Finally, our representation of reality in terms of language or symbolism is similarly constrained by what again