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Developmental Aspects of Categorized Recall in a West African Society[1]

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Studies are reported among West African populations on the relationship between preferred mode of organization of categorizable material and use of organization in recall. Various child and adult groups differed in the types of organization they imposed on the material in a sorting task, with those exposed to school and modernizing influences showing a preference for taxonomic organization. All subjects, however, used their own form of organization to order their subsequent recall of the material, supporting the idea that organizing processes in recall are universal.

The free recall task using categorized word lists, first introduced by Bousfield (1953), has become a basic tool for studying the development of organizational processes in memory.

The developmental course of performance on this task is well known. Amount of clustering in recall (a measure of the extent to which category members are sequentially recalled) has repeatedly been shown to increase with age among American children as they progress through school (Scribner & Cole, 1972; Cole, Frankel & Sharp, 1971; Mandler & Stephens, 1967; Moely, Olson, Halwes & Flavell, 1969; Neimark, Slotnick & Ulrich, 1972; Vaughan, 1968). Children of middle socioeconomic groups have been found to cluster more than those from poorer homes (Glasman, 1968).

Investigators, however, are by no means agreed as to the changes in underlying processes that might account for growth in clustering. One interpretation is that differences in the degree of clustering reflect differ-

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ences in the capacity to organize material categorically. According to Jensen (1971), clustering in free recall is one of the clearest forms of evidence of conceptual, hierarchical processes. He contends that lower levels of clustering among younger elementary school children and older poor black children are due to the absence of a "hierarchical arrangement of their verbal associative network" (p. 50).

This interpretation is called into question by studies showing that children who fail to cluster under standard free recall instructions do so under constrained recall (asking for recall by category as in Scribner and Cole, 1972) and under several cuing and instructional procedures (Becker, 1972; Shultz, Charness & Berman, 1973). Cole and his colleagues (Cole, Gay, Glick & Sharp, 1971) secured similar changes in clustering scores among nonliterate adults in West Africa by signalling categories through external or linguistic cues. Such variability in performance has suggested an alternative explanation of clustering that emphasizes the role of subject-initiated organizing activities in this task (Scribner & Cole, 1972; Moely *et al.*, 1969). This approach makes a distinction between competence (capacity to organize categorically) and performance (use of this capacity for mnemonic purposes).

Neither interpretation is exclusive. Developmental changes may take place with respect to both organizing skills and mnemonic activities. Both sets of component processes may contribute to differences in clustering but their relative contributions cannot be assessed on the basis of recall data alone. The studies presented here make use of Mandler and Pearlstone's (1966) sorting-recall procedure to provide an independent assessment of nonmnemonic and mnemonic organizational processes. They are addressed to the following questions: what developmental changes occur in the type of organization individuals impose on categorizable material? Are there developmental differences in the extent to which individuals use their prior organization of material for recall purposes? Is there an interrelationship between the type of organization and use of organization in recall?

The setting of these studies in West Africa provided an opportunity to explore the effect on organizational processes of sociocultural factors not readily amenable to investigation in the United States. One such factor is schooling. In most developmental research, variations in performance among older and younger children are linked to age differences while differences in amounts of schooling are ignored. Similarly, studies manipulating cultural group membership in this country introduce differences in economic level, social status, language and other factors that may have a bearing on developmental changes in memory performance. Some of these factors can be disentangled by using subjects in develop-ing nations that do not yet have a compulsory school system and that are in the process of assimilating modern ways into a traditional context. Kpelle society in north central Liberia has these characteristics. Subsistence rice farming remains the principal form of livelihood of Kpelle people who still carry on many of their traditional crafts and customs. At the same time, new roads are penetrating into the interior, linking formerly isolated villages to urban and industrial centers, and bringing schools, stores and modern institutions to the countryside. Because individuals participate in these institutions to varying degrees, it becomes possible to study the effects of different constellations of experience with reasonably well-matched population groups.

We will report two studies conducted among the Kpelle investigating the contribution of particular experiential factors to categorized recall. The first was designed to examine separately the effects of age and schooling on children 6- to 12-years of age. (Since Kpelle do not keep birth records, all ages are approximate.) The second explored the effects of increasing degrees of modernization on adult memory performance.

EXPERIMENT I

Subjects

Ninety-six children served as subjects. The experimental groups were 6- to 8-year old children who had never attended school, 6- to 8-year olds in the first grade (the second year in Liberian elementary schools), 10- to 14-year olds who had never attended school, and 10- to 14-year olds in grades 4–6. Since two lists of stimulus materials were used, this resulted in a $2 \times 2 \times 2$ design (Age by Education by List) with 12 children in each cell.

School populations were randomly sampled from age groups at a government elementary school located in Sinyea, a transitional road town of some 250 houses. Children attending school lived either in Sinyea or in smaller villages within walking distance. Because of the extremely high drop-out rate for girls (half of the first graders were girls but none of the sixth graders), the sex distribution for school children was determined first and duplicated in the corresponding nonschool groups. Comparative groups of nonschool children were selected haphazardly from the same villages.

Materials

Common objects were used for items instead of written verbal materials. Two 25-item lists were prepared: a taxonomic list with five items in each of five categories (*food, utensils, clothes, sewing materials,* and *hunting things*) and a nontaxonomic list composed of unrelated items. Categories and items were selected from a chart of Kpelle-language taxonomic classifications (cf. Cole *et al.*, 1971, Chapter 3, for a description of the chart and its preparation). For the taxonomic list, categories were selected to allow construction of groups in which items were functionally related. *Sewing things* and *clothes* were included as categories that might give rise to cross-over functional relationships; *foods* and *cooking utensils* were included for similar reasons and *hunting things* was added as a fifth, potentially related category. Half of the children in each age-education group were randomly assigned to one list and half to the other.

Procedure

Two Kpelle men, both high school graduates, served as experimenters, and each ran half the children in every experimental group. Sessions were conducted in Kpelle. Instructions were first prepared in English, translated into Kpelle and restored to English by a second translator until the two translators agreed on wording. Finally, the instructions and procedures were tested and modified in pilot work.

Each child was seen individually. The session began with a short conversation, followed by a practice task with six small plastic blocks, which differed in shape and color. The child was asked to put the blocks into groups so that "those that belong together are in the same group." No matter how the child sorted the blocks, the experimenter said, "Fine!" and requested that the blocks be put together again in exactly the same way as before. When it was clear that the child understood what was meant by "sorting" and "sorting the same way as before," the experimental task was introduced as a memory game played with "things you know." The experimenter held up each item in a pre-arranged standard order, had the child name it or supplied the name if necessary, then laid the item on the table, constructing a 5 × 5 array.

Instructions continued: "It will help you to remember these things if you put them into groups so that the things that go together best are in the same group. You can make as many groups as you want but you have to have more than two things in a group. When you have done this a few times I will cover the things up and see how many you can remember. You can put things into groups anyway that makes Kpelle sense."

When the first sort was completed, the experimenter scrambled the objects and instructed the child as follows: "I want you to put these things back into the same groups you made before. Put the things back just the way you had them."

When the child met the criterion of identical sorts on two consecutive trials, the objects were covered with an opaque cloth and recall was requested. The child was allowed to take as long as he wanted to remember the items. Following recall, the objects were uncovered and the experimenter pointed to each group in turn, asking, "Why did you put these things together?" Any child failing to achieve identical sorts after 13 trials was dropped as a subject. Only two children failed to qualify.

Results

The relative difficulty of the sorting task for various experimental groups is indexed by the number of trials required to reach a consistent sort. Table 1 indicates that older school children, on the average, required only half the number of trials required by all other subjects to achieve a stable organization of the material.

Since there was no significant difference between lists, analysis of variance was performed with both lists combined. Older children reached criterion in fewer trials than younger children ($F(1,92) = 14.15$, $p < .001$) and school children were faster than nonschool children ($F(1,92) = 18.85$, $p < .001$). An Age × Education interaction ($F(1,92) = 15.65$, $p < .001$) reflects the fact that schooling improved performance only for the older children: 10- to 14-year old school children were significantly better than their nonschool counterparts ($t = 5.88$, $p < .001$); whereas, 6- to 8-year old school and nonschool children did not differ significantly ($t = 0.27$, n.s.).

Organizational structure: Quantitative characteristics. Sorts were analyzed to determine the number of groups into which the array was

TABLE 1
Mean Performance Measures for Sorting, Expt I[a]

	Taxonomic list					Nontaxonomic list		
	No. of trials	No. of groups last trial	Rc first trial	Rc last trial	*S* last trial	No. of trials	No. of groups last trial	*S* last trial
6–8 years								
No school	6.16	4.33	.18	.20	.24	6.75	4.66	.22
School	5.50	6.08	.24	.28	.16	7.08	5.42	.19
10–14 years								
No school	6.50	5.92	.26	.31	.20	6.58	5.25	.22
School	2.83	6.16	.49*	.48*	.28	3.08	6.08	.21

[a] Measures are explained in text.
* Statistically reliable with Z scores at $p < .05$.

segmented on each subjects last sorting trial. The experimental constraint requiring at least three items in every group restricted the number of possible groups to a range of two to eight. As Table 1 shows, younger children tended to make fewer but larger groups. Both Age and Education work in the same direction of increasing the number of groups and decreasing their size ($F(1{,}88) = 6.51$, $p < .025$ and $F(1{,}88) = 9.82$, $p < .005$ for Age and Education, respectively).

Education effects were especially marked. Over 40% of the nonschool children used three or four groups compared to only 15% of the school children. Conversely, one-third of the school children used seven or eight groups compared to only 15% of the nonschool children. Distributions of the frequencies with which school and nonschool children used 3–4, 5–6, or 7–8 groups to segment the array yielded a significant chi-square ($\chi^2(2) = 10.13$, $p < .01$). Distributions compared by age were similar but differences were smaller and not statistically significant.

Mean number of groups used to segment the array shows little change from first to last sorting trial for any population. The basic composition of the groups is also stable over trials. As a rough measure of stability, a count was made of items grouped together on Trial 2 that were together on Trial 1. Younger children replaced an average of 18.8 items in their original groups and older children 20.2 items. Even the younger children had achieved 80% sorting consistency by the end of the fourth trial. Their difficulty appears to have been in effecting the transition from "nearly the same" sorts to "absolutely identical" sorts. School children, 10- to 14-years old, made this transition rapidly, thus demonstrating superior recall of group membership of items as well as superior recall of the items themselves on the post-sort recall test.

Organizational structure: Qualitative characteristics. The extent to which experimental populations used taxonomic categories as the basis for grouping was measuring by Johnson's Respect Ratio (Rc) (Johnson, 1967). Table 1 presents mean Rc's and shows that 10- to 14-year old school children were the only subjects whose groups conformed to the taxonomic categories at an above-chance level.

Comparison of Rc's on the first and last sorting trials substantiates the finding of basic stability of the organizational structures revealed by other measures. Children in the three populations making little use of taxonomic classes show no indication of having "discovered" the categories as a result of longer exposure to the material or repeated opportunities for sorting it.

A more detailed examination was made of the sorting data through Johnson's (1967) hierarchical cluster analysis program which generated the tree diagrams shown in Fig. 1. Numerous partial taxonomic groups

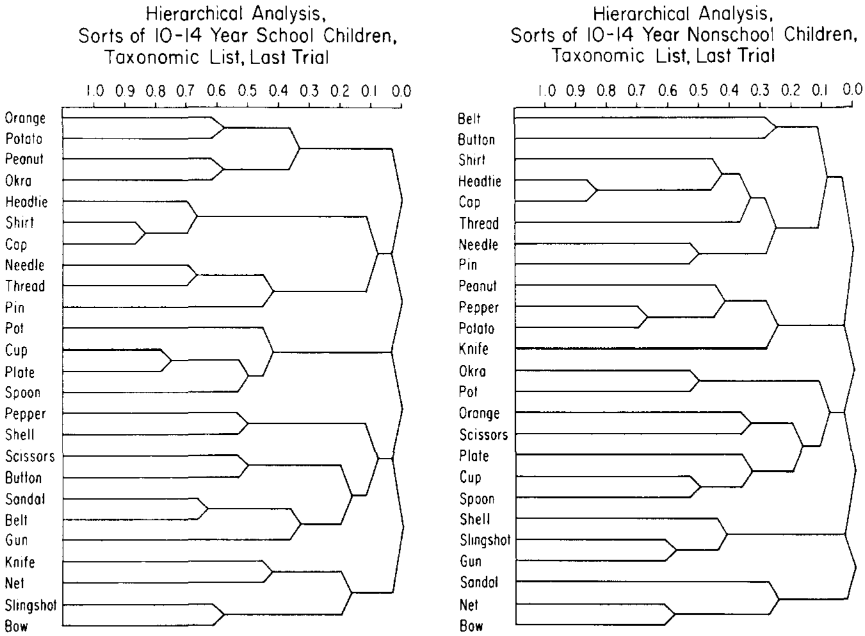

FIG. 1. Hierarchical analysis, taxonomic list, last trial. Sorts of 10- to 14-year old school children (left-hand panel). Sorts of 10- to 14-year old nonschool children (right-hand panel).

consisting of three and four items show up in the sorting performance of the 10- to 14-year old school children but no complete category appears (see left-hand panel of Fig. 1). With the exception of one pair (*pepper* and *shell*), all other pairs are intra-categorical. There is no indication in the diagram that any other grouping principle was systematically employed.

Sorts of the 10- to 14-year old nonschool children differ in a number of respects from those of their school counterparts (righthand panel of Fig. 1). There are considerably fewer compact groups. No taxonomic category is represented by more than three members. Larger groups emerge by the joining of pairs or triads from two *different* taxonomic categories, one of which has items that operate on members of the other: for example, *thread, needle* and *pin* join with *shirt, headtie* and *cap; knife* joins with *peanut, pepper* and *potato.* This suggests that functional relationships were playing some role in the grouping behavior of the older nonschool children.

Tree diagrams are not presented for the younger children's sorts of the taxonomic list. There was some intracategorical pairing among them, but no compact groups were formed by either the schooled or nonschooled children.

Idiosyncratic grouping characterized the performance of all populations on the nontaxonomic list. No items were consistently grouped together by a majority of the subjects in any population, although the fact that items are not taxonomically related does not in itself bar emergence of common meaning clusters (see Expt 2 below).

The low level of intersubject agreement on both lists is shown in Table 1 by Johnson's S Statistic (Johnson, undated), a measure of correspondence in clusterings across subjects within a population. As expected, 10- to 14-year old school children show the greatest agreement in their sorts.

Explanation of organization. After recall of the taxonomic list, subjects were asked to explain, for each group in turn, why they had put particular items together. Explanations were classified in the following manner: Reasons that did not contain a reference to any characteristic of any member of the group were coded as *arbitrary.* Examples are, "They are the same," "You told me to put them together." Reasons were classified as *compound* if they referred to different properties of items in the group, as, for example, "The *gun* is for hunting, the *needle* for sewing." The third classification, *common aspect,* includes all statements citing a characteristic shared by all members of the group. The common attribute might be functional ("They keep us warm") or perceptual ("They are all round"). The fourth classification includes those instances in which the taxonomic class name was applied to the group ("All hunting things," "Food"). The last two classifications (*common aspect* and *class name*) were considered to represent some abstraction of a unifying grouping principle and have been summed in the last column of Table 2.

Nearly all younger children gave arbitrary explanations for their groupings, making no attempt to relate their sorting behavior to properties of

TABLE 2
Proportion of Answers given for Sorting Items in Taxonomic List, Expt I

	1 Arbitrary	2 Compound	3 Common aspect	4 Class name	Total abstractions (3 and 4)
6–8 years					
No school	91	6	2	0	2
School	87	5	5	3	8
10–14 years					
No school	73	14	7	5	13
School	16	41	31	11	42

the material. This form of explanation persisted with the older children who had never been to school while it all but disappeared among 10- to 14-year old school children. The great majority of this latter group furnished explanations related to stimulus materials and task requirements, and a substantial portion (42%) gave abstract reasons. They most often cited some functional attribute of the items (what they did or what could be done with them) and these dynamic explanations outnumbered the use of a static class name by almost 3 to 1. It thus appears that categorical and functional relations among items not only influenced the sorting behavior of older school children but that they were aware that these ties constituted the basis for their grouping.

Amount recalled. As expected, older children remembered more on the post-sort recall test ($F(1,88) = 29.40$, $p < .001$) (see Table 3). In addition, there was a significant main effect of Education ($F(1,88) = 7.59$, $p < .01$). The independent contribution of Education is seen most clearly in the equality of recall scores of 6- to 8-year old school and 10- to 14-year old nonschool children on the taxonomic list.

The organizational structure of the taxonomic list conferred no overall memory advantage. Only the 6- to 8-year old school children recalled more items from the taxonomic list while other populations did equally well or slightly better on the nontaxonomic list.

The extent of the 10- to 14-year old school children's superiority in number of items correctly recalled is more fully revealed when amount recalled is related to number of sorting trials in Table 1. While younger school children also remembered more than their nonschool age peers, number of learning trials was approximately equivalent for both, suggesting that the memory advantage was greater for schooling of longer duration. The independence of amount recalled and number of sorting

TABLE 3
Mean Performance Measures for Recall, Expt I

	Taxonomic list		Nontaxonomic list			Both lists	
	No. recalled	*C*, personal group	*C*, category	No. recalled	*C*, personal group	No. recalled	*C*, personal group
6–8 years							
No school	12.75	.62	.49	12.08	.61	12.42	.62
School	16.00	.71	.31	13.33	.64	14.67	.67
10–14 years							
No school	16.33	.60	.47	17.33	.61	16.83	.61
School	18.58	.74	.57	19.58	.70	19.08	.72

trials is consistent with Mandler's (1967) conclusion that if a stable organization is achieved, recall is unaffected by the number of trials required to achieve it.

Recall organization. Order of recall output was first analyzed to determine whether subjects used the groups they had made during sorting to help them recall the items. Mean *C* scores (Dalrymple-Alford, 1970, 1972) are presented in Table 3 and show that all experimental populations, without exception, made greater use of their *personal-group* organization to structure their recall than would have been expected by chance. A three-way analysis of variance using Age, School and List as main effects showed none of these factors to be significant.

Recall output for the taxonomic list was also analyzed for evidence of *taxonomic* clustering. In every case, taxonomic *C* scores were substantially lower than corresponding personal-group scores. A two-way analysis of variance showed no main Age or Education effects, but there was a significant Age × Education interaction ($F(1,88) = 4.97$, $p < .05$). Schooling increased the taxonomic cluster scores for the 10- to 14-year olds but decreased it for the younger children. We have no explanation for this interaction.

Correlations were computed between Respect Ratios and amount recalled on the taxonomic list. The relationship was significant only for the 10- to 14-year old school children ($r(22) = .55$, $p < .005$).

DISCUSSION

We will discuss our findings in relation to the three principal questions motivating this research.

What kinds of organization do children impose on categorizable material? Available methods of analysis make it easier to characterize forms of organization Kpelle children did *not* use than to characterize their actual sorts. Taxonomic class structure played little role in the sorting activities of any but the 10- to 14-year old school group. While cluster analysis showed a few instances in which items were paired functionally by older nonschool children, these were neither common nor apparent for younger children. Further, no common perceptually-related groups appeared in the tree diagrams of any child population (cf. Greenfield, 1966). There does not appear to be an orderly developmental progression from one dominant organizational mode to another. With the exception of the 10- to 14-year old school children, Kpelle subjects made groupings based on a multiplicity of ties among items in the manner Bruner (Bruner, Olver & Greenfield, 1966) has described as *complexive.* Their sorts were highly individualized and variegated; grouping by common attributes was not apparent until the taxonomic principle began to exert a regulating effect.

Failure of 6- to 8-year old children to respect the taxonomic class structure is not surprising in relation to performance of young American children, but how are we to interpret the failure of 10- to 14-year old nonschool children to sort by category? They are well within the age range in which American children show a shift to conceptual organization (e.g., Bruner *et al.*, 1966; Mandler & Stephens, 1967) and on age criteria alone, the majority would qualify as being in Piaget's concrete operational, if not formal operational, stage. One thing is clear. Their failure to organize categorically cannot be attributed to a conceptual deficiency characteristic of Kpelle children in general. Their age peers attending school *did* observe the taxonomic categories to a considerable extent both in their physical manipulation of the items and in their verbal linguistic descriptions as well. This fact raises serious questions about interpretations of changes in classifying behavior that rely on *age* alone as an explanatory factor.

What use did children make of their own personal organization in recall? With respect to use of organization as a mnemonic device, group and individual differences are displaced by a high degree of uniformity. Even children as young as six years of age made extensive use of the organizational structure they had created when asked for recall. There is no evidence of age or school-related differences. With material consisting of unrelated items, young children were equally as efficient as older in ordering recall of items by their personal-group membership.

Since children were not asked to recall the items in any particular order and none was suggested to them, their use of personal-organization to regulate recall order must be regarded as a spontaneous mnemonic activity. Common use of this mnemonic is interesting in view of the substantial body of research portraying deficiencies in voluntary mnemonic activities among young children. Because of the complex nature of categorized recall, it becomes important to specify just which component activities of the task are involved in developmental changes. Moely *et al.* (1969) concluded that the critical activity deficiency is failure of younger children to *initiate* organizing activities rather than failure to use organizational structure to mediate recall. Their experimental procedures, however, introduced ambiguity into this conclusion. In addition to teaching children to sort pictures into taxonomic categories, experimenters also suggested that the pictures be *recalled* by category, confounding intervention in the organization of the material with intervention in retrieval processes. The present study permits a more definitive conclusion that even young children will use organization to mediate recall if a personally meaningful organization is available.

It appears, too, that the concepts of *initiation of organization* and *use of organization* do not exhaust all the component activities in this task. Subjects have also to achieve some *stable* organization of the material, and it is very clear from the present study that this is a difficult thing for them to do. Ornstein and Liberty (1973), using somewhat different procedures, found that American fourth graders had great difficulty in achieving two identical organizations of a list of words that were not taxonomically related. To the extent that there are developmental changes in children's preferred mode of organization and in their ability to organize categorically, we may expect to find differences in their achievement of stable organization; these may contribute to differences in recall clustering even when initiation of organizing activities and use of organization are equated.

What of the relationship between type of organization and recall clustering? Older school children, the more taxonomically-inclined organizers, made greater use of personal-groups to organize recall than other populations, but their superiority was slight. Absence of any advantage in recall clustering for the taxonomic list over the nontaxonomic is another indication that taxonomic organization contributed little to recall organization among these child populations.

Similarly, there is little evidence that taxonomic organization is related to amount recalled. Although older school children had highest recall on the taxonomic list, they also remembered the most on the nontaxonomic list in which class organization could play no role. The low level of taxonomic organization found among other child populations does not allow us to probe this possibility further.

Older Kpelle school children performed exceptionally on many aspects of the sorting and recall tasks. All measures point consistently to their unique position: fewer trials to sorting criterion, an optimizing sorting strategy, greatest conformity to the taxonomic structure, highest recall organization, and highest recall. On a number of these indices, Mandler and Stephens (1967) found a similar break in performance between grades 4 and 6 which they characterize as an age-related difference "between 9 and 11 years" (p. 92). We have found the same shift in performance between 6- to 8- and 10- to 14-year olds *but only for children attending school.*

EXPERIMENT II

Results of Experiment I raised the question of the potential influence of higher education in organizational processes. Experiment II was designed to test both this factor and varying degrees of modernization on performance of Kpelle adults.

Subjects

Twenty-eight men and women were selected haphazardly from each of four locations for a total of 102 subjects.

One location was a government high school in the county capital. Three others were villages informally ranked by Kpelle informants on a traditional-to-modern continuum. The most traditional was a bush village, inaccessible by road and totally isolated during the rainy season; an intermediate location consisted of small hamlets off a main road, and the most modern location was Sinyea, the transitional town previously described.

High school students were drawn from grades 9–12. All village subjects were nonliterate. In the bush and road towns, they were engaged in farming and other traditional occupations while those in Sinyea were in unskilled or semiskilled cash occupations. These groups are hereafter referred to as High School, Cash, Road, and Bush. Subjects in each group were randomly assigned to either the taxonomic or nontaxonomic list, resulting in a 4×2 design with 14 subjects in each cell.

Procedure

Instructions, materials and procedures were the same as in Expt I except that the practice task was eliminated. A Kpelle high school graduate experienced in similar research and familiar with the selected villages conducted the experimental sessions in Kpelle and recorded responses in English. All participants were paid a small fee for their cooperation.

Results

Trials to criterion. A two-way analysis of variance showed significant differences among population groups in mean number of sorting trials to criterion ($F(3,104) = 5.40$, $p < .025$) but no list effects. On combined lists, High School subjects required the fewest trials, with 60% meeting criterion on the minimum of two trials and no subjects exceeding three (Table 4 summarizes the results). Although nonliterate villagers required more trials, none took over six to reach criterion, a point of contrast with the nonschool child populations.

Organizational structure. There was considerable commonality among populations in the basic strategy adopted toward segmentation of the array. On the taxonomic list, all populations used five groups on the average (as they would if they had sorted perfectly by taxonomic

TABLE 4
Mean Performance Measures for Sorting, Expt II

	Taxonomic list					Nontaxonomic list		
	No. of trials	No. of groups last trial	Rc first trial	Rc last trial	*S* last trial	No. of trials	No. of groups last trial	*S* last trial
H.S.	2.33	4.8	.81*	.84*	.82	2.42	4.8	.47
Cash	3.33	4.8	.57*	.58*	.54	4.08	4.9	.24
Road	2.75	4.9	.66*	.68*	.62	3.08	4.6	.30
Bush	4.08	5.0	.39*	.44*	.38	3.58	3.9	.31

* Statistically significant with Z scores at $p < .05$.

category) and all except Bush villagers came close to a five group partition for the nontaxonomic list as well. As was the case with the child populations, number of groups used for sorting purposes was almost constant over sorting trials, with fractional increases bringing the mean number closer to five on the last trial.

All populations showed a high degree of consistency in their allocation of items to groups. Even Bush villagers, who took the most trials to achieve identical sorts, were sorting with 80% consistency by Trial 2. Table 4 shows that all populations had significant Respect Ratios (Rc's) on the first as well as last trials. Ratios moved up somewhat over trials, but these increases were not significant by Wilcoxon matched-pair tests. The degree to which sorts conformed to the taxonomic categories varied among populations: it was lowest for Bush villagers, intermediate for Cash workers and Road villagers, and highest for High School students. Mann–Whitney U tests confirmed the superiority of students over all three village groups. No significant differences were found between Cash workers and Road villagers but both significantly exceeded the Bush villagers.

Johnson hierarchical clustering tree diagrams show that the taxonomic categories exercised varying degrees of control over the sorting behavior of the several populations. The left-hand display panel of Fig. 2 presents sorting data for High Schoolers on the taxonomic list. All taxonomic categories emerge as compact groups with over 80% agreement. The tree diagram for the Road villagers (not displayed) also shows the five taxonomic categories emerging as groups, but these result from a slower build-up process in which initially-formed subgroups of category members merge to constitute a complete taxonomic category at scale points representing lesser amounts of subject agreement. Cash workers display a similar process for four taxonomic categories; the fifth, *clothes*, becomes

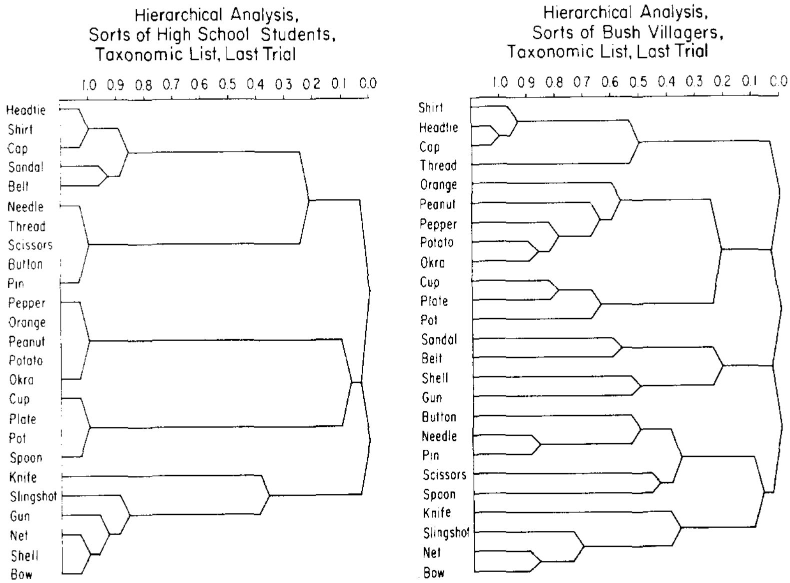

FIG. 2. Hierarchical analysis, taxonomic list, last trial. Sorts of High School students (left-hand panel). Sorts of Bush villagers (right-hand panel).

united only through merger of mediating items from the category of *sewing things*.

Among Bush villagers as seen in the right-hand display panel of Fig. 2, only one taxonomic category, *food*, emerged in its entirety. Certain core items of other categories appear grouped together with a high level of compactness but they tend to form larger groups by joining pairs or triads of other categories. *Shirt, headtie*, and *cap*, for example, are grouped together with near-unanimity, but later join with a functionally related item, *thread*, and never link up with the *sandal-belt* pair. The three utensils, *cup, plate*, and *pot* emerge as a group but *spoon* pairs up with *scissors* and becomes incorporated into a larger unit with *needle, pin*, and *button*. In the examples cited, there is a suggestion that, in addition to obvious functional ties, perceptual similarities may have been playing a role in this population's grouping performance.

It thus appears that all subject groups reflected taxonomic categories (in part or in whole) but that the groups differed in how consistently they applied the taxonomic rule to the task. High School subjects relied almost exclusively on this rule. Cash workers and Road villagers were less consistent in its application, but gave no evidence of using any other rule. Bush villagers seemed to make use of multiple grouping rules, of which the taxonomic was one.

Extent of inter-subject similarity in sorting paralleled conformity to the taxonomic structure. For High School subjects S was .82 ranging downward to .38 for the multiple-rule using Bush villagers, with Cash workers and Road villagers again occupying intermediate positions.

Although no grouping principle was built into the nontaxonomic list, certain compact groups emerged in the tree diagram for the High School subjects' sorts (not shown), some with a high measure of agreement. *Grass, mat* and *rope* was one such compact meaning cluster; *beads, shirt* and *thread* another; *cigarettes, kola nut* and *orange* a third. Several of these meaning clusters are also found among Road villagers but at a much lower level of agreement. Cash workers and Bush villagers showed agreement primarily on pairs of items and not on larger clusters. High School subjects had the highest inter-subject similarity for the nontaxonomic list, indicating that their sorting performance on this list, too, was more controlled by commonly shared semantic dimensions than was that of noneducated traditional adults.

Explanation of organization. Population differences in explanations of grouping are striking as can be seen in Table 5. High School subjects almost never gave arbitrary reasons and most commonly cited some common item attribute or class name. This relationship is reversed for Bush villagers; Cash workers and Road villagers occupy intermediate positions on these indices, with Cash workers showing some superiority in proportion of abstract reasons. Since taxonomic relationships were involved to some extent in the sorting behavior of all adult populations, disparities in verbal explanations have less of a behavioral basis than is the case for child populations.

Amount recalled. Table 6 presents mean number of words correctly recalled by the various populations. Population characteristics and nature of the material both significantly affected recall level ($F(3,104) = 8.21$, $p < .001$; $F(1,104) = 5.87$, $p < .05$ for Population and List, respectively). Pairs of means were compared by the Newman–Keuls

TABLE 5
Proportion of Answers Given for Sorting Items in Taxonomic List, Expt II

	1 Arbitrary	2 Compound	3 Common aspect	4 Class name	Total abstractions (3 and 4)
High school	3	19	56	21	77
Cash	30	24	28	18	46
Road	41	23	32	3	35
Bush	71	6	9	4	13

TABLE 6
Mean Performance Measures for Recall, Expt II

	Taxonomic list		Nontaxonomic list			Both lists	
	No. recalled	C, personal group	C, category	No. recalled	C, personal group	No. recalled	C, personal group
High school	19.93	.85	.82	17.57	.55	18.75	.68
Cash	19.21	.76	.61	18.07	.53	18.64	.57
Road	15.86	.68	.62	16.00	.52	15.93	.57
Bush	18.86	.67	.51	17.71	.51	18.28	.51

test ($p < .05$). On the taxonomic list, High School, Cash and Bush subjects did not differ significantly among themselves while they were all significantly better than Road villagers. All populations except Road villagers recalled more words on the taxonomic list and there were no significant population differences on the nontaxonomic list.

Recall organization. For personal-group recall clustering *C* scores were above chance for all populations on both lists as shown in Table 6. A two-way analysis of variance showed no significant main or interactional effect of Population, but a large effect of List ($F(1,104) = 26.02$, $p < .001$). The depressing effect of the nontaxonomic list on personal-group recall organization had no parallel in the children's recall performance.

On the taxonomic list, the High School students' mean *C* scores for personal-group surpassed all other populations and was considerably higher than the comparable score for the 10- to 14-year old school children in Expt I. On the nontaxonomic list, *C* scores were uniform for all adult populations and at a level below that shown by child populations in Expt I.

There were significant differences among populations with respect to organization of recall output by taxonomic category on the taxonomic list ($F(3,104) = 6.59$, $p < .001$). Since the High School subjects' personal groupings coincided nearly perfectly with the taxonomic categories, their mean taxonomic *C* score is almost identical to their mean personal-group *C* score. As personal-groups diverge more radically from the taxonomic structure, respective *C* scores also move further apart, culminating in a taxonomic *C* score for Bush villagers which is less than half personal-group *C* score. In line with their greater use of taxonomic grouping principles, all adult populations except bush villagers have higher taxonomic *C* scores than child populations.

There were no significant correlations within any population group between Respect Ratios and number of items correctly recalled.

Discussion

Especially interesting is the fact that taxonomic relations played some role in the grouping operations of *all* the nonliterate adult populations, including the most isolated and traditional. Similar populations among the Kpelle have not always exhibited categorical organization on tasks in which this organizing principle was available (see Cole *et al.,* 1971). As our findings make clear, however, taxonomic organization is not necessarily an all-or-none matter. Nonliterate villagers in this study appeared to use class membership as only one of a number of grouping principles. Under such circumstances, we would expect to find extent of categorical organization varying with specific properties of the stimulus materials and response requirements of the experimental task. We do not yet know just how these features of the task influence the selection of class membership as a grouping principle.

Among high school students, taxonomic organization did appear to be an all-or-nothing grouping principle. In this respect, their performance was consistent with their use of class membership as a dominant mode of organization on many different kinds of classification and recall tasks (Cole *et al.,* 1971). They might be said to use class membership as a generalized rule of classification applied to many tasks under many circumstances.

Extending the investigation to adults has thus revealed that increasing amounts of education through the high school level are related to more exclusive utilization of taxonomic grouping principles. But it has also revealed that the shift to taxonomic organization continues to develop beyond childhood years *even in the absence of formal schooling.* All nonliterate adult populations showed more conformity to the taxonomic structure than did the oldest nonliterate child population. In particular, the Cash and Road villagers who came from the same area and shared the same living environment as the nonschool children were considerably superior to them in their linguistic as well as their sorting behavior.

We have stressed adult-child differences principally because of their bearing on psychological theories of cognitive development that tend to equate "primitive" mentality with child mentality. Werner (1961), for example, describes the concepts and grouping operations of adults in primitive societies as similar to those of Western children. Presumably, young children in nonindustrialized societies share early stages of cognitive growth with those in industrialized societies, but their growth is arrested and they fail to attain "adult" status. Our findings with respect to categorical organization do not support such a notion of arrested cognitive growth.

Equally interesting are the differences among *adult* populations. All measures of performance except amount recalled segregated the villagers into two groups—those living in the bush where traditional ways are well preserved and where there is little contact with modern influences, and those living in transitional villages, open to social and commercial traffic. We do not know what particular aspects of changed living circumstances contributed to these differences but it is clear that nonliterate adult populations do not constitute a single homogeneous mass and future studies must take this fact into account.

Against this background of differences, the uniform use of organization as a retrieval mechanism by all populations is impressive. Mandler's conclusion that recall output tends to reflect the organizational structure subjects impose on material was based exclusively on the performance of middle class American school children and college students. Results of the present research showing the same tendency to be characteristic of populations at a great cultural, as well as geographical, distance lends support to his contention that such recall organizational processes may well be universal.

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