counted the displeasure and consternation of her Nigerian hosts at her inability to remember the names of local plants, which every six-year-old in the village had long since committed to memory. Additional evidence of African memory abilities is provided by Bartlett (1932). He ran a miniature memory test on a Swazi cowherder who one year earlier had been tangentially involved in a series of cattle transactions. The herder was able to recall identifying marks as well as the price paid for each cow in pounds, shillings, and pence, with almost no errors.

Both Bowen and Bartlett attribute the memory feats of their informants to their great interest in plants (or cows). The cowherder's feat of memory seems outstanding only because what is socially important to him is irrelevant to the Western observer, who therefore finds a good memory for cows and plants highly unusual. We might, according to this theory, expect a Swazi herder to be equally astounded if he encountered a Los Angeles ten-year-old trading baseball cards with a friend. The intricate recall of players, teams, batting averages, and relative standing that the successful card-trader requires would seem virtually impossible to the Swazi cowherder, to whom all baseball players look alike!

This commonsense explanation of how social relevance and interest affect *what* is remembered was neatly demonstrated in an experiment by Deregowski (1970).

He was struck by the different significances attached to time in traditional rural settings as compared with urban settings and reasoned that memory for time concepts should reflect this difference in cultural valuation. His subjects were members of the Tumbuka tribe in Zambia and were drawn from two populations assumed to reflect the greatest contrast in the role that time measurement played in their daily lives. The first group was composed of primary school students living in town: schools adhere to timetables, discourage lateness, and emphasize dates, and the urban environment in general requires conformity with time schedules. The daily life of a village dweller, however, is relatively independent of time considerations: there are no timepieces. Activities follow their own rhythm and are not governed by set schedules. For his test material, Deregowski composed a short story containing eight items of numerical information, four of which dealt with various aspects of time. After each subject heard

the story, he was asked questions that revealed how much of the numerical information was retained. As hypothesized, rural people were considerably inferior to the schoolboys in their retention of time information, but were equivalent in their recall of three of the four nontemporal concepts. Further analyses of the data showed that these differences between groups arose because the rural people handled the nontemporal concepts better than they handled the temporal concepts. As Deregowski observes, even "recall of digits is not independent of their significance and . . . such significance is culturally determined" (1970, p. 40).

The selectivity of memory is, of course, a well-documented phenomenon within Western cultures (a classic reference is Rapaport, 1950), and to the extent that it obtains among Africans and other non-Westerners, we have still further evidence of certain universal aspects of mental functioning. But, in addition to testimony about how well nonliterate people recall certain things, there have been repeated suggestions in the literature that cultural characteristics make a difference in the *way* things are recalled. Bartlett (1932), for example, contrasted two types of remembering —an active process, in which past experience and information is reconstructed for the purpose at hand, and rote memory, a recapitulation of what has occurred, which simply runs it off in the original temporal sequence (a kind of serial memorizing). He hypothesizes that rote memory is the preferred memory technique of nonliterate peoples:

> According to the general theory of remembering which has been put forward, there is a low level type of recall which comes as nearly as possible to what is often called rote recapitulation. It is characteristic of a mental life having relatively few interests, all somewhat concrete in character and no one of which is dominant (p. 264).

Another hypothesis about memory in non-literate societies stresses the special practices and techniques that such cultures must develop in order to guarantee the transmission of information from one generation to the next. The "wisdom of the elders" can only survive in the memory of the living; there is no book to look things up in, and thus the information held in mind by individual members of the culture is a valuable asset for the whole community. D'Azevedo (1962, p. 13) reports that among the Gola of western Liberia, "an elder with a poor memory or whose old

people told him nothing is a 'small boy' among the elders and might well be looked upon with contempt by younger persons." And a contemporary saying among South American Indians sadly observes that "when an old man dies, a whole library burns." Because knowledge resides in living memory, oral societies have produced special mnemonic devices to aid in the preservation of the cultural store. Such at least is the intriguing thesis of the phiologist-historian Havelock (1963), who considers the epic poem such a device and analyzes how its special features of rhyme, rhythm, and repetition contribute to its function as the "oral encyclopedia" of the social, material, and historical aspects of the culture. From the point of view of our interests, this thesis suggests that remembering in traditional societies may rely, to a considerable extent, on special memory supports and devices.

Studies in Free Recall

In the past few years, a series of studies of memory have been carried out in Africa by Cole, Gay, Glick, and Sharp (1971) as a means to deciding among various explanations of the observations we have been reporting.

Their first concern was to find an experimental tool or set of tools that would be appropriate to the study of memory processes across cultures and that could reveal *how* the people were going about the memory task. They began by seeking some procedure that could at one and the same time permit either rote learning or active reorganization of the material to occur, in order to test Bartlett's hypothesis about culture and memory.

The free-recall experiment, originally used by Bousfield (1953) for the study of organizational processes in memory, seemed an excellent candidate. A free-recall experiment is extremely easy to administer. A subject is presented a series of items, one at a time, and is told that he must try to learn them so that he can recall them later. The list can then be repeated as many times as the experimenter wishes.

Free recall is so named because the subject is free to remember in any manner he chooses. The way in which he orders the lists when recalling them in this unconstrained fashion gives important insight into the organizational mechanisms of memory. For instance, if he recalls items in the same order in which they were presented, we could characterize his performance as "rote." He might also tend to recall items in clusters, or groups based on some common category. Clustering by taxonomic category is a mode of organization prevalent among older schoolchildren in the United States (Bousfield, 1953; Cole, Frankel & Sharp, 1972; and many others). But it is possible to analyze freely recalled material in a variety of ways so as to evaluate alternative hypotheses about the way in which to-be-remembered material is organized.

As a starting point for the research, sets of items were constructed using standard anthropological eliciting techniques.* This preliminary work assured the experimenters that the test material was familiar and that the subjects knew its linguistic structure.

Table 6–1 contains two lists of items used in several studies of cultural variations in memory performance. The first list is termed

Table 6–1. List of Items Used in Kpelle Recall Studies

Clusterable	Nonclusterable
Plate	Bottle
Calabash	Nickle
Pot	Chicken feather
Pan	Box
Cup	Battery
	Animal horn
Potato	Stone
Onion	Book
Banana	Candle
Orange	Cotton
Coconut	Hard mat
	Rope
Cutlass	Nail
Hoe	Cigarette
Knife	Stick
File	Grass
Hammer	Pot
	Knife
Trousers	Orange
Singlet	Shirt
Headtie	
Shirt	
Hat	

*The data reported here are taken from studies among the Kpelle of Liberia (Cole et al., 1971).

"clusterable" because of the obvious division into easily identifiable semantic categories; the second is termed "nonclusterable" because it was constructed so as to provide minimal groupings into taxonomic categories.

The experimental attack focused on the types of persons, verbal instructions, and material conditions that could reasonably be expected to affect the rate of learning and structuring of recall under free-recall procedures. One variation involved the nature of the stimulus materials. A point that many observers of African learning seem to emphasize is the presumed concreteness of African thought. It was reasoned, then, that if people were shown the objects on the list instead of having the names of the objects read to them, recall and clustering would be augmented.

A second variation involved the nature of the lists. American evidence indicates that clusterable lists are easier to learn and are better recalled, in general, than lists whose components belong to disparate classes. If the Kpelle rely on rote memory rather than on the taxonomic organization of the list, they ought to recall both lists equally well.

Another variable that has been found to affect recall is the arrangement of items in a clusterable list. If the items are *not* randomly arranged, but rather are presented in blocks (with all items in a given class succeeding each other), clustering and recall are enhanced for American college students (Cofer, 1967).

In the first experimental series, Kpelle subjects were selected from three age groups: 6 to 8 years, 10 to 14 years, and 18 to 50 years. Within the first two age groups, comparisons were made between nonschooled children and children in the first grade and second to fourth grades, respectively. Since it is very rare to find an educated tribal adult, the experiments did not include educated adult groups.

In order to make cross-cultural comparisons, data were collected from children in southern California who are primarily white and are from middle-class homes. Although this population is clearly not optimal (a wide range of socioeconomic and ethnic backgrounds should be investigated), it was used because of its availability.

The standard experimental procedure used in these tasks was to present the test list and ask for recall on five successive trials. The outcome of this series of experiments, as well as of several additional experiments, can be summarized in capsule form as follows:

1. As American children grow older, the number of words recalled and the rate at which the list is learned increase markedly; older Liberian Kpelle subjects recall only slightly more than younger subjects, and educated subjects recall slightly more than noneducated subjects. Most striking is the fact that, on the whole, learning is very slow for Liberian subjects; only a very few more words are recalled on the fifth presentation of the list than were recalled on the first presentation.
2. Clusterable lists are learned a little more easily by all the Kpelle groups, and by all the American groups as well.
3. The American children, especially those 10 years old and older, cluster their recall—that is, items from the same taxonomic category are said together—but the Kpelle show little or no semantic clustering.
4. The Kpelle subjects all recall objects better than spoken words, but so do the Americans.

How are we to interpret these results? Taken at face value, they tell us that we should seriously question reports of fabulous memory power among traditional nonliterate peoples. Not only were the performances of our Kpelle groups poor when compared with American groups of similar ages, but educated children tended to perform better than their nonliterate age-mates. This result is just the opposite of what we would expect if lack of literacy fostered memory.

With respect to the structure of the recall performance, we might be tempted to conclude that the absence of taxonomic clustering is evidence for Bartlett's hypothesis about a "low-level type of recall" among traditional peoples. However, analyses of these data lend no support at all to the idea that the Kpelle depend upon rote recapitulation as a structuring principle. If they did, we should have found that the order in which the words were recalled would have corresponded closely with the order in which the words were presented. But it did not. Correlation coefficents were calculated for the two orders, and in no case did the Kpelle correlations deviate significantly from zero. So much for rote recapitulation!

Had the experimental series stopped at this point, our conclusions would have had to be that in a laboratory experimental situation, which makes arbitrary demands on memory, African memory (as measured by free-recall performance among the Kpelle) is worse than American memory, and that literacy im-

proves recall rather than the other way around. However, to have stopped here would have left this investigation open to a host of criticisms.

Some of the most obvious hypotheses about possible sources of difficulty for the Kpelle in this kind of experimental situation come readily to mind. Perhaps the people did not understand what was required of them; perhaps they were indifferent to the task and did not try to remember; perhaps they were deliberately playing dumb. Instead of reviewing the work that was aimed at evaluating this kind of interpretation (the interested reader should refer to Cole et al., 1971), we will describe a line of research that we think offers greater promise of helping us understand the complex antecedents of good memory performance.

We felt that the proper object of this research was to find out what kinds of conditions are required for Liberian subjects to show good memory skills in an experimental situation. Our guiding hypothesis was that something about the way in which free-recall experiments are usually conducted failed to provide subjects in Liberia with the needed reminders of the material that had been presented.

We began our new line of investigation with a vague notion that the performance of the Kpelle subjects would be improved if the categories latent in the clusterable list were somehow signaled by an object in the real world. Thus we arranged a situation in which the objects shown to our subjects were associated with chairs. Perhaps, we hypothesized, concreteness is not an attribute of the material to be learned, but lies in the relation of this material to some external recall cue.

The experimenter stood behind four chairs with the subject in front, facing him. Behind the experimenter was a table containing the objects to be remembered. As the names of the objects were read they were held up one at a time over chairs, and then the subject was asked to recall the items (but not which chair they were associated with). The procedure was repeated for five trials.

The presentation of items followed a different pattern for each of three different groups of 10- to 14-year-old schoolchildren. For one group, items from a given category were all held over one particular chair on each trial; thus each category was assigned one chair. For the second group, items were assigned at random to the four chairs, with the assignment remaining the same for each

trial. For the third group, all items were held over the same chair; the other three chairs were not used.

The chair procedure produced much higher recall, for all three groups, than any we had previously observed, making it appear that the fact of having a concrete reminder is more critical for good recall than the particular form the reminder takes. The next problem was to determine whether this "reminder" notion could be extended to other kinds of cues besides physical ones. A question of particular importance from a pedagogical point of view is whether some means of *verbal* cuing could augment recall. Could we teach our subjects to remember better using mechanisms less unwieldy than chairs?

In an initial attempt to use verbal cues, subjects were read the standard clusterable list and recall was measured under five conditions.

In three of these conditions, subjects were cued with the names of the categories in the list. At some point in the experimental procedure the experimenter said to the subject, "These things are *clothing, tools, food* and *utensils.*" One group heard this statement when the list was presented, another after the list had been read but just before it was to be recalled, and a third group heard it at both presentation and recall. A fourth experimental group served as a control and received no cuing at all. Finally, a fifth group of subjects were not cued in the manner we have described but were instead *required* to recall the items by category (we refer to this group as the "constrained" group). At the time of recall, the experimenter would say, for example, "Tell me all the *clothing* you remember." After the subject had named all the clothing items he could remember, the experimenter would ask for each of the other categories in turn. This procedure was followed on the first four trials, but on the fifth trial, without warning, the subject was simply told to name as many of the items as he could.

Comparison of the first four groups indicated that simply cuing the subjects with the category names at time of presentation or recall had little effect on either the amount remembered or clustering. There were no significant differences among groups, and performance was comparable to that obtained in the standard oral free-recall presentation situation.

The results from the fifth group, whose recall was constrained to systematic retrieval by category, were quite different. The num-

ber of words recalled on the first four trials was extremely high and, most important, it remained high on the fifth "free" trial. Clustering was forced to be perfect for the first four trials with this group, but on the fifth trial clustering remained high and was comparable to the performance of American schoolchildren. It appeared that good recall and highly organized recall could be induced through sufficiently explicit verbal instruction and training.

This is an important result when coupled with demonstrations such as the improvement of recall through the use of explicit, external memory aids (like the chairs). It tells us that we cannot speak of "good" and "bad" memory as if memory were a unitary process. Rather, we need to analyze overall memory performance into its constituent subprocesses and then determine how these processes are brought to bear on a given memory task.

For example, the fact that the constrained-recall condition greatly enhanced recall from the very first trial strongly suggests that many more of the test items were "in the subjects' heads" than they could recall. The constrained group was treated just like the other groups up to the point where they had to start telling the experimenter what they could remember. Since the constraints were introduced *after* all the items had been presented, these results suggest that the difficulty our Kpelle subjects experience is one of making stored material accessible (or, alternatively, of retrieving material that is stored in memory). It could be said that the constrained recall made stored material accessible and in the process taught the subject retrieval habits that carried over to the unconstrained-recall trial.

Having achieved such effects in our standard experimental situation, we next wanted to find out whether Kpelle would routinely use efficient retrieval processes on their own in a more natural memory situation.

In most previous research, the paradigm for the study of memory in naturalistic situations has involved recall of stories. The classic research in this area is described in Bartlett's book (1932) to which we made reference earlier. Bartlett's work, while interesting, could not completely solve our needs. We wanted to know how the skills involved in normally occurring recall (which usually involves meaningfully connected material) make contact with the skills involved in the experimental memory task (which involves disconnected material).

We chose a middle course, which we think permits us to link recall for connected and disconnected material. The basic strategy we adopted was to provide a range of story contexts in which to present the 20 basic clusterable items from Table 6-1. At one extreme, no context at all was provided (our basic oral-presentation procedure was repeated); at the other extreme, items were embedded in a story context in which each item was meaningfully linked to a neighboring item. Two alternative forms of these stories were the following:

STORY 1. A chief had a beautiful daughter, and many young men wanted to marry her. Each of them brought many presents for the girl and left them with the chief. One brought (name the tools). Another brought (name the foods). Another brought (name the utensils). And another brought (name the clothing). *What things did the girl receive? Which young man should get the girl? Why?*

STORY 2. A very handsome man, who happened to be a bogeyman, came to town one day and met a beautiful girl. The girl did not know he was a bogeyman and agreed to marry him. On the night they married, she discovered he was a bogeyman. He told her she must come with him to his farm, but she said to wait a bit while she got her things together. She knew where the bogeyman's farm was, and so she put many things on the ground in her house to show her people the way to reach his farm. She put her *plate* first, since she always ate at home. Then she put the bogeyman's *singlet* to show that he took her away. Then she put a *pot* to show that he took her first in the direction of her family's kitchen behind the house. Then she put a *knife* to show that they went past the woodcarver's house. Next was a *headtie* showing that they passed the store where she bought it. Next was an *onion* to show they passed the market, and a *cup* to show they passed the table where they sell palm wine. Next was a *hammer* to show they passed the house being built on that trail. She then put down a *hat* to show that the house belongs to the teacher. Next was a *file* to show they passed the blacksmith's kitchen. Then came a *banana* to show they took the road with the banana trees, a *shirt* to show they passed the place where they wash clothes, and a *calabash* to show they passed the place where they get drinking water. Then she put an *orange* to show that they took the trail with the orange

tree, and a *cutlass* showed that the trail was newly cut. Then came the *trousers* to show they passed the weaver's farm, and a *coconut* to show they took the road with the coconut tree on it. Then came a *hoe* to show that she was on a farm, and a *potato* to show that it was a potato farm, and finally a *pan* to show that she was at the kitchen at the farm. The girl's people saw all these things and understood where she had gone and came and rescued her. They caught the bogeyman and killed him. *Tell all the things she put on the ground and their meaning so that if you were the girl's family, you could find the girl.*

The stories were read by the experimenter who wrote down the subject's responses in the standard manner. Then a tape recorder was turned on to record the subject's version of the story.

The upshot of this experiment was that the way in which the to-be-recalled items fit into the story almost perfectly determined the organization of recall. For Story 1, there was a very strong tendency to recall the items by category. For Story 2, just the opposite relation held: items were recalled more or less in the order in which they fit into the story, and category clustering was at a minimum. And, when items were clustered by category in response to Story 1, the order within each cluster was found to have no relation to the order presented in the narrative, a piece of evidence indicating that in recall the subjects were reconstructing the material on the basis of category membership rather than reeling it off by rote. This experiment, which examines recall processes in a situation close to those naturally encountered in the culture, dispels the notion that memory mechanisms among the Kpelle are like serial automata, which run themselves off on all occasions. Rather, it shows recall processes to be flexible and responsive to the structure provided in the to-be-remembered material, even when this structure is based on taxonomic categories.

Organizing and Other Memory Techniques

Since we have now established that taxonomic structure is *sometimes* used by the Kpelle to direct recall, we can return to the question of why it was not used with the word list in the original free-recall situation. Instead of general explanations couched in

terms of good and bad memory, or "the ability to categorize," we now want to pose the question: What kinds of categorization is a traditional Kpelle person likely to apply to the free-recall task? What conditions control whether or not a category structure is used?

There are several possibilities. While Kpelle *can* utilize semantic categories, this may not be their preferred mode of organizing matrial. Perhaps they would make greater use of a structure reflecting their own preferred basis for grouping. Perhaps the difficulty arises because the free-recall situation requires the subject to reorder the material (organize it) *on his own initiative*—it has to occur to him to do it; if the thought does not occur, no reordering (structuring) will occur. (In the story-telling task, the story fixed the order that the subjects utilized, and under constrained recall, the experimenter told the subject to reorder the material on recall.)

Each of these possibilities was investigated in a separate study by Scribner (unpublished). In the first study, subjects were required to sort 25 familiar objects into groups that "went together," putting at least three items in a group. Two sets of objects were selected paralleling as closely as possible the items in the clusterable and nonclusterable lists of the original free-recall study (see Table 6–1). After the sorting had been completed, the objects were mixed up and the subject was asked to group them again exactly as he had before. This classifying activity was continued until the individual had sorted the items into identical groups on two successive trials. (This procedure and a description of the kinds of groupings that were made was described in greater detail in Chapter 5.) Once a stable way of grouping had been achieved and recorded, the objects were removed and the subject was asked to recall as many as he could. In this way, subjects were given an opportunity to organize material according to their own preferred criteria, and the experimenter had exact information about the nature and composition of each individual's groups. It was then possible to analyze the recall output, not only in terms of how well it reflected the semantic categories the experimenter had built into the list, but how well it reflected the subject's own categories (groups).

This study was run with four adult populations, selected to represent various degrees of involvement in modern institutions (high

school students, cash workers, rice farmers in a road village, and rice farmers in an isolated village far in the bush).

Perhaps the outstanding finding was that all of these Kpelle people—literate and nonliterate, cash worker and farmer, road villager and bush villager—did make use of their own groupings to structure their recall. Their recall order followed their own-group ordering to a greater extent than might be expected by chance. This common technique of using structure to guide recall is all the more interesting because different structures were involved for the different groups. The structures were most different for the two population groups at the extreme ends of the modernization scale; high school students relied almost exclusively on taxonomic categories as the basis for grouping, and bush farmers made little use of this principle. This does not mean, however, that the nature of the groupings had no effect on the amount of recall clustering: recall cluster scores in general paralleled the scores for taxonomic groupings—the high school students on top, followed closely by the cash workers and then by the two farming groups. Moreover, there was a marked decline in recall clustering, among all populations, for the list that was put together out of unrelated items, although this list, too, had been given forced organization. It would appear, then, that there is a relation between the kind of organizing principle used to group material and its efficiency as a guide to recall.

This study provided evidence that Kpelle people do take advantage of prior organization of material when confronted with a recall task; their recall is not haphazard, nor is it unrelated to what has gone before. In this procedure, however, subjects were again *required* to work on the material and reorder it. The question still remains: Do Kpelle spontaneously reorganize material as an aid to memory? Scribner's second study suggests that the answer is "rarely."

A free study situation was devised, patterned after that employed by Moely, Olson, Halwes, and Flavell (1969) in their investigation of the development of memorizing techniques among American school children. Forty high-schoolers and 40 villagers in traditional (non–cash) occupations were tested. With some variation in the manner of presentation of the material (which need not concern us here), all subjects were given a 2-minute period to study 24 familiar objects. Experimenters recorded what the subjects did to try to remember the material, with special attention to whether they made any attempt to divide the object array into meaningful and more memorizable units, whether they engaged in verbal rehearsal, and whether they tried to test themselves before the experimenter asked for recall.

Half the subjects were given broad instructions to "do anything you want to help you remember," and half were given additional instructions to carry the objects to another table "in any way that will help you remember." The instructions to "carry" the material were introduced in the belief that forced handling of the material would encourage individuals to regroup or rearrange the items. This hypothesis, however, proved to be mistaken with respect to the villagers: only 3 people out of 20 attempted to lay the objects out in groups after they had carried them to a new table, only 2 more than in the no-carry condition. Most of them laid out the objects haphazardly or heaped them up; several tried to reconstitute the original order in which the experimenter had laid them out. High-schoolers did respond to the extra prodding of the carry instructions by breaking up the original order and regrouping the items—10 out of 20 subjects in this condition engaged in some grouping activities. Surprisingly, only 3 students in the corresponding no-carry condition spontaneously engaged in the reorganization of the material. It thus seems that spontaneous structuring of material as a deliberate aid to recall is not a common technique in the repertoire of traditional Kpelle adults and that it is less common among Kpelle students than it has been found to be among American students. Moely and associates found, for example, that even at the fifth-grade level, the majority of children spontaneously used category grouping of material as an aid to memory.

Although the villagers failed to regroup the material, they did engage in other memorizing techniques—almost all named the items and rehearsed the names during the study period; some demonstrated and described the functions of the items as well. Again, cultural differences in memorization do not seem to consist in the presence or absence of mnemonic techniques *in general*, but in the utilization of a specific technique—reorganization of to-be-remembered material. The question for future research is whether this particular device for learning and recall of material is tied directly to school learning experiences or whether it is re-

sponsive to other learning experience encountered in urban or modern life.

Summary

As we remarked at the outset of this chapter, the study of memory and culture began from a different set of premises from those that motivated the study of culture and other cognitive processes; memory was the one cognitive process said to be more highly developed in nonliterate than literate peoples.

Yet when we turn to the experimental evidence, we see no hint of a *general* superiority on the part of nonliterate peoples, nor do we encounter qualitatively different modes of remembering, such as the rote recapitulation method suggested by Bartlett.

One might suppose that anthropological reports of special mnemonic powers have been mistaken or exaggerated. A more likely explanation is that the anthropological reports are correct —their informants do in fact remember things that the anthropologists find it difficult or impossible to recall. But this performance is not reflective of greater powers of memory in *general*; rather it reflects the fact that the things a Philippine native or !Kung bushman finds easy to recall are different from the things the anthropologist finds easy to recall. In short, how well someone remembers a particular subject matter depends on the subject at hand. This was certainly Bartlett's idea when he attributed his subjects' impressive recall of details about cows and cow prices to the fact that cows are central to the lives of the people he was studying. In much the same way, we find our children's memory for baseball averages and the details of movie stars' lives unusual, if not exotic.

The experimental findings on memory certainly fit this general orientation. On those few occasions where differential recall of particular content has been studied (Deregowski, 1970; Nadel, 1937) dominant cultural themes—the things that people care about—have been found to have a strong influence on what is remembered.

But in the studies we have reported on the amount and organization of recall, wherever differences in memory are encountered, they show the nonliterate peoples to be performing more poorly

than their literate, and generally more urban, counterparts. How are we to interpret these findings?

One conclusion we might come to is that the to-be-recalled materials in our experiment are not reflective of dominant cultural themes. Consequently, the subject cannot fit them into any preexisting scheme of things. In the course of normal events, things are remembered because their natural contexts are organized in ways that matter to the individual and make sense in terms of his social experiences. Presumably, the experiment in which the items to be recalled were embedded in traditional-style folk stories provided the kind of structure that ordinarily serves to organize remembering, and in that situation we found the structure of recall matching the structure of the story.

But the more typical of our free-recall tasks failed to evoke any such natural structure. At least intuitively, one can see why this might be the case. Unlike most common memory situations, our experimental version of free recall uses material that is not connected grammatically. The items named are familiar, but the motivation to remember them comes from an arbitrary source, such as the desire to earn money or appear clever. The study by Scribner in which subjects sorted objects prior to recall shows that when organization is *required,* it is made use of for the purpose of recall, strengthening our belief that we have identified the important features controlling recall.

It appears that the cultural difference in memory performance tapped in the free-recall studies rests upon the fact that the more sophisticated (highly educated) subjects respond to the task by searching for and imposing a structure upon which to base their recall. Noneducated subjects are not likely to engage in such structure-imposing activity. When they do, or when the task itself gives structure to the material, cultural differences in performance are greatly reduced or eliminated.

The fact that we are studying a rather restricted domain of memory performance in the studies described here is unfortunate. But this should not detract from the potential significance of the results of such work. There is little doubt that success in school, among other things, requires of children that they learn to commit large amounts of initially unrelated material to memory. It is unfortunate that so little research on memory and culture can be reported; a wide variety of memory tasks are currently the sub-

ject of intense investigation in the United States, and their application in cross-cultural settings would put us in a position to make stronger statements about the kinds of mnemonic skills fostered in traditional societies.

chapter 7 Culture and Problem Solving

No aspect of the relation between culture and cognition has a longer history or has produced more controversy than the question of whether the reasoning processes of preliterate peoples differ from those of industrialized peoples. For many years, popular and scientific views were in agreement that whatever other mental capacities primitive people might excel in, their capacities for sound reasoning and systematic thinking were surely deficient compared to "ours." The following statements, the first from an explorer, the second from a highly respected, early anthropologist are typical:

> The African Negro, or Bantu, does not think, reflect, or reason if he can help it. He has a wonderful memory, has great powers of observation and imitation, . . . and very many good qualities . . . but the reasoning and inventive faculties remain dormant. He readily grasps the present circumstances, adapts himself to them and provides for them; but a careful, thought out plan or a clever piece of induction is beyond him (Bentley, 1929, p. 26).

> Between our clearness of separation of what is in the mind from what is out of it, and the mental confusion of the lowest savage of our own day, there is a vast interval (Tylor, 1865, p. 125).

In the twentieth century, Lucien Levy-Bruhl, whose ideas we discussed briefly in Chapter 2, formulated a theory of primitive thought that gave the argument the particular turn that has dominated it ever since. In his book, *How Natives Think,* first published in 1910, he characterized primitive thought as *prelogical,* thereby stirring up a storm of controversy in the social sciences about the relation between logic and thought. Levy-Bruhl's statements were construed to mean that primitive thinking is *illogical,* and contenders lined up on either side of the debate over whether such an allegation was justified with respect to any human thought. In fact, however, Levy-Bruhl took great pains to point out that by the term *prelogical* he did not mean antilogical or nonlogical. Nor was he referring to a type of thought that was a forerunner of Western logical thought. Rather, he maintained that he was simply using the term to characterize a form of thinking, rare among us but dominant among primitives, that is governed by what he called a "law of participation." Under this law, phenomena have the attribute of being "themselves" and yet partaking of other phenomena as well. This kind of thinking, Levy-Bruhl claimed, stands in contrast to the dominant form of Western thinking, which is governed by the logical *law of contradiction,* under which a phenomenon cannot be both itself and not itself at the same time. He cited the following beliefs as instances of prelogical thinking: a group of Brazilian Indians claim that they are also parrots; Bororo believe that portraits possess some of the qualities of life of their models; a village man attacked by a snake feels himself responsible for the death of a child in the next village.

Anthropologists in general rejected Levy-Bruhl's theory that primitive thinking fails to reflect the laws of Western logic. He himself had made it clear that he was talking only about the general laws governing *collective representations* (roughly, beliefs) of primitive peoples, not those governing the everyday behavior of individuals in such societies. Boas (1911) was quick to follow up the implications of this approach, noting that "if we disregard the thinking of the individual in our society and pay attention only to current beliefs . . . we should reach the conclusion that the same attitudes prevail among ourselves that are characteristic of primitive man" (p. 128).

A. F. C. Wallace (1962) took another line of attack. He pointed out that if primitive peoples thought according to a radically different rule of logic, man would probably be extinct. Imagine what would happen, says Wallace, if a primitive hunter were to reason thus: a rabbit has four legs; that animal has four legs; therefore, that animal is a rabbit. In his own work (Wallace, 1970), he has demonstrated that kinship terminologies and other concept domains have underlying logical systems. He is joined in this work by other anthropologists in a new discipline, cognitive anthropology, which attempts to delineate the logical structure of primitive classification systems—an enterprise that is somewhat like a mirror image of what Levy-Bruhl attempted.

Few would disagree with the contention that many of the beliefs of preliterate people differ strikingly from ours. One example of such a difference—the belief in lightning magic among the Kpelle—was given in Chapter 1. The critical issue is what to make of such instances. What does knowledge about a belief tell us of the reasoning processes that underlie it? We would maintain that it is not possible to make valid inferences about thought processes —that is, about the specific mechanisms producing a particular behavior or beliefs—solely on the basis of evidence about the beliefs of groups or individuals. If Levy-Bruhl was correct, we can not be sure of it using only the data he presents; if he was incorrect, we could not know it if we relied on the characteristics of belief systems and conceptual systems as our evidence. Even behavioral evidence drawn from everyday observation may be inconclusive. Consider the following example (taken from Morgan, 1877): A man sees black clouds on the horizon and says it is going to rain. Did he make an inference, or did he simply remember the association, black clouds → rain? But let us complicate the example. Suppose that a man uses instruments to measure wind velocity and barometric pressure. A certain combination of wind velocity and barometric pressure is observed, and he says it is going to rain. Did he make an inference? It would seem more likely than in the first case, but it is still possible that he simply remembered this case from an earlier experience. In fact, without

specific kinds of prior knowledge about the person and the circumstances involved, it is impossible to determine whether a particular conclusion is a remembered instance from the past or an example of inference based on present circumstances. Hence no reliable evidence about the logic of the inference can be obtained from such anecdotes.

Clearly Levy-Bruhl is in an impossible position when it comes to making inferences about thought processes from information about beliefs, but so are his critics. Each can point to the reasonableness of his own explanation, but for any given instance, neither party can really determine what processes were involved.

As it turns out, these methodological difficulties in the study of thinking are not peculiar to cross-cultural research. They are at the heart of psychology's most serious scientific problems and have often been the touchstone for evaluating the scientific merit of one or another school of psychology. In the early days, the new laboratories of psychology were interested in studying thought processes, and they placed considerable reliance on the method of introspection—on securing reports from the subject about what was going on in his mind while he attempted to solve certain problems put before him by the experimenter. Certain disadvantages of this methodology were obvious from the outset: How can one study thinking in children or animals, for example? Other disadvantages soon became obvious: How can one resolve disputes as to whether there are thought processes that are not represented in words or imagery in the mind of the self-observer? Questions of this kind contributed to the conviction of militant behaviorists that the very subject matter of *thinking* was unfit for psychological study. Not only the method of introspection, but the topic of *thinking* itself dropped out of many experimental laboratories in the twenties, thirties, and forties. The Gestalt psychologists (Duncker, 1945; Köhler, 1925; Wertheimer, 1959) kept the problem alive during this period and made many valuable and original contributions, but it was not until recently that thought again became a respectable area of research for experimental psychologists of various theoretical persuasions.

The return to the study of thinking has been accompanied by some conceptual progress and some new investigative tools, which are helpful in cross-cultural study. There is now agreement at a general level among psychologists about what is meant by *thinking*, although there is little agreement about how thought processes operate. With some difference in emphasis, most definitions would be compatible with Bartlett's (1958) statement that thinking is an extension of the evidence (present in the stimulus material or in memory) to produce something new: "It is the use of information about something present to get somewhere else." Bruner's phrase, "going beyond the information given," is another general statement of this view of thinking.

The basic idea underlying these and many other contemporary definitions of thinking is that its outcome should be some reorganization of the evidence in a way that is new for the one doing the thinking (others may have achieved the solution before, but its achievement for a given person will still represent a genuine act of thinking). If a person solved a problem solely by recall—by repetition of something previously learned—we would not call that thinking. We would be more inclined to consider this an instance of remembering. If a person solved a problem entirely on the basis of trial and error, we would be more likely to speak of his performance as learning rather than thinking. Thus, definitions of thinking imply that the subject is actively engaged with the evidence in order to reach a new end point.

Another feature of contemporary thinking about thinking is that it is not identified with logic. The relation between reasoning processes and those processes formalized in logical models is considered a question to be resolved by investigation rather than one to be settled by definition (Henle, 1962).

Finally, the emphasis on separating remembered conclusions from reasoned conclusions as a basic part of the definition of thinking has led to a strong emphasis on research that involves the solution of some problem the person has not previously experienced. Often this requirement means that the problem will appear somewhat unusual, especially to people for whom the whole idea of an artificially arranged problem is foreign.

With this background material in hand, we can review some of the data that are relevant to the question of culture and problem solving. Unfortunately, in our own country research on problem solving is rather sparse and has been focused on a limited number of problems. Even this range is not yet reflected in cross-cultural studies.

Conservation

The largest single body of cross-cultural studies on problem solving deals with Jean Piaget's concept of *conservation.* In its various forms, the notion of conservation has to do with the grasp of an object's *identity* under diverse changes of appearance. In one sense, the attainment of an identity concept can be considered a problem in concept-formation, or classification. David Elkind (1969), for example, points out that all concept formation is an attempt to deal with variability in the environment, and that such variability is of two major types. The first, and the one considered in our discussion of classification (Chapter 5), has to do with the variation *between* things, what Bruner refers to as "equivalence grouping"—considering dissimilar things similar for the purposes at hand. A second type is variability *within* things: "A young tree and a child both grow, a block of ice melts, a house gets painted and a car gets dented. All of these variations of form, of state, and of appearance occur within a given thing" (Elkind, pp. 172–173). This is the kind of variation with which Piaget has long been concerned—how one grasps as the "same" a thing that undergoes drastic transformations in physical properties.

Although Piagetian conservation does represent a type of concept formation in the sense described, most psychologists deal with his work as studies in the development of intelligence, or *logical operations.* This treatment derives from Piaget's theoretical framework, in which he views cognitive development as the construction of successively more complex systems of different types. Because Piaget's conceptual framework is *sui generis,* we feel that to a large extent a decision as to where and under what headings to review his work is somewhat arbitrary. Following what seems to be the more conventional approach, we have chosen this chapter on thinking as the place to take up the cross-cultural work devoted to his hypotheses. (For an excellent summary of Piaget's theory, see Ginsburg and Opper, 1969.)

The reference experiment on conservation is depicted in Figure 7–1. In each of the panels a different kind of material is used (beads, water, clay) to study different forms of conservation (number, volume, and amount). The experiment proceeds in an analogous fashion for each kind of material. For example, a 5-year-old subject is initially presented with two rows of beads

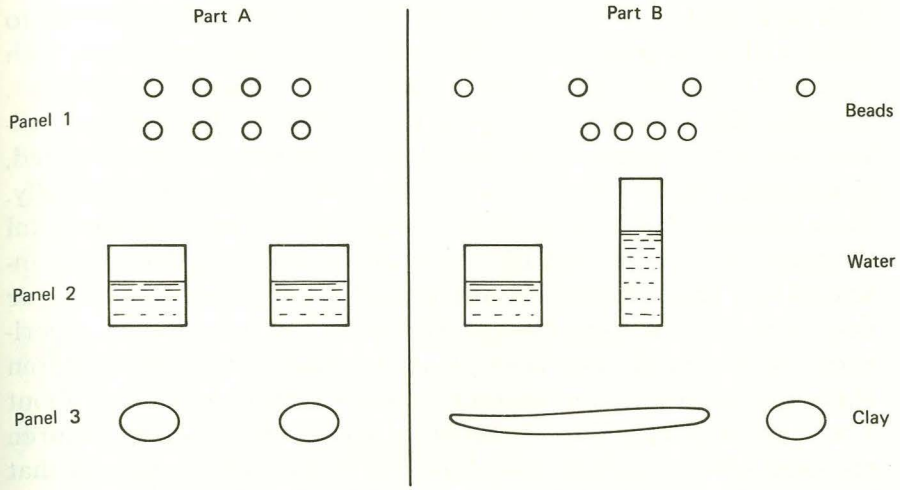

Figure 7-1. Materials used in Piagetian tests of conservation. *Panel 1,* arrangements of beads used to study conservation of *number; Panel 2,* containers of liquid used to study conservation of *volume; Panel 3,* clay used to study conservation of *amount.*

(Part A, Panel 1) of identical length and identical spacing. He is asked whether there are the same number of beads in the two rows, and he quickly agrees that there are. The spacing of one of the two rows of beads is then reduced so that it is shorter than the other row (Part B, Panel 1). Again the child is questioned: Do the two rows have the same number of beads? Which row has more beads? The child typically states that the longer row has more beads; that is, *the number of the set is not conserved when the length of the set is transformed.* An older child (say, 8 years old) will not be fooled by the change in the length of the set; he is therefore considered to have mastered the concept of number conservation.

The same kind of change occurs when the problem is presented in different forms. In Panel 2 of Figure 7–1, the question is whether or not the volumes of water in two beakers (Part A, Panel 2) are still judged equal when the water in one of the beakers is poured into a new beaker of a very different shape (Part B, Panel 2). In Panel 3, the question is whether the amount of clay is judged to be the same in spite of transformations in its shape.

For all of these problems Piaget has found a fixed sequence of development (although the exact age at which the child moves

from one part of the sequence to the next varies from child to child and it is possible for the child to be at one stage with respect to *number* and another stage with respect to *volume*). It is this idea, that the developing child must go through a specifiable series of changes in the cognitive operations he has mastered, that makes Piaget's theory so attractive to study cross-culturally. The challenge that it poses is quite specific: Is the developmental sequence that Piaget has observed in Geneva, and that many investigators have observed in the United States, truly universal, or does it depend in some way on the early, culture-specific, experiences of the child? For example, it is often noted that children begin to manifest conservation (of number, volume, etc.) at about 6 to 7 years of age. This is the same age at which many children are beginning to attend school and learn to read; it may be that what moves the child from one mode of operation to another is specific skills acquired in connection with reading and writing, not some universal feature of human development.

One of the more extensive investigations of the development of conservation has been carried out by Greenfield (Bruner, Olver, and Greenfield, 1966). Her studies were done in Senegal, West Africa, among several groups of subjects, most of whom were members of the Wolof tribe. Greenfield chose the Wolof because children from this tribe could be found not only in traditional villages in the bush, but in villages where Western-style schooling (conducted in French) had been introduced, and in the cosmopolitan capital city of Dakar, where instruction was also in French for those attending school. This made it possible for her to study the roles of urbanization and education, as well as of age, in the development of conservation.

The first task studied by Greenfield is similar to that depicted in Figure 7–1, Panel 2. The child was given two beakers of identical shape and asked to equalize the water levels in them. The water of one beaker was then poured into a taller, thinner beaker, causing the water level to rise, and the child was asked whether the two different-shaped beakers (the new one and one of the old ones) contained the same amount of water, and if not, which beaker contained more. The results of this experiment carried out on several different groups of children are shown in Figure 7–2. The figure shows that by the age of 11 to 13 years, all children who had been to school, whether from a bush village or a large

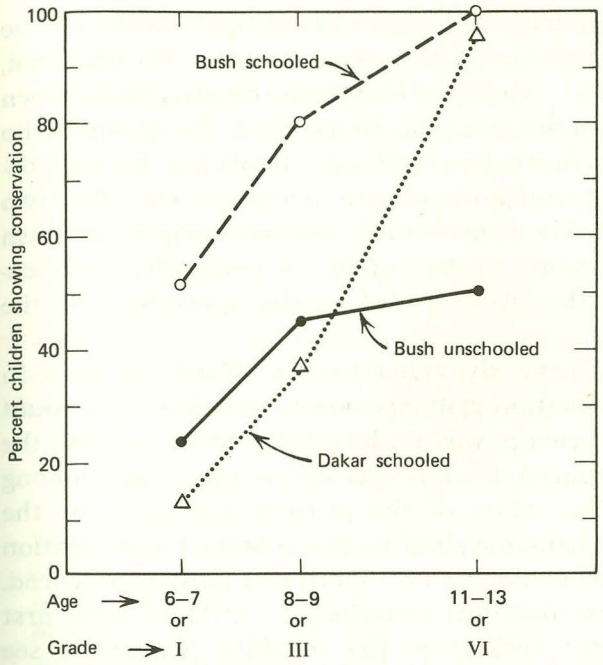

Figure 7-2. Percent of Wolof children of different backgrounds and ages exhibiting conservation of water in two beakers.

city, gave conservation responses. Only half of the nonschool children raised in the bush had achieved conservation by this age. On the basis of these and other findings, Greenfield speculates that in the absence of schooling or school-like experiences "intellectual development, defined as *any* qualitative change, ceases shortly after age nine" (p. 234). When comparison is made with Western norms for the acquisition of conservation in this situation, it is found that the Senegalese children are very similar to Western ones in terms of *grade level*, but because the Senegalese children start school at a later date, they lag slightly behind the Western norms in terms of *age*. The major conclusion from the data presented thus far is that Wolof children who have attended school perform more like Western children than like their nonschooled age mates in the same village.

A good deal of information about the children's understanding of the problem can be obtained from an analysis of the reasons they give for their responses. Greenfield distinguishes three basic kinds of justification: *perceptual* ("they look alike"), *direct-action*

(statements about pouring the water from one beaker to the other), and *transformational* ("if you were to pour this one back, it would be the same"). When she examined the relation between conservation and justification, she found that the groups who showed increasing conservation with age showed a parallel decrease in perceptual justification and an increase in the other two kinds of justification. The nonschooled children living in the bush village showed an *increase* in the number of perceptual justifications; it seems that they were fooled by the appearance of the beakers.

One explanation frequently given by the Wolof children in justifying a nonconservation response was to say that the amount of water in the two beakers was no longer the same because the experimenter had poured it. This reason is very rare among Western children. The nature of the justifications given by the Wolof bush children led Greenfield to two modified conservation experiments aimed at exploring the difficulties they experienced.

In the first of these modified experiments, children were first tested with two water beakers in the standard manner to see whether they would manifest conservation. If they did not, a second experiment was carried out. This time the beakers were placed behind a screen with only their tops showing. The child could see the water being poured from one to another, but could not see the water levels in the beakers. One would think that the screening procedure would reduce the child's reliance on perceptual cues and lead to better conservation, but Greenfield found little effect of screening. In fact, perceptual *reasons* were not in the least reduced, even though the stimuli were hidden from sight. This finding contrasted strongly with the results of a similar test administered to American children, who were measurably helped if they had previously failed to conserve and had given a perceptual reason for their choice.

The second experiment was directed at the question of "action magic," the belief of many Wolof children that the experimenter somehow influenced the amount of water present in the two beakers. In this version of the experiment, the nonschooled bush children were allowed to pour for themselves, and conservation increased markedly. This do-it-yourself procedure had no effect at all on nonconserving city schoolchildren who had failed to give action-magic reasons in the first place.

Greenfield's experiments indicate that the conservation task is by no means culture free. She found variations among her different Wolof groups, both on the basic task and in response to manipulations like the action-magic experiment. Thus, even within a single cultural group (the Wolof) performance depends on how the task is presented and the particular past experiences of the subjects (as for instance, whether they live in a rural town or the city, and whether or not they attend school).

While these variations are very clear, the explanation of them is not. Greenfield and Bruner (1969) put forth the view that Wolof children, raised in a traditional setting, never learn to make a distinction between internal (psychological) and external (physical) reality. Wolof child-rearing practices emphasize personal relations and group cohesiveness, not manipulation of objects:

> At the same time as the Wolof child's manipulation of the physical, inanimate world fails to be encouraged in isolation from social relations, the personal desires and intentions which would isolate him from the group are also discouraged. . . . [H]e becomes less and less an individual, more and more a member of a collectivity (pp. 641–642).

As a result of this traditional upbringing, the Wolof child is more likely to give social explanations than physicalistic ones. By contrast, those who are raised in an urban setting, or those who attend school, learn to emphasize explanations based on physical criteria.

This argument bears strong similarities to Berry's notion that ecological demands and socialization practices complement each other to provide coherent constellations of psychological responses to the world. However, as was the case in the studies of the influence of culture on perception, there remain many uncertainties when it comes to explaining why a particular pattern of results has been obtained.

One of the most baffling questions is how we are to interpret the finding that volume conservation is present in only *half* of the 13-year-olds who had no schooling and is, according to Greenfield, absent in nonliterate adults. As Greenfield herself points out, all people have to come to understand certain basic laws of the physical world (or at least behave in accordance with these laws) if they are to survive. Can we imagine an adult who would

pour water from a small bucket into a larger one and believe that the amount of water has been decreased by this act? In desert communities where water is a treasured commodity, everyone can be expected to conform to certain laws of conservation.

Since we have already seen that the way people perform on the more traditional concept and classification tasks is very much influenced by the nature of the materials used and the specific problem situations, it seems reasonable to assume that these factors may affect conservation performance also. Will the number of conservers be increased if more familiar test materials are used? One way to approach this problem is to look for cultural situations where children can be expected to have a lot of experience in manipulating a particular physical substance or in dealing with a specific physical problem.

Price-Williams, Gordon, and Ramirez (1969) worked with 76 children, 6 to 9 years old, in the Mexican state of Jalisco, which has many towns famous for their pottery. Half of the children were selected from pottery-making families, the other half from families of a similar socioeconomic status who engaged in other trades.

These investigators hypothesized that practice in pottery making should promote conservation of substance, and that therefore potters' children would perform better on tests of conservation using clay than other children would. This is exactly what they did find. Potters' children also gave more conservation responses in tests for conservation of number, liquid, weight, and volume, but on these the degree of superiority was not statistically reliable.

A second study emphasizing environmentally induced skills was conducted by Dasen (1973) among Aborigines of central Australia. Dasen points out that traditional Aborigines depend on hunting and food gathering for their livelihood. They often travel long distances in their search for food, and in order to survive, they must be able to locate water holes. Although they do not carry maps, they draw maps on the ground to indicate where water holes are located.

On the other hand, Aboriginal languages are very spare in their use of number and measurement terms. Numbers larger than 5 are lumped under a term translated as "big mob." Lack of number and measurement terms is by no means unique to the Aborigine and is usually attributed to the fact that in hunting societies social life is dominated by individuals and very small groups.

This contrast between spatial and measurement demands made by the culture led Dasen to propose that the Aborigine would perform better on spatial tests than on tests involving measurement.

As one of his tests of spatial ability, Dasen used two models of an Australian landscape. The models were placed next to each other, and the child was asked to name the elements of one model while pointing out its mate on the other. Then a toy sheep was placed on one model and the child was asked to place a sheep in the same place on the other model.

Once it was established that the child understood the task, Dasen placed the sheep on one model and rotated the other 180 degrees. The child's task was to place the sheep in the correct place on the rotated model.

Tests of measurement ability included tests for conservation of quantity like those used by Greenfield and tests for conservation of weight, volume, and length.

Three populations of schoolchildren were tested: a group of Aborigines who had not had much contact with Australian-European culture (low-contact group), a medium-contact group, and a group of lower middle-class Australian and European children in Canberra. Small groups of adults from the two Aborigine populations were also given selected tests.

Consistent with his hypothesis, Dasen found that the Aboriginal groups did better on the spatial tests than on the measurement tests. Data from the Canberra children show that this is not simply because the spatial tests are generally easier—the Canberra children performed significantly better on the *measurement* tests than on the spatial tests! This pattern of results fits very nicely with Dasen's hypothesis about the relation between environmental demands, culturally valued skills, and individual cognitive skills.

Dasen obtained two other results that are relevant to the question of which cultural experiences influence the manifestation of conservation under the customary testing procedures. First, he found that the Aborigine group having more contact with Australian-European culture (the medium-contact group) performed consistently better than the low-contact group (a confirmation of an earlier finding among Australian Aborgines by deLacey, 1970). Since the children in both groups were attending school, this

suggests that over and above education, or, independently of education, European contact plays an important role in test performance.

Second, many Aborigine schoolchildren 13 to 16 years of age still failed to demonstrate conservation of weight, volume, length, or liquid quantity. What is more, a majority of the adults tested also were nonconservers on these tests, even though Dasen says they tended to represent the younger, better educated, and more acculturated portion of the adult population.

This finding is by no means unique to Dasen. A large number of nonconservers was found among older schoolchildren by de Lemos (1969), who also worked with Australian Aborigines, by deLacey (1970) among New Guinea natives, and by Heron (1971) among Zambians. Clearly, educational experience in European-type schools is not a sufficient explanation for conservation performance, although it appeared to be so from Greenfield's initial studies.

Dasen's summary of Piagetian research (1972) indicates that wherever Piagetian tests have been applied in non-Western cultures (and these have been many, including, in addition to those already mentioned, Iran and China), investigators have found the same stages and sequences in the development of conservation as those originally described by Piaget on the basis of his work with Genevan children. In Dasen's own research (1973) detailed qualitative analysis showed that the reasons given by Aboriginal children for their answers were substantially the same as those given by European children in Canberra, and that their responses and explanations could be classified without difficulty into the stages described by Piaget. This common finding seems to suggest that the conservation performance is the end point of a *course* of development whose sequences are the same from culture to culture. On the other hand, what is referred to as the *rate* of development (measured by the age at which children enter the various stages) has also been consistently found to be slower for non-Western cultures, suggesting a strong influence of cultural and environmental factors. As we have seen, at least three different constellations of such factors have been shown to promote good performance on the kinds of tasks studied intensively by Piaget: the nature of the activities engaged in by members of the culture (or some subgroups, such as potters); involvement in instructional situations such as those provided in a Western-type school; and participation in social interactions with members of a Western culture. These are, of course, rather crude and global identifications of complexes of experiences whose exact nature and differential significance we know very little about. Nor do we know how—*through what mechanisms*—such experiences may contribute to successful performances on Piagetian tasks, and, perhaps more to the point, why they do contribute in some instances and do not in others.

This brings us to the most crucial difficulty we encounter in this area of cross-cultural research: What implications can be drawn from conservation and nonconservation among members of non-Western cultures? Within Piagetian theory, the attainment of various conservation concepts is considered of great developmental significance because these are the indicators that a given child has achieved generalized intellectual structures that make possible a multiplicity of intellectual operations in many different situations and problems. Goodnow and Bethon (1966) found that 11-year-old American children whose conservation performance was superior also showed superior intelligence, as measured by the California Test of Mental Maturity. But for Zambian schoolchildren, Heron (1971) found no relation between conservation of weight and scores on nonverbal reasoning tests from the British Intelligence Scale. The reasoning tests, but not the conservation performance, were related to actual school achievement. Intelligence-test performance and school achievement may well be improper measures for the investigation of the general significance of conservation performance, but we refer to these studies here to emphasize that a relation between conservation performance and other cognitive performance obtained in our culture does not hold in another. Until some relation between conservation performance and other cognitive skills is demonstrated in non-Western cultures, it is difficult to arrive at any judgment of its significance.

This is especially true in light of the difficulty of coming to grips with what nonconservation might mean. In Europe and the United States, where all normal children eventually come to respond correctly across the whole spectrum of conservation problems, such a statement as "55 to 60 percent of the 5- to 6-year-olds conserve" has a relatively clear interpretation—55 to 60 percent of the chil-

dren have entered the concrete-operational stage that *all* children *eventually* enter; the culture is homogenous with respect to adult performance. But the various traditional societies we have been studying are *not* homogenous with respect to their level of cognitive maturity as measured by conservation performance: some adults conserve, some do not.

What does it mean to claim that "tribe X does not mature past the European 11-year stage" if 50 percent of the members of tribe X conserve and 50 percent do not? No one in tribe X is operating at the "11-year-old-level" and to speak of a "leveling off of cognitive development" as if the statement applies to individuals is a serious mistake. Until we have some better idea of what induces some members of traditional societies to solve conservation problems while their neighbors do not, we cannot be certain about the significance of conservation tests as a tool for understanding the relation between culture and cognitive development.

Inferential Combination

Thinking is conceived of by some psychologists as a process by which familiar elements are combined in a new way to reach a goal. This concept is clearly embodied in an experiment first developed for the study of reasoning in rats (Maier, 1929) and applied to children by Kendler and Kendler (1967). The apparatus used in this research is shown in Figure 7–3.

It consists of a metal box, divided into three panels (A, B, and C) each with its own door. The subject is first taught that he can get a *marble* by pushing the button in the middle of Panel A. During this training, the doors to Panels B and C remain closed. In the next step, the doors to Panels A and B remain closed and the subject is taught that he can get a *ball bearing* by pushing the button in Panel C. Next, with Panels A and C closed, he is taught that he can obtain a piece of candy by putting a marble in Box B. Finally, all three panel doors are opened simultaneously for the first time, and the subject is told to do whatever is necessary to get the candy.

Formally, this problem represents the requirements for a study of thinking outlined above. The subject has to combine two independently learned acts in a new combination (open Box A

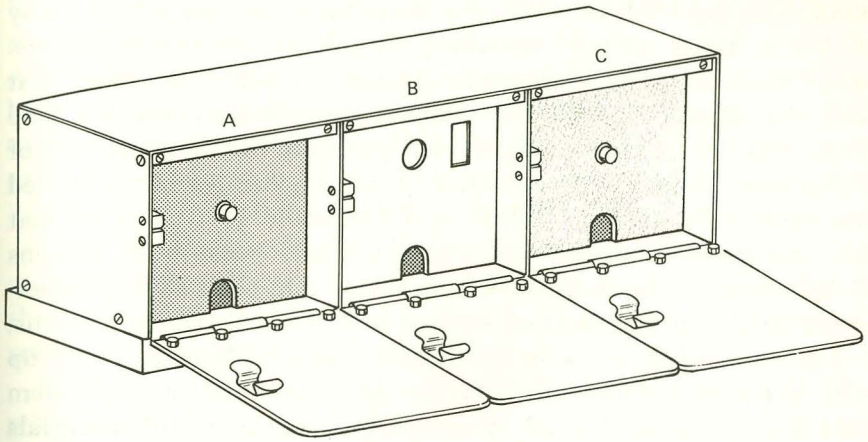

Figure 7-3. Apparatus used to study inference (after illustration in Cole, Gay, Glick, and Sharp, 1971).

to get the marble; take the marble and put it in Box B to get the candy) in order to attain his goal.

As simple as the problem appears, it is absolutely beyond the capacity of rats. Even children up to the age of about 10 years are likely to experience difficulty with it.

When this experiment was first tried out in Liberia among tribal people of various ages, they all experienced difficulty (Cole et al., 1971). Only 8 percent of the traditional, nonliterate Kpelle adults spontaneously pushed the button that yielded the marble and then placed the marble in the hole in the center panel, which yielded the candy. There were no differences among the traditional subjects as a function of age: 5- and 6-year-olds performed about as well as young adults. This percentage of correct inferential responses corresponds roughly with the performance obtained with American kindergartners (Kendler, Kendler, and Carrick, 1966).

The situation is only slightly improved by education. Groups of 9- to 12-year-old and 17- to 20-year-old students averaged 25 to 30 percent spontaneously correct inferential responses. But American third-graders obtained a score of 53 percent correct. We might be tempted to conclude at this point that the noneducated Kpelle finds it difficult to make simple inferences and that although schooling helps a little, it does not help much.

Before jumping to any such conclusions, a fuller characterization of the behavior of our subjects as well as some more experi-

mentation are both in order. For one thing, we noted that many of the subjects seemed genuinely frightened of the apparatus. Many spent inordinate amounts of time playing with screws that held the apparatus together, sticking their fingers into the hole from which the candy emerged, and generally indulging in a lot of extraneous behavior. Very often, if the experimenter prompted the subject by asking, "Which button should you press so that you can get the candy?" the subject would press both buttons simultaneously. In short, it was not clear that the subjects understood either the instructions or how to use the strange apparatus.

The next stage of experimentation was an effort to come up with a Kpelle version of the same problem—that is, a problem that had the same logical structure, but made use of materials familiar to all Kpelle people.

The solution was to use a locked box containing a piece of candy as the goal object. The box could be opened with a key (keys and locks are now generally available in central Liberia). At the start of the experiment, two keys were shown to the subject, one painted red, the other black. The keys were then placed in two identifiably different matchboxes. In the first phase of the experiment, the subject learned which matchbox contained which key (this is analogous to learning which panel contains the marble in the original version). Then the matchboxes were set aside, the two keys were presented, and the subject learned which key fit the lock and made it possible to obtain the candy. (This is analogous to learning that the marble and not the ball bearing produced the candy when inserted in the center panel of the original apparatus.) Finally, the subject was presented with the two matchboxes and the locked box and told to do whatever was necessary to get the candy.

The change in response to the problem was dramatic when the key-lock procedure was introduced. From 70 to 80 percent of the subjects (aged 7 through adulthood) solved the problem spontaneously and 90 percent solved it with a little prompting. This way of conducting the experiment makes it look as if the Kpelle experience no difficulty at all with a simple inferential problem—provided that they are familiar with its elements.

It is possible, however, that in choosing a new form for the problem, we were doing more than simply changing the particular elements. Consider the second form of the problem again. Putting

keys in locks is almost certainly a very well learned response for subjects who know about keys and locks. In fact, a key might be defined as something that opens a lock. If this is the case, we may have inadvertently been providing our Kpelle subjects with half of the answer to their problem in the key-lock version, thus making them look more competent than they would look if they had to learn the whole problem in the situation itself.

These ambiguities led to still another experiment, this time aimed at determining whether a previously learned link between the goal and the object used to obtain the goal made it easier to solve this kind of inference problem.

In this second experiment both Kpelle and American children were studied. The two conditions of greatest interest involved combinations of the procedures (and apparatus) used in the first two experiments. In the first of these conditions, subjects obtained a red or black key from Panels A or C of the apparatus pictured in Figure 7–3; one of these keys could be used to unlock the box from the second experiment. In the other condition the subjects obtained keys from matchboxes, one of which caused a candy to drop when it was placed in panel B of the original apparatus. The results were completely contrary to our expectations: performance was best when the keys were taken from matchboxes and dropped into the center panel of the original apparatus. Performance when keys were obtained from that apparatus and then used to open the locked box was no better than performance in the original experiment.

From this new experiment we can conclude that the difficulty that young children and tribal Liberians experience with our simple inference task is that they do not know how to begin. For some reason, the process involved in obtaining a marble or a key from the side panel of the original apparatus interferes with later phases of the response sequence. Cultural differences seem in this case to reside in the kinds of initial situations that promote a good beginning for problem solution, not in the ability to link separately learned elements in order to solve a problem.

This experimental sequence illustrates the care that has to be taken before a conclusion about cultural differences can be firmly grounded. In the process of tracking down the source of the difference between cultural groups, we not only located the point at which the determining differences occur, but extended our knowl-

edge of one small aspect of problem-solving behavior as well. Even such a small step forward required a good deal of work, perhaps more than the particular example of inferential behavior warranted. But progress in understanding the relation between cultural variables and such cognitive processes as inferential reasoning is probably only to be achieved by the accumulation of such little steps; jumping straight to a successful design may leave us uncertain of where we have landed.

Verbal Logical Problems

Not all studies of reasoning and problem solving have to involve pouring water and opening boxes, although psychologists tend to rely heavily on such activities in their investigations. It is also possible to study reasoning by purely verbal means, although, as we shall see, the pitfalls in such an undertaking are legion.

It has been established in several American-based studies of logical reasoning that when presented a formal logical problem, subjects are often fooled by the content of the problem into drawing conclusions that do not follow from the premises. For example, we are all familiar with the following problem:

All men are mortal.
Socrates is a man.
∴ Socrates is mortal.

We would all accept this conclusion as following from the premises, and if presented the premises alone, we could most likely arrive at the proper conclusion.

But what about the following problem?

All communists say that they seek nothing but peace.
The longshoremen's union says that it seeks nothing but peace.
∴ The longshoremen are communists.

In this case the conclusion does *not* follow from the premises, but anyone who reads the daily newspapers can find many instances of such reasoning in the comments of officials and common citizens alike.

Research into the processes underlying nonlogical responses to

such verbal logical problems has not proceeded much past the observation that content often determines acceptability of the conclusions, independent of the structure of the problem. However, what few cross-cultural data exist indicate that even the seemingly simple matter of responding to such a problem in its own terms is a learned convention.

The earliest data on this problem were collected by Soviet psychologists who were students of L. S. Vygotsky, and most notably by A. R. Luria, in the early 1930s (Luria, 1971). He presented two kinds of verbal syllogisms to collectivized and noncollectivized central Asian peasants: the contents of some were taken from the concrete, practical experience of the villagers; the contents of others bore no relation to familiar, practical life. An example of a practical problem was the following: "Cotton grows where it is hot and humid. In the village it is hot and humid. Does cotton grow there or not?" For syllogisms not connected with practical experience, he gave such logical problems as, "In the north, where there is snow all year, the bears are white. Town X is in the north. Are the bears white in that town or not?" Handling the first type of problem presented no difficulty to the subjects. They would draw the correct conclusion, but would characteristically support their answers by appealing to the facts of experience: "And that's the way it is; I know myself."

The second kind of syllogism was responded to quite differently. A typical response to the white bear problem was the answer: "How should I know what color the bear was? It was your friend that saw him, ask your friend." Almost all of the uncollectivized, nonschooled peasants replied to the problems in a similar way—they refused to accept the system of logical assumptions and to draw conclusions from them. On the other hand, people from the same villages who had had a small amount of schooling or who were engaged in collective planning of farm production accepted the problems on their own terms and drew correct conclusions.

Research among Kpelle tribesmen in Liberia indicates that their responses are like those of the central Asian peasant. The problems that were presented differed from the traditional syllogisms used by Luria; nevertheless, they called for various forms of logical inference, and the materials were culturally familiar. The following interview selections give the quality of the great major-

ity of responses. The experimenter is a local Kpelle man, the speakers are esteemed village elders.

Example 1

Experimenter: At one time spider went to a feast. He was told to answer this question before he could eat any of the food. The question is: Spider and black deer always eat together. Spider is eating. Is black deer eating?

Subject: Were they in the bush?

Experimenter: Yes.

Subject: Were they eating together?

Experimenter: Spider and black deer always eat together. Spider is eating. Is black deer eating?

Subject: But I was not there. How can I answer such a question?

Experimenter: Can't you answer it? Even if you were not there, you can answer it. (Repeats the question.)

Subject: Oh, oh, black deer is eating.

Experimenter: What is your reason for saying that black deer was eating?

Subject: The reason is that black deer always walks about all day eating green leaves in the bush. Then he rests for a while and gets up again to eat.

Like the central Asian peasant, this Kpelle tribal leader attempts to handle the problem on a *factual* basis. Mary Henle (1962), who has made extensive studies of syllogistic reasoning and whose analysis of sources of error is drawn upon here, characterizes this mode of response as a "failure to accept the logical task." The subject's failure to grasp the general concept of logical validity is illustrated by his query as to how he might be expected to answer the question when "he wasn't there." His effort to find a factual basis for arriving at a conclusion is indicated by his questions eliciting additional facts ("were they in the bush?" "were they eating together?"). When the experimenter is uncooperative, the subject finally "produces" some facts to support an answer. There is clearly involved here a process of active reasoning—but one proceeding from evidence that is real and experiential, rather than from the theoretical evidence incorporated in the problem.

Other transformations typically introduced into the problem to permit its "solution" on a factual basis are displayed in the following transcript:

Example 2

Experimenter: If Flumo or Yakpalo drinks cane juice, the Town Chief gets vexed. Flumo is not drinking cane juice. Yakpalo is drinking cane juice. Is the Town Chief vexed?

Subject: People do not get vexed with two persons.

Experimenter: (Repeats the problem.)

Subject: The Town Chief was not vexed on that day.

Experimenter: The Town Chief was not vexed? What is the reason?

Subject: The reason is that he doesn't love Flumo.

Experimenter: He doesn't love Flumo? Go on with the reason.

Subject: The reason is that Flumo's drinking is a hard time. That is why when he drinks cane juice, the Town Chief gets vexed. But sometimes when Yakpalo drinks cane juice, he will not give a hard time to people. He goes to lie down to sleep. At that rate people do not get vexed with him. But people who drink and go about fighting—the Town Chief cannot love them in the town.

It appears that this subject had a set of particular characters in mind (a certain Flumo with whom he was acquainted, perhaps) and was concerned with arriving at a conclusion that expressed the social truth as he knew it. To effect this end, he rejected the first premise of the problem and substituted for it another statement (people do not get vexed with two people). Then, like our first subject, he imported new evidence into the problm (facts about Flumo's and Yakpalo's behavior when drunk, for example), which permitted a conclusion *both* logically valid *and* factually true. While this subject's answer is "wrong" as far as the experimental problem is concerned, it is the outcome of a beautiful piece of logical reasoning from new premises. We can easily see this by recasting his statements into more traditional syllogistic form:

Flumo's drinking gives people a hard time. (Explicit premise)
Yakpalo's drinking does not give people a hard time. (Explcit premise)
People do not get vexed when they are not given a hard time. (Explicit premise)
The Town Chief is a person. (Implicit premise)
Therefore, the Town Chief is not vexed at Yakpalo. (Conclusion)

These examples are representative of findings in a study involving a large number of subjects and different kinds of logical