Category Behavior in Natural Ecologies and in Cognitive Tests

CHARLES M. SUPER and SARA HARKNESS
Harvard University

LAWRENCE M. BALDWIN
Miami University

Consider the following four objects: orange, ax, tree, and knife. If you were asked to say them back to me as part of a longer list, you might not say them in the same order. You might group them by their semantic class: tree, orange; ax, knife. Or, you might cluster them by functional pairs: ax, tree; knife, orange.

Research on culture and classification has used a variety of techniques to study the phenomenon of cognitive grouping, including clustering in free recall, physical sorting of pictures and objects, and word associations. A recurring contrast in this kind of work is between an organization based on the taxonomic or semantic class of an object (all the tools together, all the animals, etc.), and one based on functional aspects of objects (all dinner-related things together). The terms used to draw this contrast are many, and vary in their connotations; elements of ethnocentrism and racism occasionally further muddle the literature. Nevertheless, the most frequent finding, which we have replicated during our fieldwork in rural Kenya, is that uneducated peoples of nonindustrial societies do not usually group by taxonomic category in formal cognitive tests, whereas educated people from industrial environments do.

Of course, the most recent and comprehensive attempts to understand this phenomenon is that by Cole, Scribner, Sharp, Gay, Glick, and others, usually referred to, for convenience, as "Cole and his colleagues." Western education emerges as the dominant independent variable in their work, not only for its strong association with increased use of taxonomy in grouping behavior, but also for its more pervasive, productive effects on test-taking behavior. They also present evidence, however, that use of taxonomic groupings increases "when people move from isolated village life to towns more affected by commerce and the exchange of people and things" (Cole and Scribner, 1974, p. 122).

Our goal in this paper is to illustrate two kinds of ecological factors that influence naturally occurring category behavior, and to outline their possible relationship to category behavior in experimental situations. First, how do people arrange physical objects in normal, daily life? Observation of our Kipsigis neighbors in a farming community in western Kenya

suggests that everyday behavior is similar in important ways to the results of formal experiments. Consider the behavior of a local woman who worked for us in the kitchen. On her first day, she put all the tea things together after washing: the teakettle and teapot along with the cups and saucers. The basis for this grouping is obviously their related functions. It is striking, however, not only because it is not the way we usually do it, but also because it is inefficient, given the way we make and serve tea. Is Kipsigis behavior in their own homes so inappropriate?

Of course not. Most people, most of the time, organize the things they use every day in a reasonably efficient way. For the rural Kipsigis woman, it is easiest to keep all the tea things together. The tin teapot and cups are always used at the same time and in the same place, and they are never used in combination with anything else. So one usually finds all tea implements together, drying in the sun; clean and in a chest or small cupboard; or dirty and waiting for washing. Other cooking and eating implements (a big pot for *kimiet*, the local maize mush; perhaps another for boiling a green vegetable; and several tin bowls or plates) are also usually nearby. They are not always carefully sorted and stacked, because there are so few of any one kind, and they will all be used for the next meal anyway.

Compare that to a standard American kitchen. There are a dozen or more dinner plates, salad plates, cups and saucers. There may be separate sets for breakfast and for fancy dinners. There are different sizes of drinking containers, made of plastic or glass, each type designed for a particular kind of liquid or kind of user (e.g., children). Out of this array, a small number of a few kinds will be chosen for the average meal.

It seems that when there are many identical or functionally interchangeable members of a category, and several categories from which elements are chosen in varying combinations, life is simpler if the objects are arranged by taxonomic class. The work of maintaining the organization is more than offset by the gain in access time. If, however, there are few members, few classes, and little recombining, it's not worth fighting the taxonomic entropy, and the best criterion for putting things together is whether one will need to use them together.

If categorical behavior is influenced by contextual or ecological factors, one should be able to find contexts that reverse the comparison we started with, and illustrate Americans using a functional grouping and Kipsigis using a categorical one. The way a typical American man might arrange his clothes for temporary storage is such a context. His everyday clothes are kept in a bureau, with all the socks together in one drawer, all the shirts together in another, and so on. Every day he selects one item from each category for wearing. This fits the taxonomic half of the rule stated above. This American also

plays tennis, but not often. He has one pair of tennis shorts, one pair of good athletic socks, etc., and they are all kept together in the same place. There are not many members of each category of tennis clothes, and they are not recombined with other clothes, so they are put together in recognition of their common use.

The corresponding Kipsigis illustration is difficult to find, leaving aside a few overly simple cases, such as keeping together all the interchangeable maize cobs. We can find one good example, however, in the store of a local woman. She sold a large variety of goods, including sugar, children's clothes, aspirin, teacups, matches, baby jelly, candles, party noisemakers for initiation ceremonies, and so on. How were they arranged? Identical items of a very narrow class were, of course, kept together (all the teacups), and the most frequently sold items were generally kept in reach of the front counter. Beyond that, there was a great deal of jumble, some big groups around a common function (tea leaves, tea strainers, sugar, teapots), and several taxonomic nuggets. Nonstaple edibles were together on one counter: five kinds of hard candies, manufactured crackers and cookies, and chewing gum. Salt for people and salt for cows were next to each other, a situation that would never be found at home but which does follow the Kipsigis custom of using the same word for both kinds. Several groups of clothing were next to each other (men's undershirts and shirts, women's shirts, petticoats, scarves, etc.), with some attention to higher-order criteria of age and sex. They were surrounded, however, by soaps and cooking fats, whereas other clothes were hanging from the ceiling. Why were the clothes and food intermixed? Because, explained the woman, the shop was new; when she gets time she will put all the clothes on one side of the store, and all the food on the other.

Our argument so far can be summarized easily. People organize objects around themselves in a way that is reasonably efficient with regard to both retrieval and maintenance. When there are many similar or identical objects in a class, several related classes, and a need for choosing varying combinations of items selected from these classes, the most efficient method of organization is by class, that is, by taxonomic group. Otherwise, efficient grouping amounts to physical proximity of things that will be used together. Cultures or subcultures that are materially simple will rarely require categorical organization, but, when the immediate context does make it more efficient, one will see adoption, in that context, of the taxonomic grouping. Western cultures, with their vast numbers of things, more often require taxonomic organization for efficient functioning. In specific contexts, in which such grouping is not worth the maintenance effort, the categories will collapse around their context of use, for example, "tennis clothes."

A second, probably related, aspect of daily life which bears on test behavior is the kind of experience people normally have with objects—whether they are encountered as exemplars or particulars. During the course of a day, we sit on many equivalent chairs. We have fleeting contact with many members of the class. To this we might compare the old Kikuyu man who carries his special stool with him even when he goes visiting. Of course, we, too, may have our special chair for TV or reading, and through repeated encounters, have a very particularistic view of it. But as with arranging members of a set in space, our physical ecology, with so many mass-produced objects, leads us to know many objects as exemplars, as "a chair," rather than "the chair." This holds for many classes, including people. In a rural setting, one has more frequent encounters with a smaller number of people. This leads, we expect, to little emphasis on within-class similarity and little attention to the class attributes, to the taxonomic criteria.

This contrast in daily experience parallels a recurrent contrast in linguistic and psychological theories of cognition and memory. Both taxonomic and contextual knowledge are needed, for example, to understand the difference in meaning of the following two sentences: "The tank is overflowing," and, in a military context, "The tank is overpowering." The word "tank" derives its meaning in part from its location in a taxonomic network containing other concepts, such as "cup" and "tub," or "truck" and "gun." In addition, the context in which the word appears determines which network is used. In other words, both the particular use of the word and the taxonomic status of the class it exemplifies are important.

Psychological theories of cognition make a related distinction between episodic and semantic memories, that is, memories formed around a particular encounter or set of encounters with an object, and those formed around the semantic or taxonomic features of the words (Tulving and Donaldson, 1972). Similarly, Norman, Rumelhart, and associates (Norman and Rumelhart, 1975) have constructed memory models based on event nodes and property relations. Lastly, there is a substantial literature on the syntagmatic-paradigmatic shift, a maturational change in the organization of word associations from sentencelike relations to taxonomic similarity (e.g., Sharp and Cole, 1972). It seems reasonable that dealing frequently with similar exemplars, thinking about them in their absence, organizing them for examinations or reports, and using them in many different contexts, all press for semantic encoding and retrieval. Frequent encounters with the same object, or with objects strongly embedded in a stable context, might lead to episodic memories.

It would be nice to say that behavioral and cognitive habits learned in the dominant ecology are carried over to the testing situation, and stop there. But

we suspect the relationship is more complicated, and there are two good arguments against the generalization notion. First, category behavior is sensitive to the immediate contextual demands, as the examples of the Kipsigis store and the American tennis clothes suggest. If the normally predominant habits do not generalize to these exceptional cases, why should they generalize to testing?

Second, we are not certain that situations requiring taxonomic organization or leading to semantic memory do, in fact, predominate in our culture. Ask a college professor to list all of his pipes. Will the list be organized around the taxonomic features or will there be particularistic chunks pertaining to ones that handle well, ones that are broken, some bought on a particular trip to Europe, ones that can be smoked without holding in the hand, for example while driving? Think of all the things in your living room—is your remembering organized around all the tables, then all the lamps, then all the pictures, etc.? Or around functional units, such as an end table, chair, footstool, and lamp? We can also note that the syntagmatic-paradigmatic shift mentioned earlier has recently been shown not to occur for American subjects, even by college age, if low-frequency words are used as stimuli (Stoltz and Tiffany, 1972). The theoretical problems of cognitive organization in various tasks, and their dependence on experience and domain are, of course, complex and we do not propose a solution here. The point we wish to make is, simply, that no one really knows what the "dominant" modes of experience and memory are in our own culture, or even if such a concept makes sense.

Aside from the issue of generalization, however, we do know some specific reasons for the Western or schooled subject to be taxonomy-prone. First, he is familiar with the social and sociolinguistic structures of the testing situation. It is similar to interaction in the classroom and in the home, at least for middle-class families (Harkness and Super, 1977). He is also ready to assume certain things about the task itself, namely that there is a principle behind the experimenter's question which can generate the appropriate answers (Cole and Scribner, 1974). Because most schoolwork involves memorizing facts, the schooled subject is skilled in strategies for remembering and retrieving, and ready to see that they are being called for in the task. A final aspect of schooling, like everyday life in Western ecologies, is the drive toward dealing with objects in their absence, and dealing with them largely as exemplars of a higher-order class.

We started out looking for parallels between (1) a population's typical performance on formal tests of cognitive organization, (2) naturally occurring category behavior outside of tests, and (3) the ecology of everyday life. We found them. On the basis of our experience in Kenya—long on time but short on n—

it seems that grouping of objects by related use is more common and more sensible in materially simple societies. It is precisely such populations that give "functional" responses on cognitive tests. In addition, the way people in such contexts encounter objects can be related to the formation of episodic, rather than semantic, storage. Both domains of experience, we propose, join with the psychology of test-taking to produce the societal contrasts in test behavior.

Of course, it takes more than a few parallels to construct a good theory, or to buttress it with good evidence. Generalization remains an immediate problem for our approach: generalization across cognitive domain, across individuals in a culture, and across types of task demands. But the parallels are enticing.

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Some Problems in the Study
of Schooling and Cognition

HERBERT GINSBURG

University of Maryland

Recent cross-cultural research concerned with the effects of schooling on the development of cognition has important implications for both the conduct of education in developing countries and the under-

standing of cognitive growth generally. This paper examines some assumptions behind work on schooling and cognition, and makes suggestions concerning research in the area.

A popular hypothesis is that schooling improves thinking in any one of several ways. Scribner and Cole (1973) have pointed out that schooling is said to teach the child both to transfer knowledge across situations so that he need not approach each problem *sui generis,* and to verbalize cognitive processes. Cole, Sharp, and Lave (in press) discuss another hypothesis: that schooling promotes general flexibility in reasoning. The latter authors then criticize these assumptions on a variety of grounds. First, the empirical data are inconsistent: sometimes the facilitative effects of schooling are found and sometimes they are not. Second, there is a possibility of test bias. The typical research procedure is to give both schooled and unschooled subjects a variety of psychological tests. Yet the tasks and operations measured by some of these tests may be more familiar to schooled than to unschooled subjects. Third, it is not clear if many of the tests are valid indices of intellectual functioning, particularly as it occurs in everyday life. Because of these and other shortcomings in the available research, the relations between schooling and cognition are as yet imperfectly understood.

Fortunately, Jean Lave's research (1977) on tailoring in Liberia suggests some new approaches to questions on schooling and cognition. She has shown that it is crucial to examine the effects of schooling on *everyday* cognition. First, she discovered certain intellectual activities indigenous to the day-to-day work of a particular profession. She found that Liberian tailors with varying amounts of schooling engage in certain arithmetic and measurement operations of some complexity. Second, she administered transfer tasks of two kinds. One involved new arithmetic and measurement problems within the familiar context of tailoring. The other involved tasks that were formally equivalent in terms of the required arithmetic, but were presented in a form more appropriate to the context of formal education. Lave's main question concerned the extent to which the amount of tailoring experience and the number of years of formal education influenced transfer on each type of task. The general finding was that each kind of experience assisted transfer within familiar contexts, but not within unfamiliar ones. Tailoring experience promoted success across tailoring problems; formal educational experience promoted success across school problems. Thus, transfer is not the unique product of school experience, and seems to operate within limited contexts.

Lave's work is important in that it employs tasks that measure cognitive operations which are known to be used in the everyday lives of largely uneducated people. Unlike most research on schooling and cognition, this procedure eliminates bias that favors the