The Social Organization of Knowledge and Practice: A Symposium

In a discussion of closely related research, the authors of this symposium examine evidence for the situationally specific character of problem-solving practices. They document situational variation in what constitutes a problem, in the procedures used, in the distribution of knowledge among people and settings, and in success at problem-solving by the same people in different contexts. These findings provoke speculation about relations among social contexts, knowledge, and activity, and about relations between school-learned problem-solving techniques and those learned and used in other settings. Arithmetic practices observed in Liberian classrooms, among grocery shoppers and novice dieters, and in product assembly tasks among commercial dairy workers provide the empirical basis for the discussion. ARITHMETIC; CULTURE AND COGNITION; EVERYDAY PRACTICE; PROBLEM-SOLVING.

Introduction: Situationally Specific Practice

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The articles that follow originated in a symposium of the conventional variety at the American Anthropological Association meetings of 1983. But they also form a symposium in a less common sense: a published group of essays on a given subject. Though they speak to a variety of theoretical issues, the articles are alike in addressing questions about cognitive processes and problem-solving in everyday settings. Together they illustrate a wide variety of theoretical ramifications emerging from research on everyday practices. The people solving problems and the

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settings in which this activity takes place include Vai school children in Liberian classrooms, grocery shoppers in California supermarkets, novice dieters in Orange County attending diet organization meetings and cooking in their kitchens, and icebox workers in a large commercial dairy in Baltimore. Earlier contributions to *AEQ* (Erickson 1982; Lave 1982) have suggested that several problem areas could benefit from further research: educational activities other than in school; relations between content to be learned and the processes of learning, whether in or out of school; and, more generally, the contextualized, socially organized character of learning and of knowledge itself. This symposium discusses ongoing attempts by the authors to pursue these issues.

One of our findings is that people do arithmetic and other kinds of problem-solving in richly varied ways in different situations: *Variation* in everyday problem-solving practice, rather than similarity, is emphasized here. At the same time, there is general agreement that there are theoretically crucial ways in which people are similar in how they vary. There is also agreement that the significance of the work lies beyond what we have learned about problem-solving in specific situations, although that, too, is of interest. Moreover, these studies of arithmetic and other problem-solving activities have relevance for a wide variety of theoretical issues including cognitive theory; theories of culture conflict in schools; the cognitive consequences of schooling; decision theory; and the nature of social practice.[1]

It might be useful to outline briefly some of the characteristics of situation-specific cognitive activity that, in my view, are common among the articles. In addition, there are three other empirical studies that should be mentioned because they help to establish a coherent picture of everyday cognitive activity. James Herndon describes in vivid terms the varied arithmetic performances of his pupils in an essay called "The Dumb Class" (1971). He discovered one of his students working in a bowling alley as a paid scorer for an eight-member bowling team. This led Herndon to create a series of bowling score problems in his math class, which the expert league scorer was unable to solve. In another study, psychologists in Brazil went as customers to local open air markets and put market children through arithmetic gymnastics, buying unusual quantities of fruits and vegetables from them, asking prices, and so on (Carraher, Carraher, and Schliemann 1982, 1983; Carraher and Schliemann 1982). They then tested the same children in school with arithmetic problems identical to those they had attempted to solve in the market. The third relevant study, also on arithmetic, was carried out by Scribner in a commercial dairy. She and her colleagues were able to compare performance levels and strategic arithmetic procedures in everyday work settings and on tests by icebox warehouse workers, bookkeepers, truck drivers, and others who varied in amounts of schooling and kinds of work experience (Scribner and Fahrmeier 1982).

The findings in these studies, and the results reported in the articles that follow, converge. First, people use arithmetic procedures more complex than many of them have had the opportunity to learn in school. Scribner's research (Scribner and Fahrmeier 1982), for instance, suggests that the dairy preloaders, who average about 6 grades of schooling completed, were doing arithmetic typical of 8th and 9th graders. Second, perhaps the most startling result of all these studies is that, although people often make arithmetic errors initially in other-than-school situations, these errors are part of a process that results in ultimate decisions that arithmetically are correct. This appears to be the case for workers filling dairy orders, for market sellers figuring the cost of produce, and for shoppers making best-buy purchases in the supermarket. Thus, in Brazil the market sellers produced correct arithmetic results 99 percent of the time. Scribner noted that in the icebox, the dairy preloaders made no errors during her observations; and in best-buy arithmetic undertaken in the purchase of 65 items under Murtaugh's observation, 98 percent of the calculations were arithmetically correct (Murtaugh 1985).

These quantitative data suggest that there may be a qualitatively different organization of arithmetic in different settings; the procedures observed did not look, feel, or sound like school arithmetic performances. Indeed, on school-like tests, the grocery shoppers averaged 59 percent, the market sellers 74 percent, and the icebox workers 64 percent. In each case the research was designed carefully to make the problems in test situations comparable to previously observed problems in everyday settings.

Furthermore, computational techniques varied strongly between tests and other situations. In a school-like situation, people tended to produce, without question, algorithmic, place-holding, school-learned techniques for solving problems, even when they could not remember them well enough to solve problems successfully. By contrast, in situations that appeared quite different from school lessons, the same people used varied techniques and invented units with which to compute. For example, the dairy loaders used case prices, and tailors in Liberia computed in "trousers' worth" of cloth, a one-and-a-quarter-yard unit (Lave, n.d.; Scribner and Fahrmeier 1982). People changed problems, decomposed and recomposed them in ways that reflected the organization of the activity at hand as well as the structure of the number system, and often turned the social and physical environment into a calculating device. They did "gap-closing" arithmetic, to borrow a term from Bartlett's pioneering work (1958). That is, in order to *have* an arithmetic problem in the supermarket, the shopper had to see both a problem and the partial form of a solution at the same time. The process of solving problems was not linear, but dialectical, the problem and the information with which to solve it changing each other until a coherent pattern of relations was constructed (Lave, Murtaugh, and de la Rocha 1984).

There appear to be discontinuities between problem-solving in the supermarket and arithmetic problem-solving in school. School problems seem designed primarily to elicit the learning and display of procedures, using set inputs. School lessons are fraught with difficulty and failure for many students. On the other hand, extraordinarily successful arithmetic activity takes place in situations outside school. Indeed, it is difficult to discuss the work described in these papers without referring continually to schooling, often in terms that place it in contrast with everyday problem-solving activities. Add to this pervasive dichotomy the special status attributed to school arithmetic by everyday practitioners. Researchers in the Adult Math Project discovered that *all* participants had poor opinions of their arithmetic practices in everyday settings. They apologized for not doing what they called "real math"—the math taught in school. This is especially interesting in the face of their extraordinary arithmetic efficacy in kitchen and supermarket.

There does not seem to be any simple social organization of knowledge and practice that accounts for situationally specific variation in arithmetic activity; thus, we have to deal with school as a special case. One of the interesting theoretical issues raised in several of the articles, then, is how to interpret school-situated arithmetic in relation to other situations. Here I propose a line of argument with which the other authors may not agree. In information processing psychology, especially in recent work on mental models, and in decision theory, theories typically link programmatic norms for practice, or "knowledge," *with* practice, in a relation that the linguist Rommetveit (1983) calls negative rationality (see also the introduction to Gentner and Stevens 1983). That is, the researcher establishes on a priori grounds what constitutes an optimal, value-free, context-free process for solving physics problems or choosing between alternative gambles or producing the correct utterance or deriving its canonical meaning. Empirical investigation then shows that people fall short of realizing these norms in practice.

The ideology of arithmetic taught in school, and its practice outside school, can be described in the same terms. This is hardly accidental, for cognitive theory, asserting normative models for abstracted, context-free instruction, is institutionalized in this culture in the arithmetic socialization of children in school. Functional theories of school effects on cognition, cognitive theory, and folk theory as well, paint a picture of school as teaching "completely general" algorithmic procedures for solving arithmetic problems. In theory the procedures should be transportable to any and all other situations where, because they are context-free, they should be universally applicable. This theory predicts less adequate realization of arithmetic algorithms at increasing time or distance from school settings, and treats highest level school performance as the appropriate measure of general arithmetic competence. Research on everyday practice, however, stands in conflict with the functional theory of schooling.

Instead, evidence from the Adult Math Project suggests that, at least in the United States, schooling always teaches an ideology, but only partially and sporadically a technology, of arithmetic practice. Arithmetic is part of the general rational empiricist ethos of schooling, purveyed as an objective, utilitarian, and rational activity. Schooling inculcates this ideology effectively. Murtaugh's analysis of arithmetic in the supermarket (Lave, Murtaugh, and de la Rocha 1984; Murtaugh 1985) shows that shoppers use best-buy calculations to produce a utilitarian explanation or justification for the choice of grocery items they themselves have narrowed to an essentially arbitrary binary choice on qualitative grounds.

But the specific recipe for arithmetic practice that follows from the ideology that prescribes linear, algorithmic, precise, complete calculations is not based on an analysis of *practice* in or out of school. From the perspective of everyday practice, algorithmic arithmetic procedures taught in school leave arithmetic stripped of relevant content, cumbersome (because of the requirement that they be general), and inappropriately technologized (requiring pencil and paper or a calculator) for most situations most of the time. The ideology of arithmetic practice is not, in fact, a very useful guide to the practice of arithmetic. Yet it is the ideology that has lent inspiration to a priori normative models, not only of arithmetic but of cognition more broadly conceived. This certainly helps to account for the long-term obscurity of everyday practice within the social sciences.

Arithmetic practice has special characteristics in school because classroom lessons are complex situations where ideological socialization is intense. Indeed, we recognize this in special purpose folk terminology: "cheating" gives everyday practice special, negative connotations in the classroom. This characterization masks conflicting aspects of everyday and school practice by rejecting the former. Evidence for the fundamental similarity of practice in and out of school is too complicated to discuss here. At the very least it is possible to give an example of how the ideology of school lessons, and the practice of arithmetic in school, bear quite inexact relations with one another.

This point may be easier to see in schools outside the United States. Brenner's article demonstrates that teachers in Liberian schools teach American "new math" lessons, neither encouraging nor discouraging arithmetic practices brought to the classroom by Vai pupils but not included in intentionally taught math lessons. Pupils in fact use a syncretic approach to arithmetic problem-solving, incorporating both Vai and Arabic arithmetic characteristics. The culture conflict model of exported schools imposed upon other cultures, to which her work speaks, implies, like other theories alluded to above, that either school ideology is enacted literally in practice at the expense of the imposed-on culture, or that no math will be learned. The syncretic practices in Vai schools are at odds with this theory.

In general, the special normative status attributed to school arithmetic has grown from mistaking a programmatic ideology for an analysis of practice. Partly, the ideology of math is a poor theory of practice because it supposes that arithmetic activity is value-free, information-seeking, factual, and an end in itself. In her article, de la Rocha demonstrates what happens when dieters try to cope with the school-like normative program of a dieting organization. The program proposes a precise, rational, measurement-based approach to the control of food intake, but dieters quickly experience conflict between the elaborate program and the economies of time and effort required in cooking meals for a family. This work demonstrates that contradictions in values and the need for action motivate arithmetic problem-solving in many circumstances. Re-evaluating an old distinction between abstract and concrete thinking, it is "whole-person," richly contextualized arithmetic activity that prevails in everyday settings.

To summarize: In various ways the authors explore relations between settings, activities, the nature of problems and problem-solving, and the specific character of everyday problem-solving practice. Such research stands at an intersection of theories of socialization, schooling, cognition, ideology, and social practice. Because this is so, there are many lines of theoretical argument to be explored in addition to the one I have put forward here. It is appropriate, then, that the other members of the symposium now speak for themselves. Hugh Gladwin provides a summary and conclusion.

Endnotes

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1. This work is directed toward anthropological issues concerning culturally-specific relations between schooling and everyday practices at two different levels: that of theoretical relations between schooling and practice, and that of arithmetic procedures in everyday activities and in school. The former is emphasized here. As Brenner's work suggests, there is a rich basis for pursuing the latter in recent work on math learning (e.g., Brainerd 1982; Carpenter, Moser, and Romberg 1982; Ginsburg 1983; Lancy 1978, 1983; Petitto 1979, 1982, n.d.; Resnick and Ford 1981; Saxe 1982; Saxe and Posner 1983; Schoenfeld 1982). We hope to address these issues in detail in the near future.

NOTE: **References** cited in this symposium appear in a collected bibliography that follows the concluding article.