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THE QUARTERLY NEWSLETTER OF THE LABORATORY OF COMPARATIVE HUMAN COGNITION

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Introduction

The current issue of this *Newsletter* is devoted to a readmiration of the work of Sylvia Scribner. Sylvia was a member of the Laboratory of Comparative Human Cognition during its formative years at the Rockefeller University and a valued associate until her death in the summer of 1991.

The contents of this issue are divided into two major sections. First, we present two heretofore unpublished papers. "The Consequences of Literacy" was written in 1968 while Sylvia was a graduate student at the New School for Social Research. It pre-dates and pre-views lines of research which she would undertake when she joined LCHC a few years later. "Mind in Action: A Functional Approach to Thinking" was presented to the Society of Research in 1983 shortly after Sylvia had joined the faculty of the Graduate Center of the City University of New York. In addition to describing her now-classic study of cognition and work in a dairy, it points back at the way in which this work grew out of her research on literacy and it points forward to new lines of work on the nature of work and cognition which are being continued by her students and colleagues.

The second section of this issue presents the commentaries of 25 of Sylvia's colleagues who were invited to comment on one or both of the papers. These commentaries are presented in alphabetical order. At the end of this section, I have added some comments of my own, directed less at the work itself than at the process of working with Sylvia and the social and cultural context in which that work was conducted. In recognition of the incompleteness of our efforts to provide the broadest appropriate range of commentaries, we invite our readers to submit their own 1000 word commentaries, should they be moved to do so. We will be glad to publish them in a later issue of the *Newsletter*.

Note: In her citations to chapters from the monograph by Bruner, et al., Sylvia failed to note that the authors made a point of ascribing authorship of each of the chapters to the particular people whose names were listed at the head of the chapter, referring instead to Bruner, et al. or simply Bruner. We have take the liberty of including the proper references in such cases. We also note that the only surviving copy of this manuscript in our possession was missing some of its references. We have filled in the appropriate references where they could be located.

Michael Cole

The Cognitive Consequences of Literacy

Sylvia Scribner

February, 1968

Introduction

The supreme challenge confronting social scientists, C. Wright Mills (1963, p. 425) observed, is that of developing a "concept of mind which incorporates social processes as intrinsic to mental operations."

If this problem is central to the analysis of human society and its history, it appears no less central to the study of the growth of the individual mind. It is a challenge to the psychologist as well as the sociologist, and in this paper, I should like to consider—in a free-ranging and speculative manner—one possible psychological response to this challenge.

We may begin with the observation that a number of social scientists in recent years have sought a link between mind and society by assigning to psychological processes the function of "mediating mechanisms" in cultural development and social change. Some, in fact, have found the role of these mediating mechanisms to be so crucial as to consider mind, rather than society, their rightful object of study.

We are not proposing that psychologists respond by "taking over" society as their scientific domain. But we do suggest that the converse proposition - namely, that social processes function as mediating mechanisms in psychological change and development - may be of major theoretical and practical importance for psychology.

My own interest has been in exploring one aspect of this general hypothesis—the possible interconnections between social inventions and cognitive development. To suggest that inventions modify thought processes may appear at first sight either odd or trivial: odd because the term "invention" usually brings visions of hardware to mind - the axe, the wheel, the printing press or computer; trivial because there does not seem much new to be said about man, the tool-making animal, whose interaction with the environment proceeds by technological rather than biological change. Yet among the most significant social inventions whose implications are still to be fully

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explored are the magnificent conceptual systems which lie at the base of all human culture. Many of these truly involve "stupefying leaps of the imagination:" systems for reckoning time using units which have no counterpart in nature (hours and minutes); number systems based on the discovery of zero, the nothing quantity; or writing systems which construct an arbitrary equivalency between two sensory modalities (sight and hearing).

These, too, are "tool systems" used by man to control and alter his environment. If we accept the validity of the brilliant insight - that the tools man uses to shape nature to his purpose in turn help shape his own nature - we should be prepared to find that these conceptual inventions lead to significant transformations, not only in human culture, but in the mind of man. Like technological inventions, they become part of the real world outside of man, the world with which he interacts, which he reflects and symbolizes. Thus conceptual inventions which are social in origin and part of the human legacy have the potential through processes of cultural transmission of being internalized by the individual and becoming part of his inner world.

In this paper we will be indulging in speculation about the possible psychological consequences of one such conceptual system, a system widespread but not yet universally shared—writing. We wish to explore the thesis that writing, which objectifies the spoken language and creates new symbolic languages for man to manipulate, makes possible the attainment of a new higher level of conceptual thought. Seen from the viewpoint of society, the consequences of literacy will be manifested in new kinds of intellectual systems and cultural products, from the viewpoint of the individual, in new modes of concept formation and in awareness of the act of thought itself.

Our exploration of this thesis will lean heavily on extrapolations from social science and psychological literature. There are no experimental data now available to support our hypotheses directly but there are sufficiently provocative suggestions from field and laboratory studies, we believe, to argue for its cogency. In the final section of this paper, we will present some of the relevant empirical data but we have first to consider the question: what is the basis for singling out "writing" as a possible significant mechanism in cognitive growth?

It must be acknowledged that few psychologists to date have considered writing worthy of special interest and attention.¹ While there has been a remarkable growth of research in language development and the role of

language in various cognitive processes in recent years, most investigators have conceptualized language as internalized speech only and have not addressed themselves to the possible special characteristics of its written form. Anthropologists and historians, on the other hand, have long been intrigued by the circumstances surrounding the invention and evolution of writing. Far from being merely a recording device for speech, writing² is known to be an item of culture quite distinct from language with a different origin and history (Hoijer, 1960, p. 216).

There is first the fact of writing's very late invention. While we do not know "man" without "language," it is conservatively estimated that at least one million years intervened between man's first appearance and the beginnings of written record (Movius, 1960, p. 49). Many great arts of civilization (pottery, weaving, agriculture, domestication of animals) were mastered in early stages of the Neolithic period but systematic writing systems did not appear until approximately 3,000 B.C. Like the "great arts," however, writing, too, was invented independently by different peoples in different corners of the globe at different times in world history.

Interesting, too, is the fact that the first writing systems had nothing to do with speech. They were completely independent systems of communication. The "conventional visible signs" utilized in different scripts may have had their origin in direct pictorial representation of the events to be communicated, or they may have been symbolic from the outset (as in various mnemonic devices) but in either event they communicated directly without mediation of the spoken word. Phonetic writing systems which establish an equivalency between word and visible sign did not come into existence until 1,000-700 B.C. (Gelb, 1952).

Even in these most highly developed systems which make it possible for man to write anything that he can say, writing has continued to make use of "purely visible signs" to express distinctions and meanings not found in speech.³

At the same time that phonetic writing systems have drawn speech and writing closer together, writing has been used to create original languages having no counterpart whatsoever in oral communication. We refer to the many and varied notational systems used by the sciences and to mathematical and logical languages which all exemplify the "trans-speech" nature of writing.

But the aspect of writing that has most captured imagination is the regularity with which its appearance

has always been accompanied by far-reaching changes in all important spheres of life, by rapid and remarkable developments in government, art, commerce, industry and agriculture. This "co-appearance" of writing and technological and intellectual development has led most scholars to date the beginning of "civilization" from the advent of writing, and to use written language as the "bench-mark" separating the primitive from the complex society. Whether the particular view of the historical impact of writing is negative (Writing, says Levi-Strauss, introduced exploitation of man by man into human society) or positive ("... an immense stride forward in the history of mankind, more profound in its own way than the discovery of fire or the wheel" says Diringer, 1962, p. 19) it appears incontestable that its invention played a profound role in the transformation of human culture.

An interesting and unusual attempt to explicate the relationship between the development of writing and the appearance of new cultural products is found in a study by Goody and Watt (1963) which examines the consequences of the diffusion of the alphabetic writing system on Greek philosophy. They suggest that the mastery of a phonetic writing system by a relatively broad strata of the population in early Greece was instrumental for the emergence of two new forms of human intellectual endeavor—the origin of history as distinct from myth, and the founding of formal logic. Alphabetic writing played this role, they maintain, not merely because it preserved the content of man's knowledge in easily accessible form, but because it was a mode of communication whose characteristics facilitated the development of skeptical and analytic modes of thought.

This interpretation clearly suggests that psychological processes formed the link binding together three distinct social phenomena - the spread of literacy, the origin of history, and the appearance of formal logic. History and logic, like all other intellectual systems, are products of human thought: It is in the writings of Xenophanes (and his unrecorded counterparts) that we find rejection of myth; in those of an Aristotle, the rules of logic. While one could think of their intellectual creations as arising from old ways of thought furnished with an expanded store of information and different tools of communication, it is not unreasonable to look upon them as arising from changed ways of thinking made possible by the mastery of the written language. In this light, history and logic can be taken to represent the externalization and formalization of new thought-ways attained by the philosopher-scientists of early Greece through the spread of literacy.

This leads us quite directly to the more general hypothesis with which this paper is concerned - that literacy, a skill by which the individual appropriates a social product (writing) for private use, is a pivotal mechanism in cognitive growth.

Literacy is a fact of history not only in respect to whole cultures but in respect to the individual as well. The process of cultural development is collapsed and condensed, as it were, in the life span of the individual. Each man, whatever the culture into which he is born, must acquire and assimilate some portion of the knowledge and techniques developed over past centuries by his predecessors. Whether he does in fact appropriate these cultural products and when he does so are, to a large extent, socially determined matters. Thus, reading and writing skills became instrumental during adolescence in ancient Greece and are introduced to the child of six in the United States today. For the vast majority of mankind - child or adult - they have yet to become operational skills. This very fact of the independence of literacy from age and biological processes of maturation makes it an attractive point of entry for scientific inquiry into the relationship between "society" and "mind."

Even considered apart from this grand design and simply from the point of view of specific issues in developmental psychology, literacy commends itself as an object of study. Developmental psychologists have made considerable progress in delineating the changes in cognitive processes that take place as the infant grows to adolescence. But, as Flavell (1963) and others remind us, we have not made corresponding progress in identifying the specific mechanisms which bring about the transition from one mode of operation to another. Rather than engage in debate over the global concepts of "culture" and "constitution," an analytic investigation of the effects of specific skills such as those involved in literacy cannot fail to deepen our understanding of the intricate and varied ways in which individual and cultural factors relate to each other in the course of intellectual growth.

Our plan is to begin with an examination of the spoken and written language systems to identify their differentiating characteristics. We will then proceed to an analysis of the mental operations involved in learning how to use the written language and those which the existence of the written language, in turn, makes possible. On the basis of this theoretical analysis, we will formulate "guiding hypotheses" about the specific changes in thought processes which may be either dependent upon (or nur-

tured by) the attainment and exercise of reading and writing skills. We will then consider these hypotheses in the light of research findings from two fields of work—studies of nonliterate thought in primitive cultures and studies of nonliterate thought of children.

Our hope is that this excursion into the literature will lend sufficient support to our thesis to encourage a direct research attack on literacy as a mechanism of cognitive growth.

Reading and writing, the traditional concerns of educator and psychologist alike, may yet provide us with new clues about the nature of mental life if we broaden our concerns from what their mastery requires to what such mastery contributes to the process of cognitive development.

The Spoken and the Written Language

It has been common for linguists to dismiss language as a derivative form, hardly worthy of study in its own right. Bloomfield (1933, p. 282) says:

A speech utterance is the same whether it receives a written record or not . . . For the linguist, writing is, except for certain matters of detail, merely an external device like the use of the phonograph which happens to preserve for our observation some features of the speech of past times.

Lotz, (1961, p. 2) a linguist who stresses the symbolic rather than the behavioral aspects of language, fleetingly refers to "script" as one of the secondary symbolic systems "which lends permanency to the expression."

In recent years, greater interest has been shown by linguists in written language, and their relative neglect of this area until now is somewhat understandable in view of the fact that comparative linguistics must deal with many language systems that exist only in oral form. It appears doubtful, however, that psychologists who are interested in language from the standpoint of human behavior, can afford to ignore the many ways in which written language⁴ differs from spoken language. In actual usage, the lexicon, grammar and style of both forms of language are radically different. Basil Bernstein (1964, p. 253), well known for his comparative studies of spoken English, has identified two different kinds of language systems which he designates as "formal" and "public" languages.⁵

The chief characteristics of formal language are:

1. Accurate grammatical order and syntax regulate what is said.

2. Logical modifications . . . are mediated through a grammatically complex sentence structure, especially through the use of conjunctions and subordinate clauses.
3. There is frequent use of prepositions to indicate logical relationships as well as temporal and spatial contiguity.
4. There is frequent use of impersonal pronouns.
5. There is a discriminative selection from a range of adjectives and adverbs.

In contrast, the chief characteristics of public language are:

1. Short, grammatically simple, often unfinished sentences with a poor syntactical form.
2. Simple and repetitive use of conjunctions.
3. Little use of subordinate clauses to break down the initial categories of the dominant subject.
4. Infrequent use of impersonal pronouns as subjects of conditional clauses or sentences.
5. Rigid and limited use of adjectives and adverbs.
6. A large number of statements which signal a requirement for the previous . . . sequence to be reinforced: "Wouldn't it? You see? You know?"
7. Idiomatic selection from a group of idiomatic phrases will frequently occur.
8. It is a language of implicit meaning. (italics in the original)

The "formal" and "public" languages described in this manner are terms used by Bernstein to designate the speech systems of the English middle-class and working-class respectively. But we see how aptly they can be used to highlight some of the common distinctions between written and oral forms of discourse. Without invalidating Bernstein's argument that speech systems are generated from, and in turn, reflect the differing social relationships within the several classes, it does not seem out of line to suggest that some of the differences between working-class and middle-class speech may simply be those of fully literate versus basically nonliterate⁶ speech. This is

to say that written language, once acquired and internalized, turns back upon and interacts with oral language so that subsequent language development issues from the mutual influence of the one upon the other. We can think of these two language systems as two intersecting circles which partially overlap but have independent areas as well. They move closer together as the individual becomes "more literate." From this point of view, although the genesis of the systems is inextricably linked with their form, any one language specimen of an individual who has attained competency in both systems may more closely approximate either the oral or the written system irrespective of the particular form in which it is expressed. Thus we can have oral written language (as in formal argument, speech making, dictation) and written oral language (as dialogue in plays and novels). We have only to think of the difficulties and special arts involved in such transpositions to appreciate that written and oral languages are in behavioral respects different "systems."

We would now like to take our comparison a little deeper by considering some of the characteristics of reading and writing which we feel may be of significance to the psychology of cognition.

1. Writing produces a material product.

Every act of writing in any writing system with the use of any implements gives language a corporeal form, objectifies it.

This process of objectification changes the relationship of the individual to language in a number of ways. Through writing, language is converted from a temporal to a spatial dimension. Once spatialized, it is freed from a given temporal sequence and is available for, what Piaget would call, reversible operations. "Timeless" language can be stopped, run backwards as well as forwards, broken up into all kinds of units and sequences, organized and reorganized in countless ways - in short, it comes under the language user's control. As this implies, although written language is static and contrasts in this respect with spoken language which is always "language in action," it enables the language user to play a more active role; he can manipulate its symbols in ways more varied and complex than speech alone makes possible.

Another way of looking at this is to observe that writing separates the producer from the product. Oral language exists only at the very moment that the individual is in the act of creating it, whereas writing separates our language from us and sets it in the outer world, making it

available for inspection and contemplation by its creator as well as by others. In this way language itself becomes an object upon which we work, not merely an instrumentality through which we work to gain other (non-language) ends.⁷

2. Writing externalizes thought.

Insofar as thought is expressed in language and language is objectified in writing, writing in some part represents objectified thought. In this sense the writer, looking upon what he has written, reviews his own thought. While the analysis of external reality can be carried out by conceptual thought embodied in oral language,⁸ conceptual thought embodied in *written* language may well be the necessary condition for the analysis of thought itself.

Vygotsky (1962) looked upon inner speech as the end state of a process of internalization and abbreviation of social speech. The use of inner speech for reasoning (thinking) about one's own thought processes might similarly represent the internalization of a process of criticism which initially takes place in interpersonal dialogue and goes "inside" via an intermediate stage which makes use of the written statement as the "other." The Socratic dialogue became famous as a method of arriving at "clear thinking," as a technique of education in the art of reasoning. It proceeded by making ideas the object of investigation through oral interrogation conducted by two people; one expressed the idea and the other examined and criticized it. With ideas given permanent form in writing, however, the two roles are more readily combined in the same person: the author of the idea can "stand back" (in Socrates shoes, as it were!) and subject it to a critical "second" look. This particular usefulness of the written statement is quite explicitly recognized by many who turn to pen and paper for help in clarifying their thoughts. Once the role of critic of one's own thinking becomes stabilized through the technique of writing and editing, it may become internalized and the "editing" come to precede (and not necessarily always eventuate) in the writing.

3. Written language is more abstract⁹ than spoken language.

Written language has sometimes been called an abstract activity because it is a second order symbolization—one in which the symbol is twice removed from its referent: the visual symbol represents, not the referent, but a symbol in another sensory modality.

This analysis seems appropriate for the period of written language acquisition. Visual marks initially have

no direct semantic significance; their meaning is mediated through corresponding sequences of phonemes. As the reader or writer acquires skill, however, spoken words and phrases may drop out of this mediating position so that in time the written marks are themselves directly comprehended.¹⁰ From the external point of view, writing would remain a second order symbolization, but from the individual cognitive point of view, we would have to identify the actual stage of the process to determine whether or not it could be characterized as "second-order" symbolic activity.¹¹

There is another sense in which we can speak of reading and writing as more "abstract" than speaking. Every utterance is made in the context of a concrete situation. According to Werner and others (e.g., Werner & Kaplan, 1963), it is this situation as a whole, including the child's activity in it, which for the child just beginning to talk constitutes the diffuse meaning of verbal expressions. Only slowly are specific word meanings differentiated out of this total context. Even for adults, situational factors continue to play an important role in spoken language signification.

In written language, the "situation" is not concretely given but itself has to be constructed through the text. Thus the words carry a double burden: they not only have to convey a specific communication but the same words have to convey the "context as a whole." In this light it is interesting to speculate on the ease with which comic strips are grasped by otherwise poor readers. Perhaps one of the facilitating factors is that the comic strip anchors words and expressions in a concretely given situation; it exactly specifies, in pictorial fashion that can be "directly apprehended," (i.e., nonverbally) who is talking, to whom, and under what circumstances.

"Being taken out of context" also means that written language is stripped of all the expressive features of direct communication - inflection and tempo of speech, facial expression, gesture and the like which enrich language meaning. Comprehension of a written text is divorced from such aids and to a much greater extent than obtains in oral speech has to become a more purely cognitive activity.

We should take note of the fact, too, that spoken language ordinarily receives direct semantic ratification through the responses of others. Meaning in written language is ratified (or supplied) only through other symbols. Here indeed we may speak of second and third and fourth order symbolization.

Finally, we may consider the manner in which the relationship between the physical and semantic properties of words change as they undergo transformation from the auditory to the visual modality. To some extent, however slight, there is an integrative bond between the two sets of properties in oral language. As we have indicated, there are occasions when pitch, stress, and other physical features play an important role in conveying the meaning. Word appearance in the written text does not ordinarily serve this end. For usual purposes,¹² so long as certain minimum standards of legibility are met, variations in word size or letter formation are of no account. When reading, we handle words as semantic units and have no commerce with their physical properties. We are considered to have achieved excellence in reading when we do, in fact, read for meaning and *not* for words. And the dominance of word meaning over word form in the written text is tacitly acknowledged in the advice that "Poetry to be appreciated should be read aloud"; it is in the oral condition that attention is paid to word form.

4. Literacy skills require an analytic approach.

It seems to make psychological sense to think of the unit of spoken speech as being the whole utterance. From a developmental point of view at least, it appears to be the case that word meanings are only gradually differentiated from the child's early holophrastic expression. In contrast, written language cannot be mastered by a progression from the "whole expression" to the component unit. Whether the particular reading method employed selects the word, part of the word or the letter as the initial unit, the student is required to analyze the familiar utterance into unfamiliar parts and then to resynthesize them.¹³

This analytical translation of sound into visual form or visual form into sound through syllabification or discovery of "grapheme-phoneme correspondences" is a formal activity, not directly meaningful in itself. It is merely a means to an end (reading comprehension or writing facility). Thus, in the acquisition of written language, technical skills must to some extent be considered independently of the content. In spoken communication it is only in cases of defect (speech or hearing impairment) that the technical skills required in language production have to be specifically trained apart from the functional use of the language.

It follows that there is a greater separability or differentiation of the various processes involved in the utilization of written language. It is sometimes true in oral language that utterances are run off as automatic sensori-

motor habits, but it is more generally the case that the physical utterance and its signification are integrally related. In written language, on the other hand, it is not uncommon to have meaning, sound and sight functioning independently. Once we acquire skill in reading, we "recognize" words which we cannot pronounce and may not understand; we may grasp the meaning of a word without being able to pronounce it; or pronounce it without knowing its meaning. Similarly in writing, we may find that we know a word but we are not at all sure of its correct visible sign.

Thus from the outset, the individual undertaking to learn how to read or write confronts the "machinery of the language"; he has to become aware of its components and of the various operations required to produce or comprehend it.

5. Literacy skills must be acquired consciously and intentionally.

Psychologists studying the cognitive development of the child can hardly find two more contrasting "learning situations" than those involved in the acquisition of speech and written language. In the former case we are hard put to it to discover how the language is "learned," in the latter we encounter difficulties in explaining why the language is *not* learned.

When it is said that speech is acquired spontaneously and written language deliberately, one refers first of all to the fact that literacy is systematically taught over a long period of time and that direct teaching plays a relatively minor role in the child's mastery of speech. But more than this is involved in the distinction. The crucial role in learning written language is not played by the teacher but by the child himself who must direct the process, participate in it actively and intentionally and keep it under conscious control.

Why this must be so has already been indicated in the previous sections where we reviewed the abstract aspect of writing which requires the child to create the situation and the context, and its analytic characteristics which require him to become aware of its component processes so that he can manipulate them.

Vygotsky (1962, p. 99) has very beautifully expressed still another characteristic of written language which makes imperative its conscious direction:

Written language demands conscious work because its relationship to inner speech is different from that of oral

speech. The latter precedes inner speech in the course of development while written speech follows inner speech and presupposes its existence (the act of writing implying a translation from inner speech). But the grammar of thought is not the same in the two cases . . . Inner speech is condensed, abbreviated speech. Written speech is deployed to its fullest extent, more complete than oral speech . . . The change from maximally compact inner speech to maximally detailed written speech requires what may be called deliberate semantics - deliberate structuring of the web of meaning.

Vygotsky concluded that the difficulties in the development of written speech and the lag between it and oral speech can be attributed to these intrinsic features. "The discrepancy is caused," he said, "by the child's proficiency in spontaneous, unconscious activity and his lack of skill in abstract, deliberate activity" (1962, p. 100).

It remains only to be added that not only during childhood but throughout life the act of writing remains a deliberate act. Unlike other highly developed skills which become automatized, writing must always be consciously attended to. When our attention wanders or control falters, errors creep into our productions—errors of a kind rarely encountered in spoken language, such as the omission or transposition of key words necessary to carry the meaning of the sentence.

It cannot be maintained that reading and writing skills are necessarily the very first skills which children acquire intentionally and consciously. But in our society, they are among the first *cognitive* skills to be brought under conscious self-direction, and so can be expected to exert the greatest influence on the developing intellectual functions.

6. Written language is essentially private.

Reading and writing are private acts and they therefore provide an individual relationship to words and thought. In oral language there are always at least two people involved at the same time with the same set of words. Under these circumstances, language is embedded in a shared situation, and it fulfills its communicative function, at least in part, because there is some commonality of perception and understanding among the speakers. Spoken language, in fact, is often modulated so as to enhance this commonality among the participants of the conversation or the members of a particular language community.

The user of written language is performing in a solitary rather than a social manner. The intellectual opera-

tions involved are detached from the "common perceptual world"; they cannot spontaneously reflect commonalities but rather must construct them anew whenever the reader works upon a new communication, and this construction must be carried out without the benefit of "feed-back."

While reading is a private act it does not mean that it is more "personal" than speech. We have already seen that writing objectifies language and thought. This means that at the same time they are withdrawn from the social world, they are also "depersonalized" and can be more effectively utilized because the self is in some measure detached from them.

This analysis has been concerned with the distinguishing features of written language and with the nature of the intellectual operations required for its mastery. We have suggested that writing is a new form of communication, a new "modality" as it were, through which the individual acquires information about, and interacts with, others and his environment. We have also suggested that the mental skills involved in reading and writing are qualitatively different from those developed spontaneously in the acquisition and use of oral language.

What consequences for thinking processes would this analysis lead us to postulate? On a *a priori* basis only, we might hypothesize two principal effects of literacy,¹⁴ one deriving from the product of writing, the other from the psychological operations which it involves.

Hypothesis 1. Literacy moves thinking to a new conceptual level. Writing changes the relationship between word and thought. By giving language a corporeal form, writing provides thought with word-objects to manipulate. We may expect that thought based on manipulation of word-objects will attain a conceptual level further removed from the physical world of things than is possible for oral thought.

Hypothesis 2. Literacy moves thinking from the spontaneous to the conscious level. Reading and writing are consciously controlled activities which *require* awareness of one's own thought processes, as in translating "inner speech" to outer form. High levels of proficiency in reading and writing should facilitate the development of reflective thought - thought which thinks about itself and can give an account of itself. Another way of saying this is that the individual acquires the ability to make the act of thought itself an object of thought.

If literacy is a mechanism through which a new level of conceptual thought is attained, then the speculations we

have made should prove congruent with observations of differences between "literate thought" and "nonliterate thought" in two major fields of inquiry - anthropology and developmental psychology. By maintaining that the empirical data derived from investigations in both of these fields are relevant to our hypotheses, we are not allying ourselves with the position that child thought and primitive thought are "alike" nor with the now discredited position that people in primitive societies are of "inferior" mentalities. We do maintain that, if conceptual systems help shape the mental life of man, man's mental products should be *predictably* different in cultures which possess or fail to possess the particularly important tool system of the written language.¹⁵ If a comparative study should reveal this to be the case, we would have no grounds for inferring that the mental capacities or laws of thought are different in adults of more or less technologically advanced societies. We would have grounds, rather, for inferring that the existence of a written language system (probably along with other technological systems)¹⁶ is related to changes in the way man *utilizes* his mental capacity. To substantiate this inference of a relationship between literacy and certain modes of thought we would need to turn to psychological studies of the development of thought processes in the individual to see what differences there are, if any, between literate and nonliterate children or adults *within one culture*. Developmental psychology offers some relevant data. For confirmation of the "strong hypothesis" that literacy operates as a causal mechanism giving rise to the emergence of certain kinds of thinking, we require a series of experiments in which the factor of literacy is independently manipulated to determine whether predicted changes in intellectual function occur as individuals acquire a level of proficiency in the uses of reading and writing.

With these clarifying comments let us turn first to some interesting comparisons that have been made between thought systems in oral and literate cultures. These analyses have been selected, not for their representativeness, but for their particular relevance to the point of view we have been advancing here.

Thought Systems in Oral and Literate Cultures: Some Selected Observations

Levi-Strauss' description of the "Savage Mind" makes an especially interesting starting point - first, because he is widely recognized for his original contributions to the analysis of primitive thought systems, and second, because he is the leading contemporary opponent to a developmental point of view in respect to the intellectual

attainments of simple and complex societies. Primitive thought and modern science, he maintains, (1966, p. 15) are not to be considered a function of different stages of the human mind but rather as two different strategic levels at which nature is accessible to scientific inquiry. They are two parallel modes of acquiring knowledge.

In opposition to the view that primitive thought is in any way less scientific or logical than modern thought, he cites generic terms in primitive vocabularies (such as "animate," "rational" and the like) which he believes to evidence "abstract" thought. He stresses other commonalities: both mythic and modern scientific thought demonstrate a thirst for objective knowledge of the universe; both proceed by ordering, classifying and systematizing information; both are based on the principle of determinism; both use techniques of active and methodical observation, of experimentation based on hypotheses; both combine interest in the practical and the theoretical; both create logic systems based on selected fundamental antinomies. These commonalities lead Levi-Strauss to conclude that the two thought systems require the "same sort of mental operations."

Given this central theme, it is all the more interesting to follow Levi-Strauss' *differentiation* of mythic and modern thought. Characterizing mythic thought as a "science of the concrete," he describes it as concerning itself with the organization and exploitation of the "sensible" world in "sensible" terms - as working with phenomena adapted to the functions of perception and imagination. Mythic thought seeks the interconnections of objects through their "secondary" qualities - those that are part of living experience - whereas modern science travels a road more "remote from sensible intuition" and searches for necessary relations in the structural qualities of things. The distinctive attribute of mythic thought is that it stands "midway between percepts and concepts." It makes use of signs which "like images are concrete entities but have some limited capacity for reference." Terms that enter into logical systems as signs always carry with them the manifold properties of their referents, and while their meaning can be sufficiently generalized to serve the purpose of the system into which they enter, they are not capable as concepts are of entering into *unlimited* relations with other entities of the same kind. The possible combinations of signs are restricted by the tangible properties they possess which limit their deployment.

Classification systems composed of signs in which tangible properties inhere have a "polyvalent logic" which appeals to "several, formally distinct types of connection

at the same time" (1966, p. 61). Connections, or meaning equivalences, may be based on contiguity (the Anthill Clan is linked with the Snake Clan because snakes hide on anthills and with the Grass Clan because grass grows on anthills); on resemblance (red ants and cobras are linked by their color); on common function (bees and carpenters belong together because they both build) or historical association (elephants and clay are associated because in the old days women used elephant footprints to cook in before clay pots were invented).¹⁷ But what is especially important to an understanding of primitive theory is that several different kinds of relationships between terms may characterize any given classification system.

We have selected the following example to illustrate this "polyvalent logic." The Osage system of classification divides all animate and inanimate things into the three categories of sky, land, and water as follows:

Sky	Water	Dry Land
Sun	Turtle	Bear
Star	Mist	Porcupine
Crane	Rush Plant	Deer
Night	Fish	Eagle
Heavenly bodies		

The position of "eagle" in the "dry land" category would be incomprehensible, Levi-Strauss points out, if it were not known that in Osage thought eagles are associated with lightning, lightning with fire, fire with coal, coal with earth. Eagles qualify as land animals because they are "masters of coal." Here we see existing connections between things making up a chain of associations that eventually results in the categorization of eagle as a land animal. But note that when eagle is so classified, it is on the basis of a symbolic connection - master of coal - derived from the association chain, whereas the other terms enter the system on the basis of direct factual connections (bear and deer *live* on land) or actual physical properties (mist *is* a form of water).

Levi-Strauss is convincing in his demonstration that primitive thought is conceptual in the sense that it is capable of generalization. At the same time, and outstandingly, it is conceptual thought rooted in concrete experience, tied to the actual properties of things or events, "entangled in imagery." As Levi-Strauss puts it, mythic thought lacks the kind of concept which is open for relations with terms with which it has no *existent* connec-

tions, direct or derived. This kind of concept is present in modern scientific thought where it plays a decisive role in creating new meanings and in projecting the merely possible as opposed to the actual.

Since Levi-Strauss' methodology relegates historical questions to the realm of the contingent, when he rejects the notion of "stages or phases in the evolution of knowledge" (1966, p. 22) he supplies no alternative explanation for the difference between mythic and scientific thought nor of their historical order of appearance.

In the analyses of Stanley Diamond (1964), an anthropologist with extensive field experience among the people of West Africa, we meet again with the distinction between primitive thought and the "pure concept" but combined with some speculation as to "historical causation." Primitive thought is a mix, both concrete and abstract. It is abstract because, "in the basic sense every linguistic system is a system of abstractions; each sorting out of experience and conclusion from it is an abstract endeavor; every tool is a symbol of abstract thinking; indeed, all cultural convention, all custom is testimony to the generic human capacity for abstracting." At the same time, the abstractions of primitives "... are indissolubly wedded to the concrete; they are nourished by the concrete ... ultimately induced, not deduced" (1964, p. 186). If this sounds like a contradiction to us, it is only because we in the Western world have come to reserve the term "abstract" for a particular form of abstraction, the Platonic abstraction. Plato's definition of the abstract as pure idea stripped of all concrete properties coincided with the rise of the political state which destroyed primitive community and severed the thinker from the man of action, leaving one to pursue the "abstract" in philosophy, the other to labor with the "concrete" in life. This specifically Platonic abstraction has become so entrenched in Western thought that we erroneously conclude that primitives are deficient in the abstract capacity because they do not think like Platonists.

In the works of the classicist Eric Havelock (1963), Plato again emerges as the pivotal historical figure proclaiming the movement from one mode of thought to a qualitatively different one. But these contrasting modes of thought are now designated "poetic" and "philosophical" - the one imagistic, temporally organized, subjective; the other conceptual, analytic and objective; the one Homeric, the other Platonic. Each mode requires a language appropriate to its material and intellectual style. And Havelock's original contribution is to suggest that the language appropriate to the Platonic mode of thought could

arise only when the technology of preserved communication changed from oral recitation to written record.

In the days before Homer and for many generations after him, the Greek cultural book - all the accumulated public and private law, traditions, customs and mores - was perpetuated by being stored in personal, living memory. The epic poem, narrated, recited and memorized, was the vehicle of its transmission. The several hundred years intervening between Homer and Plato saw the gradual extension of writing from occasional use by a privileged few in fragmentary memoranda to general use in plays, speeches and other texts of connected discourse read by many. Paralleling this extension of literacy was the development by pre-Socratic philosophers of a new language with a syntax and lexicon suitable for the expression of conceptual thought.

Plato both reflected the impact of these new language habits and heralded their hegemony in fields of the intellect. He was the outstanding, perhaps never surpassed, advocate of the new (written) language of philosophical knowledge, foe of the poetized (oral) statement. How do these "knowledges" differ? Knowledge that must be preserved in the oral state is compelled to be obedient to the psychological requirements of memorization: it must be stated in language that is regularly patterned, that is visually rich and imagic, that personifies impersonal phenomena, a language of action depicting events and doings - a language, in short, that is designed to excite emotion and promote subjective identification with the material so that it will more easily become "part of oneself." The epic poem or other form of oral narrative thus presents knowledge in the form of concrete events, organized in a time sequence; it cannot present knowledge in the form of timeless data, organized in a hierarchical system of relations or categories.

But Havelock is not engaged in a literary critique. His contention is that this style of oral composition represents a particular cast of thought, an "oral state of mind." In this state: thought and language are tied to the concrete; concepts such as wrath, piety, justice exist only in specific instances of behavior. Affective and cognitive attitudes are intertwined making for a knowledge which is both subjective and objective at the same time. Most importantly, (1963), when all phenomena are described as present events or doings you do not have generalizations couched in the language of universals.

These characteristics of oral thought were unnecessary, even impedimental, in the new literate society. When

knowledge no longer had to be shaped to the needs of memorization, retention and recall, the writer became free to abandon the narrative form for a reflective reorganization of the material. The reader could refrain from emotional identification with the content and adopt an analytic, critical attitude towards it. With the written sign present to refresh memory, the concept need no longer be embedded in character or event - it could exist in its "simple purity," uncontaminated by specific instances. Plato, says Havelock, conformed to the literal meaning of the Latin term "abstraction." He tore the "object" out of context and recreated it by an act of intellectual isolation and integration (p. 256).

It is not the justice of Havelock's interpretation of Plato nor his judgements of the poetic statement that concern us here. Rather we are interested in the fact that the three authorities we have cited (and others might have been chosen), in spite of their different starting points¹⁸ and variations in their analyses of the characteristics of primitive thought all appear to have similar views on what primitive thinking lacks. Absent from such thought is the "pure concept, the universally generalizable or deployable term which has been emptied of tangible properties. In certain forms of post-literate thought - call it "modern scientific" (Levi-Strauss), "Platonic abstraction" (Diamond) or the "language of philosophy" (Havelock), new meaning systems are created with just such concepts. Here we believe lies the "heart of the difference" between modes of thought which operate with the oral language only and those which arise in societies in which the written language has been disseminated.

This difference is clearly quite closely related to our first hypothesis in which we suggested that mastery of the written word should make possible the attainment of a new conceptual level. We should like to refine this hypothesis further in the light of our discussion of primitive thought but before we can do so it is important for us to clarify our vocabulary. We intentionally defined the "universally deployable concept" as one "emptied of physical properties" in order to avoid the ambiguities inherent in the usual modifiers "concrete" and "abstract." The meaning of these terms in the passages quoted is unstable and unclear. But in their imprecise usage of these psychological concepts, social scientists only mirror and magnify the confused usage in the psychological literature.

The two principal senses in which "abstract" has been used in these discussions of primitive thought have been to indicate 1) presence and extent of generalization (a generalization-differentiation dimension) and 2) distance

of the meaning term (sign or concept) from the actual properties of things (a sensory-nonsensory dimension). Thus Levi-Strauss argues that primitive thought is abstract because it engages in extensive classification which involves generalization and differentiation. Here he relies on the first meaning. Primitive thought, on the other hand, is concrete because it is entangled with imagery and tied to the sensible world. This is the second meaning. "Concrete" and "abstract" are here not antonymic but obviously ordered on different dimensions of meaning.

As a first step toward trying to clarify the relationship between these terms, let us apply the term "generalization" to one or more processes of thinking¹⁹ that result in the establishment of meaning equivalences among things. Psychological investigations demonstrate that a number of different kinds of processes may be involved in generalization, often, but not necessarily, including the process of abstraction. The Pavlovian generalization phenomenon takes place on the basis of perceptual similarity. Generalization of the grasping reflex in the infant, according to Piaget, occurs on the basis of functional equivalence (the "nutritional" value to the reflex activity that various objects possess). These are examples of nonabstractive generalization in the behavioral realm. In the cognitive realm, psychologists investigating language development and concert formation have shown that young children generalize on the basis of maximal similarity among things or on other points of contact among "whole" items (items whose properties have not been analyzed). These, too, are examples of non-abstractive generalization.

On the verbal level, however, the great majority of generalizations among adults occurs on the basis of abstraction, defined here as the thought process by which one isolates a single aspect of an object from the whole.

An abstracted attribute may be more or less close to material reality. It may be a sensory feature (hue, sound), or a real function ("things to smoke"). But it may also be a nonmaterial attribute which for want of a better name we will refer to here as a "semantic" property - a meaning that an item has by virtue of its subsumption in a certain class within a classification system. Certain attributes are "isolatable" on either a perceptual or a semantic basis (color is a case in point)²⁰ and there is no hard and fast line between them but every investigator has had to take into account the dimension from sensory-to-semantic and struggle for proper terms with which to describe it.

Thus we find several sets of distinctions to be considered. There are nonabstractive and abstractive generaliza-

tions and, within the latter category, we can further distinguish between generalizations based on an isolated sensory and those based on an isolated semantic attribute. Clearly, generalizations that are based on the abstraction of nonmaterial attributes will have the greatest flexibility and broadest reach.

"Generalization" and "abstraction" then, because they vary in kind, are inadequate terms unless further qualified for discriminating between primitive and modern scientific thought.

We confront a similar difficulty with "concept-conceptual." Some psychologists apply the term "concept" as a label for any generalization or meaning equivalence. They insist that all verbal thought is conceptual. According to them, the word, by which we name discrete objects that differ in many respects as the same thing, functions as a concept. While this has some face validity, it is such an all-embracing definition that it becomes difficult to distinguish between levels of word meaning. Others think it necessary to reserve the term "concept" to only those meaning equivalences that are based on abstractions of a nonsensory attribute consistently applied (as by "rule"). The difficulty here is that this "strict" definition frequently leads to the foolish dilemma of our having to characterize the primitive scientist-philosopher as "nonconceptual" because his meaning systems lacked this kind of concept, while we describe tens of thousands of school children in technically developed societies as "conceptual" because they have attained this kind of concept.

What is clearly needed, it appears, is some differentiation of levels of conceptual thought that will permit us to remain loyal to observed differences between modes of thinking without denying to any normal human thought the generic capacities for generalization and abstraction. As we elaborate more refined tools of experimentation and a more analytic theoretical approach, we may in time develop a scheme that will do full justice to both the universals in mental functioning and to its diversity and complexity. At the present time, let us try to integrate what has been said about distinctions between nonliterate and literate thought in a theoretical framework that makes use of a two-way distinction only - a distinction that roughly parallels the observations of the differences between mythic thought bound to the world of things and scientific-philosophic thought created with the "pure concept."²¹ Our hypotheses about the influence of literacy on cognitive processes are found to fit well in this scheme.

The primary distinction we make between the two levels of conceptual thought is that in one the referent

content of the concept is an object or some aspect of an object or material reality, while in the other the referent concept is another concept. The existence of the first level is necessary for the emergence of the second, since the concepts of the first level are the "objects" of the second. First-level concepts are formed through commerce with physical and social reality mediated by oral language. In the formation of this kind of concept, the word directs attention to properties objects have in common and it functions as a name or label for this "commonness." On the second level, the word directs attention to the semantic properties of other words (verbal concepts) or, to put it a little differently, to some attribute or aspect of a concept. These concepts are more likely to be formed through the process of verbal definition than through direct encounter with some aspect of material reality.

On both levels, concepts are organized in hierarchical systems representing different kinds and degrees of generalization. However, on the level of object-concept, generalization may be nonabstractive whereas all generalization of the "word-object" concept is abstractive generalization. On both levels the meaning of the concept is to some extent dependent upon its position within the system of which it is a member, but the word-object concept's meaning may be wholly defined by its position in that system. An illustration of a concept on the first level is a particular number - "five" for example. The number is a concept which stands for a set of objects. "X" in algebra, however, is a concept which stands for a set of numbers. The meaning of "five" can be expressed by pointing; the meaning of "X" only through verbal definition by means of which the term is related to the whole system of which it is a part.

At the earlier stage certain aspects of objects had been abstracted and generalized into ideas of numbers. Algebraic concepts represent abstractions and generalizations of certain aspects of numbers, not objects and thus signify a new departure - a new higher level of thought. (Vygotsky, 1962, pp. 114-115).

The following table presents the comparison schematically, and simplistically.

Within this schema, primitive thought - that is oral thought - is conceptual thought on the first level; modern thought is conceptual thought on both levels, the second made possible by the invention and diffusion of writing.

This schema, however, is essentially a statement about the nature of cognitive growth. The questions that flood to mind are many. What is the evidence for the de-

Theoretical Comparison of Conceptual Levels

Level 1 Object Concept

1. Direct relationship to some object or attribute of an object.

Object of thought is an object.
2. Generalization on the basis of objects or attributes of objects; generalization of things.
3. We are aware of the object of thought, not of our mental activity.
4. Language internalized as inner speech regulates our behavior.

Through language we become conscious of our behavior, we describe it and reflect upon it.

Function: "Analysis of reality with aid of concepts" (Vygotsky)

Level 2 "Word Object" Concept

1. Indirect relationship to object; object is mediated by some other concept.

Object of thought is a verbal concept (word).
2. Generalization of earlier generalizations (concepts) - therefore, generalization of thought.
3. We are aware of the act of thought.
4. Written language that is internalized regulates our thinking.

Through this new system of language, we become conscious of our thought, we can describe it and reflect upon it.

"Analysis of thought with aid of concepts" (Vygotsky)

velopment of "two levels" of thought in children? Does it appear to be a universal stage of cognitive growth or is it dependent on cultural factors? Is there any evidence that literacy is implicated in its development?

Just as in the case of the anthropological literature, we will find the psychological literature merely suggestive. Developmental psychologists have only slowly moved away from major concern with changes which are a "function of age" to interest in the possible influence of cultural factors on cognitive growth. Nevertheless, there have already been some exciting findings which bear on our hypotheses. Let us turn to some of these studies.

Schooling and Thought: Suggestions from Developmental Psychology

Vygotsky (1962), a pioneer in research on concept formation, was led by the outcome of his experiments to differentiate between two kinds of concepts - the "everyday concept" that develops spontaneously in the course of living and the "scientific concept" which is acquired

through verbal definition and is usually transmitted through formal (school) instruction. "Brother" is an example of the first type; "slavery" of the second. The course of development of the two differs: the every day concept becomes crystallized as a result of contact with numerous examples; its referents are known and the concept develops "upward" from these slowly becoming related to other concepts and becoming incorporated in a conceptual system. The scientific concept, on the other hand, starts from the "top down"; its relationship to other concepts and its place in the system are given theoretically but its specific referents or exemplars must be acquired by its application to given instances.

In a comparative study with school children aged 8-10, Vygotsky found that the development of scientific concepts runs ahead of everyday concepts. Children were asked to complete sentences expressing causal relations using simple familiar material from everyday life and material taken from social science courses, viz.: "He fell off his bicycle because . . ." and "Planned economy is possible in the U.S.S.R. because . . ." Nearly 80% of the

8-year-olds could correctly complete the sentence fragments using scientific material whereas only 59% were able to do so with the everyday material. The intriguing fact is that the 8-year-olds who completed the "bicycle" sentence by adding the phrase "Because he broke his leg" were never guilty of such nonsequiturs in their spontaneous conversation. They were able to use "because" correctly in daily speech but unable to do so deliberately, Vygotsky says, because conscious usage requires that one be aware of "because" as a concept - i.e., know its meaning and use and the specific relationship it expresses between terms.

Since scientific concepts are formed in the process of instruction and the child is questioned, corrected and forced to explain them, he becomes conscious of their meanings and interrelationships from the very outset. This helps him to achieve a grasp of terms like "because" which express these relationships. Consciousness and control of the scientific concept lead the child to become conscious of his everyday concepts and these, too, become systematized and their relationships understood. By the age of 10 in Vygotsky's investigation, there was no longer a disparity in expression of causal relationships: "The formal discipline of scientific concepts gradually transforms the structure of the child's spontaneous concepts and helps organize them into a system; this furthers the child's ascent to higher developmental levels" (Vygotsky, 1962, p. 116).

As can be seen, Vygotsky stressed the role of school as a crucial lever for intellectual development. In a series of experiments concluded with his students,²² he attempted to elucidate the relationship between formal instruction in other school subjects such as reading and writing, grammar, and arithmetic and such intellectual functions as the child's awareness of his own operations in problem solving, his concept of number and understanding of figurative meanings and relationships. These investigations compared the "level of maturity of psychic functions" at the beginning of schooling and after a prolonged period of instruction. Vygotsky concluded 1) that the psychological functions studied unfold in a continuous interaction with the contributions of instruction; and 2) instruction usually precedes development. But what is most interesting is that Vygotsky does not hold the customary view that instruction is instrumental because of the information it *transmits*. He wryly notes that the superiority of the child's control of scientific concepts can hardly be due to "knowledge" since fact and familiarity are all on the side of everyday concepts. The significant influences of school instruction seem to be two: imparting to the child already

organized systems of verbal concepts which interact with and move on the development of his spontaneously acquired concepts (as discussed above) and giving the child practice in certain *mental operations*. This latter point can be clarified by citing Vygotsky's own analogy between the formative influence of scientific concepts and that of foreign language learning.²³

The influence of scientific concepts on the mental development of the child is analogous to the effect of learning a foreign language, a process which is conscious and deliberate at the start. In one's native language, the primitive aspects of speech are acquired before the more complex ones. The latter presupposes some awareness of phonetic, grammatical and syntactic forms. With a foreign language, the higher forms develop before spontaneous, fluent speech . . . In his own language, the child conjugates and declines correctly, but without realizing it. He cannot tell the gender, the case, or the tense of the word he is using. In a foreign language, he distinguishes between masculine and feminine gender and is conscious of grammatical forms from the beginning (1962, pp. 109-110).

This comparison is closely akin to our analysis of the differences between the spontaneous use of speech and the use of written language. And, as we know, Vygotsky himself applied the same analysis to writing; he repeatedly stressed its analytic and abstract nature, and its dependence on conscious control of one's own mental operations. Scientific concepts, foreign language, grammar, and "written speech" all represented new functional systems to him - systems which required and helped to establish in the child an abstract, self-conscious and controlled level of thinking. These systems which "drive on" the process of cognitive development are products of "schooling," not life.

Piaget, as is well known, differs from Vygotsky on the role of instruction in cognitive growth denying it any role in effect, but he has presented us with a coherent theory and systematically obtained data on certain qualitative changes in thinking which occur from birth to adolescence. Piaget considers that intelligence progresses through a fixed order of stages, each of which is characterized by thought structures which enable the child to master and perform certain specific kinds of intellectual operations. We are mainly interested in his characterization of the last two stages - that of concrete operations marking the period from 7 to 10 or 11, and formal operations which are fully achieved in late adolescence and constitute "adult thought."²⁴

During the period of concrete operations, the child masters the logic of classes and relationships, but only in

relation to the manipulation of actual things. He groups and classifies according to actual connections among objects or events and he can handle relations of order among things (serialize them) when he is dealing with their perceptible properties. He has difficulty, however, in stating the general rule for a classification or handling relationships that are expressed verbally. An illustration given by Piaget is the following:

Ten-year-old children are asked to order objects in one or more series - let us say, pieces of paper of different sizes and varying shades of gray. Most of them will handle this problem successfully and arrange the paper in series that range from lighter to darker and smaller to larger. But confronted with a classical reasoning test such as Burt's (Edith is fairer than Susan, Edith is darker than Lily, Who is the darkest of the 3?) they are unable to handle the relationships correctly. In sum, the child can *put things* together in a way that shows a logical grasp of their relations but cannot deal logically with verbal expressions of these relations.

By 11-12 the child enters the period of formal operations and becomes capable of handling classifications and relationships in terms of verbal propositions. As Piaget (Inhelder & Piaget, 1958) puts it, the child becomes capable of intellectual operations about reality rather than being confined to working on reality itself.

On the level of propositional thought, when the child is operating with verbal statements about things, many relations among things become possible that have never been encountered in actuality. Propositional thinking, therefore, takes account not only of the real but of the possible and hypothetical. It can develop classification schemes by formulating theoretical possibilities without proceeding from the observation of actual properties. It is not consistent with Piaget's theoretical framework to discuss these differences in terms of concept formation but we cannot fail to be struck by the correspondence between his characterization of "propositional thinking" and Levi-Strauss' definition of modern "scientific thought" which differs from mythic thought in possessing a concept that has been freed from its connection with actual things and is capable of projecting the "merely possible." The changes Piaget describes as involved in the transition from concrete to formal operations are certainly concordant with our hypothesis about the development of "second-order concepts" which are based on other concepts and their semantic properties rather than on objects and their material properties.

Piaget's investigations have also revealed certain other characteristics of propositional thinking which are in line with our speculations and the observations of Vygotsky. At this stage, the child is capable of reflective thinking. He can give a logical account of his own operations - what he did and why it worked - and can think logically about thought. Protocols of young teen-age subjects attempting to solve certain scientific problems²⁵ indicate that attainment of a "solution" involves not only getting "b" to follow "a" but being able to grasp and to state the *necessity* for this sequence.

As Piaget describes the operations which he considers characteristic of formal operational thought - the highest stage of thought - the conviction mounts that many if not all of these would be inconceivable if it were not for the existence of written languages and the child's acquired skill in manipulating the symbols of these languages. This, of course, is far removed from Piaget's own view, but it seems to be a reasonable extension of his principal dictum, "penser, c'est operer." To *think* in abstract propositional terms must be a consequence of having acted upon or manipulated abstract propositions externally. Such actions would seem to be dependent upon the possession of reading and writing skills. It is difficult to imagine that oral speech alone could provide the mechanism for such continuing and extensive symbol manipulation. And, of course, by the age of 11 or 12, the child in Geneva and other industrialized societies has had four or five years of experience in reading, writing and arithmetic.

Unfortunately, there have thus far been few attempts to replicate Piaget's studies and observations on the stage of formal thinking among adolescent populations of other cultures. One follow-up study conducted in England with boys in junior high grades up through training college concluded that ability to solve the experimental problems was not dependent on knowledge of specific subject matter but that the "cultural milieu, climate of opinion or the general experience to which the person is subject is of the greatest importance in developing thinking skills" (Lovell, 1961, p. 152).

In a comparative study of school children in the U.S.A. and Hong Kong (Goodnow & Benton, 1966), it was found that lack of schooling among the Hong Kong children upset their ability to solve a combinatorial reasoning task which Piaget uses to illustrate certain cardinal characteristics of propositional thinking.

The effect of schooling, as distinct from other differences in culture, has been most extensively explored in a

recent series of comparative studies by Bruner, Olver, & Greenfield (1966) and their associates.²⁶ These psychologists tested several hundreds of children in such varied social settings as the suburbs of Massachusetts, Mexico, Alaska, and Africa. In these studies an attempt was made to vary independently three major cultural factors which are usually treated as one conglomerate: national culture, living environment (urban vs. rural setting) and schooling. While there are a number of interesting observations emerging from these comparisons, the most pronounced and most general conclusion reached by the investigators was that, of all the three dimensions explored, *schooling is by far the most influential in affecting cognitive skills.*

The effect of schooling was most dramatically demonstrated in Greenfield's studies conducted among the Wolof people in Senegal, West Africa (Greenfield, 1966; Greenfield, Olver, & Reich, 1966). A number of families in the bush now send their children to school whereas others of similar status have not enrolled their children in the educational system. This aspect of a culture in transition enabled the investigators to construct matched groups of schooled and unschooled children within one village and to compare these to a group of Wolof children living in the metropolitan center of Dakar and attending school there. Here then for the first time in cross-cultural studies in cognition there was an opportunity to evaluate intellectual performance along independent dimensions of village vs. city life, school vs. no school and village school vs. village, no school.

Cognitive processes were assessed on two concept tasks: Piaget's conservation task involving judgments of equality of liquid poured into different sized beakers (Greenfield, 1966) and a concept formation task developed by Hornsby (Olver & Hornsby, 1966; Greenfield, Reich, & Olver, 1966). On the Piagetian problem, school children from the bush performed in a manner that was highly similar to the performance of their school compatriots in Dakar. But what is even more interesting, their performance was almost indistinguishable from that of American and Swiss children of the urban middle classes. Analyzing performance at the various stages from non-conservation to conservation, the investigators found that the bush children were on the average one year older than their American and European counterparts when they achieved the various levels, but in terms of *school grade level*, their progress was identical (Greenfield, 1966). Unschooled Wolof children, on the other hand, showed an entirely different pattern of performance and, in this study, fully one-half failed to achieve conservation even at the highest age tested (11-13). A follow-up study conducted

by the same research team among unschooled Wolof adults showed the same proportion failing to achieve conservation, leading to the suggestion that "without school, intellectual development defined as any qualitative change, ceases shortly after age 9" (Greenfield, 1966, p. 234).

While these findings of "no-conservation" are in conflict with those of another study of African children (Price-Williams, 1961) and need further confirmation before acceptance, the existence and nature of the intellectual differences between Wolof schooled and unschooled children is a finding of great importance.

The author has this to say about this crucial difference (Greenfield, 1966, pp. 234-235): "The parallel findings [between bush schooled, Dakar schooled, American and Swiss children] cast strong doubts on any simple maturational notion of development. Rural Wolof children exposed to a certain set of cultural influences, namely the school, differ more from other rural Wolof children raised without school than they do from European children."

The qualitative nature of the difference between schooled and unschooled as described by the investigators is of special interest because it accords quite closely with our hypothesized difference between literate and nonliterate thought. Take this one illustration: The unschooled children did not understand the standard experimental question, "Why do you *think* this glass had (more) or (equal) water?" Greenfield was forced to change the question to, "Why *does* this glass have (more) or (equal) water?"

It would seem that the unschooled Wolof children . . . do not distinguish between their own thought or a statement about something and the thing itself. *Thought and the object of thought seems to be one . . .* Consequently, the idea of explaining a statement is meaningless; it is the external event that is to be explained (Greenfield, 1966, p. 232). (Emphasis supplied)

The fact that playmates who went to school had no difficulty with this question lends weight to the point of view that it is not membership in a technologically complex society *per se* but specific educational experiences which make possible the development of reflective thought.

Tests involving a concept formation task (conceived along the more traditional line of requiring statements of likenesses among items) yield further support for the suggested link between school and the development of reflective thought (Greenfield, Reich, & Olver, 1966).

Wolof children showed the same developmental pattern as all other national groups studied in respect to, what the authors call, the "structure" of concepts: as age increased, items were more frequently grouped together by the use of some superordinate rule which governed whether they were considered "alike" or "different." This age-related change cut across the rural-urban and school-no school divisions. But, only the school children showed a growth in the ability to state the rule that was governing their groupings. To state the rule you are using requires that you be aware, not only of the task, but of your own approach to the task - a kind or level of thinking apparently absent among the unschooled children in this study and present among their student friends.

Finally, Olver and Hornsby (1966), Maccoby and Modiano (1966), and Greenfield, Reich, and Olver (1966) report a similar developmental pattern among American, Eskimo, Mexican and Senegalese school children in the attributes of objects selected as the basis for an equivalence grouping. Between the ages of 8-13, children in all of these countries shift from reliance on perceptual attributes to wider use of functional and nominal attributes²⁷ as grouping criteria - a shift which has been traditionally considered a shift from "concreteness" to "abstraction." Rural Wolof school children also make this shift although they do not attain the same proportion of functional and nominal responses as their "city cousins" (Greenfield, Reich, & Olver, 1966). Unschooled rural Wolof children, however, depart from the observed pattern: they continue to rely almost wholly on perceptual attributes such as color or other distinctive properties making for observable physical similarity among things. With these data in hand, it is not surprising to find Greenfield, Reich, & Olver, (1966, p. 315) concluding that "schooling appears to be the single most powerful factor we have found in the stimulation of abstraction."

Like Vygotsky, Greenfield, Reich, and Olver attempt to push further into "the school experience" to identify the specific factors at work and like him, but in accord with Bruner's theory of the importance of systems of cognitive representation, Greenfield, Reich, and Olver speculate about the crucial role of language:

Where there is difference [between schooled and unschooled] is in how language is used and what opportunities are provided for different uses. Here again school is important. For it is the school children who have the greater opportunity to practice language in contexts that do not carry the meaning for them automatically, who are forced thereby to use sentences to the full. They are the ones who, moreover, are led by the nature of school lessons to

translate their experiences and actions into words and sentences that will satisfy a teacher and thereby learn to reorganize experience and action to conform to the requirements of language (Greenfield, Reich, & Olver, 1966, pp. 316-317).

And, finally, Greenfield, Reich, and Olver point explicitly to the use in school of the written form of language which heightens linguistic competence and thus symbolic functions in general.

The contemporary developmental studies we have reviewed, then, are beginning to lay an empirical base for studies of the interactional effects of specific cultural institutions and specific cognitive processes. In this "unravelling" of the cultural web, the school appears to be emerging as a crucial factor in cognitive growth. While the written language is an indispensable and inseparable feature of the school experience, the converse does not hold. The opportunity still remains to investigate the impact of written language acquisition divorced from the school context - a step which the pioneer studies of Vygotsky, Piaget and Greenfield suggest may further *unravel* the complexities between culture and mind.

Notes

¹Vygotsky is a notable exception and the views presented here are greatly indebted to his work.

²For the purpose of this discussion, we will accept Gelb's (1952, p. 12) definition of writing as "Human intercommunication by means of conventional visible signs."

³There are special signs such as . . . for an omission, modifications in spelling to distinguish between two words not differentiated in speech, such as "sea . . . see" and identifying labels or symbols used extensively in commercial and cartoon literature.

⁴"Written language" here and throughout most of this paper will refer mainly to the alphabetic system, although with modifications many of the same observations could apply to other systems.

⁵In this presentation I have eliminated a number of characteristics given by Bernstein and simplified his wording to some extent.

⁶Nonliterate is not to be taken as illiterate. The distinction is between levels of mastery and utilization of reading and writing skills. As I am using the terms here, "illiteracy" denotes the complete absence of skill; the existence of some skills with only minimal utilization is here termed "nonliteracy." "Full literacy" defines a stage where the written language has been internalized. In between there are many levels of varying proficiency. When

we hypothesize that literacy will have certain cognitive consequences, we are of course referring not to the minimal but the higher levels of literacy and to actual use of literacy skills.

⁷Magic offers the most dramatic examples of language used instrumentally to impose subjective wishes on reality.

⁸See discussion below of Levi-Strauss' views on the science of pre-literate peoples.

⁹The term "abstract" has a multiplicity of meanings which reduces its usefulness in discussions of cognitive processes. We discuss these varied usages below but here we are letting the word stand as a convenient label for a number of written language features having to do with the "greater distance" of the written than the oral word from the social and physical context.

¹⁰McLuhan (1962), a severe critic of the phonetic alphabet, speaks of it as a system which "abstracts meaning from sound" and then "translates sound into a visual code"—an interesting analysis which leaves us with both visual and auditory signs bereft of meaning. It would seem that both our oral and written languages are incomprehensible.

¹¹deGroot's (1966) analysis of the superiority of chess masters in solving chess problems has led him to the interesting conclusion that their skills have transformed what was initially an inferential analysis of the open moves on the chess board into direct perception of the possibilities. In other words, he conceives of a progression at a certain high level of skill from "conceptual" to "perceptual" information processing. This observation seems pertinent to the reading situation as well.

¹²We will let the special cases of advertising and other exhortatory material stand as major exceptions, and the use of bold-faced and italicized type in various kinds of texts stand as a minor exception.

¹³Gibson, Pick, et al. (1962, p. 554) define the learning-to-read task as that of discovering the higher-order invariants that are the appropriate units of analysis. They call these spelling-to-sound correlations "grapheme-phoneme correspondences."

¹⁴These hypotheses may be stated either in "weak" or "strong" form. The weak form would be that literacy is a facilitative mechanism; the strong form that it is a causal mechanism in the effects postulated. Although the distinction is clearly crucial for research purposes, we do not feel that it is necessary to develop it for the purpose of this speculative analysis.

¹⁵As we have noted, writing is a prerequisite for the development of many of the conceptual systems which furnish the building blocks of modern science.

¹⁶Any approach which starts off to "demonstrate a link" between literacy and cognition is likely to oversimplify and over exagger-

ate the "uniqueness" and "significance" of the skills involved in literacy. In the modern as well as ancient world, the spread of literacy is always accompanied by other significant social changes, and it is difficult to single it out from the entire complex of conditions as being *the* factor responsible for change. With this caution in mind, however, it would still seem necessary to balance the risk of oversimplifying the effects of a single social phenomenon taken in isolation with the risk of continued avoidance by psychology of the significant dimensions of social life.

¹⁷These illustrations given by Levi-Strauss show remarkably similar principles of grouping to those described by Vygotsky (1962) as characteristic of "complex thinking." In complex thinking, as distinct from concept thinking, items are grouped together on the basis of contiguity, resemblance, or being found together in nature.

¹⁸One was seeking the invariant characteristics of human mind, another the factors responsible for the demise of the primitive community, and the third a meaningful explanation for Plato's attack on poetry.

¹⁹"Generalization" is also commonly applied to the *outcome* of acts of thought but that is not our usage.

²⁰Several "blue" items may be classed together because they look alike but even if they have such different values of hue as not to appear similar they may still be grouped together as representatives of a theoretical color category "blue." The actual basis for grouping would have to be tested by observation of the grouping performance. As is clear by now, the same word - "blue" - may represent different kinds of generalizations.

²¹It will be seen that our characterization of these two conceptual levels draws heavily on Vygotsky's analysis of the differences in stages of generalization. We have drawn freely from his presentations and those of his colleagues and successors (see especially Davydov, 1967) but we have modified, reformulated and added to them in line with our own views of the role of literacy in the attainment of a new conceptual level. Our starting point is the changed relationship between word and thought as a result of mastery of writing, a point of view never expressed as far as we know by Vygotsky.

²²Unfortunately, Vygotsky does not describe these studies in detail, and his bibliographic reference is to unpublished student theses.

²³Vygotsky was obviously referring to the traditional form of language instruction which stressed mastery of grammar and the written language rather than conversational use.

²⁴Piaget uses ages as approximate only, acknowledging that they will differ from culture to culture within an invariant sequence of stages.

²⁵Inhelder, B. and Piaget, J., 1958.

²⁶All of these studies were published in a single book edited by Bruner, Olver, & Greenfield (1966).

²⁷Bruner uses this term to refer to the use of a superordinate class term to group items, such as "fruit," "clothing" and the like.

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Mind in Action: A Functional Approach to Thinking

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I welcome this chance to talk to you. What I have decided to do is spend the time, not summing up past work, but introducing a new line of research that I undertook several years ago and that I think has important implications for adult learning and development.

I will introduce this research by asking you to imagine the following scene. My colleague and I are standing between stacks of milk cases in the refrigerated warehouse of a dairy. (My colleague's name, by the way, is Edward Fahrmeier and he is an important contributor to the research I will be telling you about.) Ed is armed with a sketch pad and pencil which he manipulates somewhat clumsily because he is wearing mittens. I am clutching a microphone and a tape recorder, having trouble holding on to them because I was not clever enough to wear mittens. We are watching a man called a preloader assemble just the right number of cartons of milk to fill a driver's order, and we are diagramming on paper and describing into the tape recorder exactly how he does this. Every now and then, when our hands and voices shake with cold, we run outside to sit on the factory steps. The 38 degree warehouse temperature collides with the 98 degree temperature of an August evening in Baltimore. Thawed, we return for more data collection.

In spite of the hazards of naturalistic observation portrayed in this episode, observation is an important component of the research project my title refers to—studying mind in action. What I am trying to do is analyze the characteristics of memory and thought, not as they appear in isolated mental tasks, but as they function in the larger, purposive life activities in which we engage. This approach contrasts with the dominant view in cognitive science today. The prevailing perspective views mind as a system of symbolic representations and operations that can be understood in and of itself, in isolation from other

systems of activity. Accordingly, most researchers studying mental operations proceed by giving people isolated mental tasks to accomplish. If we study memory, we ask people to remember some information of event; if we study problem-solving, we ask people to talk aloud while solving problems. In these tasks, remembering and problem-solving are goals in themselves. When research is well developed, it is sometimes possible to specify the component operations in a task with sufficient precision to program them on a computer—a computer which sits in a room having no transactions with the external environment, a computer that is, so to speak, lost in thought.

This approach to cognition has many important achievements. Without minimizing them, it is fair to say that the metaphor "mind as computer" fails to capture significant aspects of human mental functioning. Memory and thinking in daily life are not separate from, but are part of, doing. We understand cognitive tasks, not merely as ends in themselves but as means for achieving larger objectives and goals; and we carry out these tasks in constant interaction with social and material resources and constraints. Unlike computers that *only* sit and think, people think while playing, working, creating art and talking with one another. How does thought embedded in these on-going activities compare with thought processes on isolated mental tasks? In recent years, as a result of the penetrating critiques of Cole, Bronfenbrenner, Neisser and others, we can no longer take for granted the optimistic assumption that laboratory-type tasks capture the critical characteristics of mental processes embedded in life activities. To discover the functional properties of thought in action requires that we take a look at the actual phenomena under natural conditions.

That is what my enterprise is about. I am attempting to place the study of naturally-occurring activities at the center of cognitive inquiry. As my opening anecdote illustrates, I am grounding this enterprise in the study of activities which are of exceptional importance to youth and adults in our society—activities which we call work. In the workplace, tasks must be accomplished which require selection and retention of information, accumulation of knowledge, mastery of new symbol systems and on-line problem-solving - all in the service of getting other things done. How do adults cope with these demands? How, without formal instruction, do new workers acquire the intellectual skills these pursuits entail? And most importantly, how do cognitive skills in the workplace compare with those nurtured and demanded in academic settings? I went to the milk-processing plant in Baltimore to begin an exploration of these questions.

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This is a preview of my research and my thesis. Before I take you back to the Dairy to tell you what we did and learned, I want to provide a brief account of how I came to this venture, the developmental questions it addresses and the theoretical framework which guides it.

My interest in studying intellectual aspects of practical activities grows out of earlier attempts to understand the formative role of culture in cognitive development. In spite of the ambiguities that plague the field, cross-cultural research has revealed that the human intellect is not only universal in its *capacities* but diverse in its ways of *functioning*. After years of probing, psychologists and anthropologists have discerned some patterns in this diversity - patterns that reflect the impact of particular social institutions and practices. Most prominent in this line of work is the well-demonstrated association between Western-style schooling and features of performance on cognitive tasks.

While the interpretation of school-related cognitive skills is controversial, their very existence is a challenge to our theories. Even if we view such skills as specific rather than general in nature (and this view has been convincingly argued) we still confront a remarkable fact: an historically evolved and culturally rooted institution - school - fosters intellectual achievements that developmentalists, until recently, attributed solely to age.

Nor is school unique in its formative effects. New studies in Africa, the South Pacific, Pakistan have been documenting, sometimes with fine precision, the cognitive impact of other educative institutions - such as apprentice training and tutorial instruction in crafts and trades. This research has focused on the specialized knowledge and specific abilities that individuals acquire through participation in indigenous pursuits.

My own research among the Vai with Michale Cole has shown that literacy, too, has cognitive consequences of a specialized kind. The Vai people practice literacy in three scripts - two handed down without schooling and English acquired in government schools. We went to Vailand hoping to prove that literacy, with or without schooling, promoted higher mental abilities that humanists have long supposed it to do. Our expectations were dashed. Nonschooled literacies among the Vai were not like schooled literacy. We found no *general* effects of literacy as such and no higher skills common to all three literacies.

But we did find particular effects of particular literacies - memory skills associated with one, communication

skills with another. In each case the specific skills linked to a given script closely paralleled the uses of that script in Vai society.

This outcome suggested to us the need to rethink the nature of literacy. Instead of conceiving of literacy as involvement with written language that is the same everywhere and involves some fixed inventory of capacities, we began to think of literacy as a term applying to a varied and open set of activities with written language. These activities might range from simple letter-writing to the composition of historical chronicles. In this view the cognitive skills that literacy fosters will also vary - with the kind of activities with writing that particular cultures develop and individuals within a culture are motivated to undertake.

At the conclusion of the Vai research, I put forward a conceptual framework to integrate these cross-cultural studies and guide future research on culture-based skill systems. I call this a practice framework of cognition. You may recognize it as bearing some resemblance to activity theory in Soviet psychology. My version is not a formal theory but a set of coherent constructs which may be helpful in re-thinking the relationship between mental skills and culturally-organized activities.

Let me give you some unelaborated definitions and allow later descriptions to flesh out their meaning. By a practice, I refer to a socially-constructed activity organized around some common objects. A practice involves bounded knowledge domains and determinate technologies, including symbol systems. A practice is comprised of recurrent and interrelated goal-directed actions. Participants in a practice master its knowledge and technology and acquire the mental and manual skills needed to apply them to the accomplishment of actions' goals. Navigation is a practice; so is letter-writing; and I will shortly point to others.

This practice framework implies a methodological principle. If skill systems are activity or practice-dependent, one way to determine their characteristics and course of acquisition is to study them as they function in these practices. To put it somewhat differently, the practices themselves need to become the objects of study. Observational methods are necessary to determine what tasks are involved in certain practices and to describe their characteristics. Experimental methods are needed to refine these descriptions and analyze the component knowledge and cognitive skills involved in task accomplishment. In a rudimentary way, we attempted to carry out this progression from observation to experiment in the Vai research

but were hampered by conditions of work in an unfamiliar culture. I came home, convinced I needed to be a native to undertake a research program that could test this methodology and elaborate the conceptual framework.

What practices should be selected for initial studies?

I chose work for reasons of significance and strategy. Significance is apparent. Just as play represents the dominant activity of preschoolers, and school a dominant activity for children and youth, work is a principle activity for adults. Work occupies the bulk of our time. We tend to identify ourselves through our work: you are a psychologist, she is a surgeon. Work offers us many occasions for acquiring knowledge and developing expertise. While we are certainly not wholly defined through our participation in society's labor, it is unlikely we can fully understand the life cycle of development without examining what adults do when they work.

Considerations of research strategy pointed in the same direction and led me to concentrate my first effort in a single industrial plant. In developing methods for studying thought in activity, we benefit from an environment that imposes tight constraints on performance. A factory is such an environment. Its production system shapes occupational activities in both their social and technical aspects. Goals are predetermined and explicit. In choosing to study factory work we can bypass the need to proceed from fully explicit definitions of "practice" and "goal-directed actions." We can take advantage of natural categories available in the industrial environment, allowing *occupations* to represent *practices* and *work tasks* to represent *goal-directed* actions.

Finally, in many factory occupations, work is embedded in larger manual activities which have observable behavioral outcomes. Thought is related to action in ways that facilitate psychological reconstruction of the knowledge and operations brought to bear in accomplishment of a task. If we can achieve some rigorous analysis of tasks involving external operations, we might then go on to consider how such analyses might function as models for understanding cognitive tasks whose operations are primarily internal.

And so, through this detour, we arrive at the Dairy in Baltimore. We spent six months becoming acquainted with its operations, and, quite unfairly, you have to rely on a short segment of a videotape to give you a bit of background knowledge. I will be illustrating our research with a detailed case history of one job - and even a brief glimpse of what a milk-processing plant looks like will

help you follow the description. The concrete details will tell you more about the intellectual intricacies of work tasks than sentences of glittering generalities.

(Tape)

Here is our research design in a nutshell. We selected three occupations and four work tasks for cognitive analysis. Two tasks involved physical objects - product assembly carried out by preloaders, and counting stock, an inventory job. Two tasks involved symbolic manipulations - pricing delivery tickets and forecasting the next day's orders both the work of wholesale delivery drivers. In each instance, we began with observations of the job as it occurred under normal working conditions. We then constructed a model and simulated the task in experimental sessions. To explore the effects of job experience, we gave all job simulations to individuals from all occupations. Each occupation served as expert on its own task and novice on the others. We also included two distant novice groups - office workers in the Dairy and 9th grade students in a nearby junior high school.

I have selected product assembly for discussion. This job, considered one of the most unskilled in the Dairy, is carried out in the refrigerated warehouse which was the opening scene of my talk. Preloaders arrive at 6:00 P.M. to find awaiting them a sheaf of delivery orders called load-out order forms. Each form lists the products and their amounts that a wholesale driver has ordered for his next day's delivery. The preloader reads the form, locates the products and transports them to a common assembly area near a moving track which carries them past a checkpoint out to the loading platform. Speed counts - the preloader's shift lasts until all load out order forms are processed and all trucks filled. Accuracy counts - the checker sends incorrect orders back to the preloader for re-assembly.

An interesting feature of this job involves the symbol system used on the load-out order form to express quantities. Drivers place their orders for products in terms of the number of *units* needed - how many *half-pints* of chocolate milk they need or *quarts* of skim milk. Fluid products are not handled by unit within the plant, however, but by case. Since cases are standard size, the number of units they hold varies with the type of container - one case holds 4 gallons, 9 half-gallons, 16 quarts and so on.

When load-out order forms are produced, the computer cases out the drivers' orders by converting units into case equivalencies. If the required number of units does

not amount to an even number of cases, the left-over amount is expressed in units. Rules of conversion result in some mixed orders being expressed as cases *plus* units, for example 1 + 6, and other orders as cases *minus* units, for example 2 - 7.

Thus preloaders confront mixed numbers on the load-out order form, numbers drawn from different base systems depending on the container size they qualify. How do they handle these? Do they always fill them as written - that is, do they always add units to an empty case when the order calls for a case plus units - as in 1 + 6 - or remove units from a full case when the order calls for that as in 1 - 6? Informal observations suggested that preloaders had worked out interpretative procedures for the number representations and often departed from literal instruction.

We planned a night of organized observation to obtain more systematic information, and two of us took up posts at a spot near milk products which had the greatest number of mixed case and unit orders. I have already described our procedures. Our diagrams and transcriptions permitted us to reconstruct for each order the exact array the preloader found on arrival, the moves he made, and the final state of the array. With these classes of evidence on hand, we analyzed the product assembly task as an example of problem-solving within the tradition of laboratory-based research.

The first thing we learned from our systematic observations is that the preloaders had a large repertoire of solution strategies for what looked like the "same problem." One order — 1 - 6 quarts — occurred six times while we were in the icebox. Remember there are 16 quarts in a case so that 10 were needed. On two occasions, this order received literal solutions: the preloader removed six quarts from a full case. But on four occasions, the order was rewritten behaviorally. All of these transformations took advantage of partially full cases to reduce the number of units that had to be moved to satisfy the order. In some of the *take-away* (1 - 6) problem was changed to an *add-to* problem: 2 units were added to 8 in one instance and 4 units to 6 in another.

Nonliteral solutions such as these require that the assembler transform the original information into some representation that can be mapped onto quantitative properties of different arrays. We may infer that such solutions involve mental processing, or broadly speaking, mental work, over and beyond retention in short-term memory of the quantity given on the load-out order sheet (which literal solutions also require). When does a preloader elect

to engage in such additional mental work? Are nonliteral solutions haphazard or rule-governed? We postulated a "law of mental effort": "In product assembly, mental work will be expended to save physical work." We tested this possibility against our observational records. These records provided us with a precise metric for scaling physical effort - the number of units an assembler moved in completing an order. By comparing various modes of solution in terms of the number of moves they required, we could determine which strategy represented a "least-physical-effort solution" under a given set of circumstances. We refer to these as optimal solutions.

Applying this definition to our observational records, we found that preloaders used literal strategies 30 times and 25 of these were least-physical effort strategies. Nonliteral strategies were adopted 23 times; on every occasion such strategies represented a least-physical effort solution. The evidence overwhelmingly favored the postulated relationships between mental and manual effort on this task.

At this point we moved to task simulation in our lab at the Dairy to further the analysis. We prepared facimiles of load-out order sheets, restricting orders to quantities of less than a case. The informant, after reading the order, proceeded to an assembly area where we had set up an array consisting of a full case, an empty case and a partial case. The number of units in the partial case varied from trial to trial to fulfill parameters of the problem list.

Over two administrations and some 100 problems, preloaders distinguished themselves from all other groups. They selected optimal nonliteral strategies over 70% of the time - even under the artificial circumstances of our task. Rankings of other groups also highlight the role of experience. Inventory men and drivers who occasionally did product assembly were not far behind preloaders. Office workers with no experience in the task but familiarity with the Dairy used optimal, nonliteral solutions in less than half the instances in which they were strategies of choice. As for students, complete novices, they were with few exceptions single algorithm problem-solvers. Instead of adapting solution strategies to the least-effort principle, they carried out literal instructions on almost all the problems.

Even when novices selected an optimal strategy, they carried it out quite differently from preloaders. Audio and video records indicate they relied heavily on numerical solutions and counting operations, especially on early trials. Here is an example from an office worker's protocol. The order is 1 - 6 quarts (one case of 16 less six). She begins to fill the order and says:

It was one case minus six, so there's two, four, six, eight, ten, sixteen (determines how many in a case; points finger as she counts). So there should be ten in here. Two, four, six, ten (counts units as she moves them from full to empty). One case minus six would be ten.

In contrast, preloaders often appeared to shortcut the arithmetic and work directly from the visual display. A preloader is discussing how he filled an order for 1 case - 8 quarts: (order of eight):

I walked over and I visualized. I knew the case I was looking at had ten out of it, and I only wanted eight so I just added two to it . . . I don't never count when I'm making the order, I do it visual, a visual thing you know.

We have still additional evidence that different processes of comparison and solution characterize expert and novice assemblers. A particularly crucial phase of the assembly is the premovement period - the interval between a person's arrival at the array and execution of the first movement. All office workers on some occasion counted outloud during this phase, preloaders never did. We also measured the duration of the premovement period for all 90 problems which had optimal solutions. Decision time averaged 1.4 seconds per problem for preloaders, 3.2 seconds for office workers. This time differential supports the interpretation that preloaders were using perceptual information from the array to determine quantity while clerks used slower, enumerative techniques.

How does a product assembler become a skilled optimizer? No formal instruction is involved, although tips are undoubtedly passed on from old hands to newcomers. In studies now underway in our CUNY Graduate School laboratories, we find that most high school students switch from literal to optimizing strategies on their own as they gain experience with the task; they learn through doing. These studies are also providing a nice confirmation of our hypothesis that optimizing in its initial stages involves expenditure of mental effort to save physical effort. We systematically varied the solution complexity of problems and found that those requiring fewer mental steps were among the first to be solved optimally. More intellectually demanding problems received literal solutions longer, and with some student apprentices, never became fully optimized.

I do not have time to describe problem-solving skills on all the other jobs we studied. But I will tell you a bit about our analysis of the delivery ticket pricing task to demonstrate that, in spite of marked surface differences across tasks, we are discovering some common, perhaps

very general, characteristics of problem-solving on the job.

Pricing delivery tickets is all symbolic work. Wholesale drivers are responsible for determining the cost of their daily deliveries to customers. For this purpose, they use standard delivery tickets, preprinted with the customer's name and the products usually purchased. When a driver completes a delivery, he enters the amount of each product on the ticket, expressing this amount in units - 70 quarts of skim, 200 half-pints of chocolate. He then calculates the price for each line item and totals the dollar value of the entire delivery. Accuracy counts. Each driver is responsible for the exact value of products he takes out of the Dairy. Speed counts, too, for the driver's day begins at 3:00 A.M. and does not end until 1:00 or 2:00 in the afternoon. To help the driver price out, the company provides a mimeographed wholesale price list for all major products. All prices are expressed in units on this list because the price structure consists wholly of unit prices. Since the size of each product order is recorded on the delivery ticket in units, and prices are in units, the computation task seems straightforward: take the unit price from the price list or memory, multiply it by the number of units delivered and enter the result in the appropriate column.

Informal observations revealed that drivers, no less than preloaders, frequently departed from this literal format. Mr. B., a driver I rode out with, provided one of the first instances of an alternate pricing strategy. He read the item "32 quarts lowfat" on his delivery ticket, found a price on a crib sheet in his pocket, doubled it and entered the answer. He had read "32 quarts" as "2 cases" and used a case price in his solution.

The milk case played an instrumental role in the product assembly task, both in its physical aspects as a container, and in its symbolic aspects - as a variable that could take certain number values. Pricing out is an activity occurring wholly in the symbolic mode. As a material object the case is without significance for this activity. Yet it appears here, too, as a variable in arithmetic operations. Unremarkable as this may first appear, one can think of the case price as a prototype of human sign, creating activities that play such an important role in theories of higher mental functions. An object which first possesses instrumental value in physical activity begins to serve a sign function and become incorporated in mental operations.

Through a series of simulations, proceeding in the manner described for product assembly, we learned that the use of case price techniques marked the performance

of all experienced drivers. When unit quantities were evenly divisible into cases, they used case prices alone. On other occasions, they factored unit quantities into cases and units, and used both prices in various combinations. The versatility of some drivers was impressive. One man, about to retire after 37 years of service, was a mental math virtuoso: he used 25 different case and unit calculation strategies to solve pricing problems that had the identical units-times-unit-price format.

A problem by problem analysis of solution strategies showed that the case price technique functioned as an effort saver in a manner analogous to the nonliteral optimal solutions in the product assembly task - with an important difference. The effort saved here was *mental*, not physical. Use of case price either eliminated computation altogether or simplified it. This effort-saving interpretation is supported by our studies which mapped case price knowledge of individual drivers against their solution strategies. Drivers only used case prices when they knew them or had them readily available on personal crib sheets; no driver computed a case price on the way to a solution.

Our final observation is that drivers were not locked into a case price strategy any more than they were to a unit price strategy. In one experiment we prepared delivery tickets on which some problems could be simplified by use of *unit* prices - 101 quarts for example which can be easily be solved as 100 plus one. Other problems lent themselves to *case price* solutions. Drivers were flexible problem-solvers, using the arithmetically simpler strategy in accordance with the problem's numerical properties. Students were inflexible problem-solvers. Most clung to a literal unit price strategy throughout. When some adopted a case price strategy, they used it for all problems, covering scratch sheets with long division to find a fraction of a case. White collar and warehouse workers fell between the two groups.

Some Concluding Remarks

Let me now try to establish ties with the broader questions that motivated these studies of practical thinking at work.

One motivation was a test of method. We wanted to determine if we could bring some rigor to the study of naturally-occurring activities. Our entry into the real world was guided by a practice approach to cognition which helped us carve out units of behavior which we could subject to cognitive analysis. These units were work tasks

within occupations. Using a research strategy that moved from observation to experiment, we succeeded in achieving a fine-grained specification of the knowledge and skill components of several tasks. My students and I - King Beach, Joy Stevens, and others - are now trying to extend the framework to new settings, different occupations and different kinds of cognitive skills, such as memory and spatial reasoning.

We cannot yet offer an assessment of how far we may travel with the approach we have taken but we have gained some confidence in the analyzability of intellectual components of work. As we proceed, certain old dichotomies that have impeded the adoption of an action-oriented approach to thought become increasingly irrelevant. Observation is not opposed to experiment, but may be the forerunner of it. Description is not opposed to explanation but may function as a first approximation to it.

A second purpose of this research was to examine the formative role of practical activities. We began with a theoretical orientation holding that cognitive skills take shape in the course of participation in socially organized practices. We elected to examine practices that involve neither esoteric bodies of knowledge nor high technologies. Yet the experience-based nature of skilled problem-solving was evident in all the tasks we analyzed. In every group comparison, the occupation with one-the-job experience provided the greatest number of experts. The job-related nature of cognitive skills was most readily discernible in contrasts between Dairy workers as a group and students as a group. The claim we make goes beyond the commonsense observation that "practice makes perfect." We have not been concerned, nor have we offered facts here, about *accuracy* or *speed* of performance. The changes we have documented are *qualitative*, not *quantitative*. Our analyses demonstrated that modes of solution change with experience. Practice makes for difference - the problem-solving process is restructured by the knowledge and strategy repertoire available to the expert in comparison to the novice. Other studies have shown such qualitative changes in pursuits such as physics and music. Our research suggests that a pattern of development from novice to expert performance may not be restricted to such demanding activities but may represent the course of adult skill acquisition in the mundane pursuits we commonly think of as "unskilled." The human implications of an approach to work which recognizes it as formative - as educative in the broadest sense of that term - are both exhilarating and sobering - exhilarating in terms of future possibilities and sobering in terms of many present-day realities.

A third purpose of this research was to increase our knowledge about the nature of this phenomenon that I call thinking-in-action, or practical thinking. Although we have examined only a half-dozen tasks, they share common features which offer interesting suggestions for a general theory of practical thinking at work.

One feature of skilled problem-solving is the dependency of problem-solving strategies on knowledge about the workplace. The industrial world as we found it was not only made up of things but of symbols that were in significant respects peculiar to that setting. Mastery of both knowledge and symbol systems was a precondition for skilled problem-solving. A preloader could only depart from a literal solution to an order when he understood the symbol "1 - 6" and knew its numeric value. A driver could only regroup 33 quarts into 32 and one for pricing purposes when he saw the cases in the numbers. Skill in the Dairy was not content-free.

Variability was an outstanding feature of skilled performance on all tasks. On first inspection, product assembly and pricing out appear as prototypical examples of repetitive industrial work. They both present the worker with recurring problems of the same kind, often of an identical kind. Yet workers brought a diversity of problem-solving operations to these same-problem formats. This problem-to-problem variability was not foreshadowed in laboratory research nor accounted for in formal models of problem-solving. Variability is often treated as a perturbation in an otherwise orderly system.

Bartlett's classic studies of thinking are an exception. He considered problem-solving to have the same characteristics of skilled performance in other modalities, and he held that a defining attribute of skill is variability. Moreover, skilled variability is rule-governed. He said:

... all forms of skill expertly carried out possess an outstanding characteristic of rapid adaptation ... so what is called the same operation is now done in one way and now in another, but each way is, as we say, "fitted to the occasion."

This is a fitting description of the kind of thinking we have seen in action at the dairy and other work sites. Following Bartlett, we might consider these regularities as forms of adaption and put to future studies the following proposition: skilled practical thinking at work is goal-directed and varies adaptively with the changing properties of problems and changing conditions in the task environment.

Must we leave the concept of adaptive thinking on an analogical level? Our research raises a line of speculation that may be worth pursuing: practical thinking at work becomes adaptive when it serves the interests of economy of effort. Product assembly provided a vivid example of thinking saving manual effort; pricing out a parallel demonstration of thinking saving mental effort. Labor psychology laboratories in Paris and Dresden report that working people in those countries, too, evaluate their actions on the basis of an effectiveness criterion - a ratio of effort to result. This search for the economical, optimal solution appears to regulate many mental and manual activities in the workplace, spawning variation. Optimizing thinking stands in sharp contrast to the kind of thinking exemplified in the use of a single algorithm to solve all problems of a given type. Algorithms describe how *computers* solve problems. Variability and flexibility describe how *skilled* workers solve problems. Here we have a basic structural difference between formal, academic thinking and practical thinking at work.

These observations allow us to generate a speculative but intriguing model of the course of development of work-related skill systems. In contrast to the conventional psychological model of learning which assumes a progression from the particular and concrete to the general and abstract, skill acquisition at work seems to move in the direction of mastery of the concrete. The novice enters the workplace with a stock of knowledge, some school-based and some experience-based. Learning at work consists of adapting this prior knowledge to the accomplishment of the tasks at hand. Such adaptation proceeds by the assimilation of *specific* knowledge about the *objects* and *symbols* the setting affords, and the *actions* the work tasks require. Domain-specific knowledge reveals relationships that can be used to shortcut those stipulated in all-purpose algorithms. With domain-specific knowledge, expert workers have greater opportunity to free themselves from rules, and to invent flexible strategies. Skill in this model implies not only knowledge and know-how but creativity—an attribute of the work group as a social entity if not of each individual within it.

Work activities have certain peculiarities and cannot be considered representative of all practical thinking in action. Cognitive studies of work are only beginning, our models are tentative and our findings preliminary. But I hope that they suggest the theoretical and practical importance of studying the role of work in the developmental process. I hope, too, they convey a conception of mind

which is not hostage to the traditional cleavage between the mind and the hand, the mental and the manual.

At the end of one interview, a seasoned delivery driver described to me the public's image of a milk man. He said, "Most people believe you only need a strong back to be a milk man. But, come to think of it, there is a lot of brain work involved." I think he is right.

Scribner on the History of Work

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The idea that Sylvia Scribner is gone is hard for me to comprehend fully. Having known her, aside from a brief correspondence, solely through her writing, she certainly seemed alive to me as I read her 1968 manuscript on literacy and her 1983 lecture on work. I have returned to her writing about once a year for some time now, and each time I have been challenged to think more clearly about cognition and its place in society. Though her texts evince an unusual depth of learning, what is most striking to me is precisely that these depths remain latent: not diagrammed at tedious length but simply left waiting for the student who would commit to sustained critical dialogue with them.

So I hope it is fitting that I offer to her memory an account of my own recent engagement with Scribner's texts, specifically the 1983 lecture on work. This lecture reports an exploration of learning and memory as they manifest themselves out of laboratories and in "purposive life activities."

At issue, in part, is the relationship between laboratory experiments and the rest of life. Although she deprecates laboratory experiments as "isolated," she does not throw them out the window. Instead, building on a theme that dates from her earliest work, she explores the actual nature of this "isolation." The fault of conventional laboratory experiments, she argues, is not that they hold fixed a boundary between "laboratory" and "ordinary life;" it is simply that they never investigate what the boundary should reasonably consist of. In what units, with what boundaries, do "tasks" naturally occur?

In their study of dairy workers, then, Scribner's research group made a controlled transition from ethnographic study to informal focused observations to bona fide laboratory experiments. The boundaries of "tasks" were to be discovered through observation, not derived from cognitive theories. The resulting experiments demonstrated that the supposedly unskilled labor of dairy workers entailed complicated forms of practical reasoning that depended in wholly unobvious ways on the detailed circumstances in which they were performed. The workers' techniques for filling dairy orders were highly adapted to their precise goals and settings.

This is surely an important result. I propose to explore it in a sociological context slightly broader than Scribner articulates in her lecture. Now, I have never been inside a dairy and cannot reanalyze Scribner's ethnographic materials. As a result, my comments are no more than speculative suggestions.

Scribner's overall goal is what she calls a "practice theory of cognition." To call cognition a "practice" is to say several challenging things. The first, already remarked upon, is the impossibility of specifying the content of cognition except in relational terms, that is, in terms of its embedding in the tasks and settings of practical activity.

The second is that, inasmuch as tasks and settings are historically specific phenomena, cognition itself is likewise historically specific to some great extent. This theme arises early in Scribner's work, particularly with reference to Vygotsky's analysis of the interactions between cognition and writing. In the present context, the same theme should direct us to the historical specificity of factory work as a context for practical cognition.

The third is that, inasmuch as tasks and settings are themselves bound up in complex relations with many other things, cognition itself should require specification in these broader contexts. In other words, it might be possible to specify the particular elements of the dairy and the order-filling task to which the loaders' skill is adapted, but this list of elements requires its own explanation in terms of dairy work and its complicated interconnections with other sites of activity.

These analyses should be performed not just for dairy work, but for laboratory psychology as well. After all, we need to explain why Scribner's research group found it possible to abstract work tasks and transpose them into laboratory tasks. Part of the reason, I would suggest, is that working in a factory and being an experimental subject are

broadly analogous forms of activity. Both typically take place in a "white room" far from home and built, owned, and decorated by someone else for the purpose of organizing the work. Both try to separate "work/experiment" and "life," leaving only the money as a connection between the two. In particular, both circumscribe the individual's personal relationship with the employer/experimenter, so that everything happens within rituals whose form can be routinely anticipated in advance and conventionally narrated in retrospect. The abstraction of factory tasks, on this account, is a different sort of thing than the abstraction of PTA meetings or family dinners or love affairs, each of which structures "tasks" and "settings" within the fullness of complex human relationships, into which no simple partitions have been placed by institutional structures of economics or epistemology.

These considerations suggest returning to the analysis of the dairy. Scribner observes that the qualitative changes inferred in the transition from novice to expert dairy-loading cannot be generated by an algorithm. But she also suggests that the observed changes can be explained by a "law of mental effort": "In product assembly, mental work will be expended to save physical work." This is different, to be sure, from the "laws" that generations of industrial and cognitive psychologists have reified in "practice effects" and the like, all of which are focused on "time" rather than on "physical effort." But just as surely the "law of mental effort" is itself specific to this setting; when those dairy workers go home to cook dinner or practice with their bands, they will probably balance economy of physical effort against the virtues of their food and their music, none of which can be measured in the way that milk-loading can. And, indeed, factory workers in different settings construe the same "task" in considerably different ways, leading to deliberate slow-downs and sabotage, to genuinely collective effort, or to some other complex and historically specific goal.

None of this is to disagree with Scribner's analysis. Rather, it is to sketch something of the horizon of investigation that I find to be compellingly implicit in it. If Sylvia Scribner's pioneering work on practical cognition has left us this horizon of future research, then it is certainly an honor to inherit it from her.

Scribner's Uses of History: From the Field into the Factory

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I was intrigued by Sylvia's cultural research on literacy, memory, and syllogistic reasoning as a new graduate student. Having initially been attracted to the City University of New York by her work in Liberia, I suddenly found myself studying people arranging milk cartons and cases in a simulated milk processing plant. This evoked a case of graduate student anxiety, the sort that can be viewed as productive in retrospect.

The previously unpublished papers of Sylvia Scribner's chosen for this special issue mark the same phase shift I encountered in New York. The papers laid the conceptual groundwork for her and Michael Cole's study of literacy among the Vai (1981) and for her final, but ongoing program of workplace research (Scribner, DiBello, Kindred & Zazanis, 1991; Scribner, Martin, & Beach, in preparation; Scribner, Beach, & Zazanis, in preparation; Scribner & Sachs, 1990). As with any cross-section from history, understanding the transformation of Scribner's research program as it moved from literacy practices to issues of cognition in the workplace benefits from some extrapolation beyond the papers. In doing this, several key conceptual formulations become clearer.

Reading "The Cognitive Consequences of Literacy" (1968) and "Mind in Action: A Functional Approach to Thinking" (1983) in sequence, a tension seemed to exist across both, between two historical processes: societal change and individual development. It was this tension that tied the two phases of Scribner's program of research together for me, though perhaps in a different way than she would have conceived of it (Beach, 1992). More importantly, her provisional resolutions of this tension as analytic syntheses were central to her development of the concepts of practice and adaptive flexibility and it is this that I would like to discuss briefly here.

In the earlier of the two papers (1968) Scribner forms two hypotheses about written literacy that are speculated upon as a sort of thought experiment throughout the rest of the paper. They are: writing moves thinking to a new conceptual level, writing moves thinking from the spontaneous to the conscious level.

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She cites the broad historical analyses of Goody & Watt (1963) and Havelock (1963) in suggesting in her thought experiment that the thinking processes of those who live in cultures that have developed a system of writing should differ from those living in cultures which have more fully developed other forms of communication. This move relates together several levels of historical process cited in her seminal 1985 chapter on "Vygotsky's Uses of History." The clearest tension, however, exists between the history of literacy development in particular societies and the development of literacy as part of ontogenesis. She then takes to task two simplistic notions related to this tension.

One is that writing is the only route to the development of abstract generalizable reasoning processes, therefore members of societies that do not emphasize a written mode of communication are hampered in reasoning abstractly, generalizing, and therefore in thinking conceptually. She argues that all language is by necessity an abstraction if we do not limit ourselves to the narrow Platonic conception of the "abstract," stripped of all contextual ties. Oral language can be generalizable and at the same time abstractive or nonabstractive whereas all generalizations in written language are necessarily abstractive. Both are conceptual, however. This tentative formulation begs for a level of process that mediates between the sociogenesis and ontogenesis of literacy by encompassing different functions of language and associated cognitions. This presages her development of the concept of practice.

The second notion taken to task is that the effects of schooling and written literacy on cognition are isomorphic. Though written literacy is perhaps an inseparable feature of schooling, the converse does not hold true, argues Scribner. Again the tension is between sociogenesis, in this case the development of institutions such as the school, and individual ontogenesis. The analytic uncoupling of the two proposed in the conclusion of her 1968 paper again points to the need for a mediating construct for rethinking relations between society and cognitive development.

The tension between sociogenesis and ontogenesis is analytically synthesized in Scribner's conception of practice, first presented in the *Psychology of Literacy* (1981) and later in her invited address to the Society for Research in Child Development.

By practice I refer to a socially-constructed activity organized around some common objects. A practice involves bounded knowledge domains and determinate technolo-

gies, including symbol systems. A practice is comprised of recurrent and interrelated goal-directed actions. Participants in a practice master its knowledge and technology and acquire the mental and manual skills needed to apply them to the accomplishment of action goals . . . the practices themselves need to be considered as objects of studies (1983, p.104).

A further synthesis of the tension between societal and individual histories occurs through her practice approach to cognition in the workplace. In this case the tension was first narrowed to the history of a particular practice, dairy preloading, and its relation to individual development. Preloaders fill symbolically-represented orders for dairy products by reorganizing the actual products into full and partial cases. Scribner devised a methodology comparable to Vygotsky's microgenetic method. It consisted of miniaturizing, accelerating, and genetically simulating part of the practice of becoming a preloader. Rule-governed variability in the use of strategies was a hallmark of becoming an experienced preloader and was therefore afforded as part of the simulation (Scribner, 1984).

Scribner's later successful simulations of this process among middle school students in New York unfortunately has yet to be fully reported in print. They supported the notion that individuals faced with a variable yet repetitive set of practical tasks will, with certain goals, develop a flexible repertoire of strategies that adapts to the changing nature of the task. What makes it adaptive is the repertoire's continual fine tuning with the task environment, as well as its simulation of adaptive flexibility in a work practice that is a part of American society.

While such adaptive flexibility in practical problem-solving is necessarily more general than the performance of a single task or a single strategy derived from that performance, it is not abstracted in the sense that it can be developed or used independently from the nature of a particular task. Here we again see the development of a nonabstractive generalization, in this instance by highly literate American middle school students performing a work-derived task rather than by members of a non-literate society in Scribner's earlier thought experiment.

The concept of a practice and, within it, the concept of adaptive flexibility represent a progressive, and clearly productive analytic synthesis of tension between two historical processes, a tension that appears in both phases of Scribner's work. Changes in society in relation to the psychological development of individuals will continue

thrive as locus for theorizing, research, and intervention—now enhanced by Scribner's conception of practice and adaptive flexibility.

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Does Practice with Specific "Linguistic Devices" Matter?

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As Sylvia Scribner makes clear in her 1983 paper, the Vai research (Scribner & Cole, 1981, hereafter S&C) severely constrained claims for the cognitive consequences of literacy that she and so many others had made. At least since 1981, literacy has to be understood not as one side of a great intellectual divide, but as a set of specific practices with written language.

One practice S&C investigated (Ch. 12) was the pressure for more elaborated meaning exerted by Vai letter writing. In their experiments, Vai script literates produced more items of information and more non-narrative descriptions than non-literates when explaining a game or giving directions to their farm, when both were dictating explanations for strangers. It was less clear, and less important for S&C's focus on cognitive consequences, how the actual language of the literates' dictation compared with their written versions. Moreover, because S&C's analyses were all done on translations from Vai into English, they "could not make any fine-grained evaluation of the linguistic devices used in the Vai language" (p. 207).

Theories about "linguistic devices" used in speech vs. writing have been as subject to great divide interpretations as has literacy, and comparative research has had similar weaknesses. Much of it can be criticized for treating speaking and writing as generalized activities, and for comparing either very different genres (e.g., oral conversation and written essays) or samples of texts aggregated across genres.

A recent monograph makes a significant step forward. Macaulay (1990) analyzed speech/writing differences while holding constant not only genre but speaker/writer and topic. Finding texts that meet these stringent criteria for five genres (narrative, description, exposition, instruction, and argument) must have been quite a task in itself, but find them she did.

Consider one example of "the resultative/causative split between them [speech and writing] in the representation of events" singled out for special mention in the

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preface (unpaged). It comes from a description by British Columbian mountain man Martin Starret of cattle driving at the point where the cattle have to be led into a narrow lane that leads down to the water's edge and across a gangplank onto a ship. Here are the oral (resultative) and written (causative) descriptions of that point in the procedure:

And they'd get along this street till and and they had a kind of receiver fence I guess you'd call it along the bank so they wouldn't get over there and the gate would open on the other side to make a funnel shape and they'd get them into that corral. (oral)

A substantial gate in the exit of the log fence when being opened allowed the cattle to be driven into a log chute which would allow perhaps three animals to walk abreast down the steep incline to an additional gangplank. (written, p. 70)

Macaulay points out sources of the confusion in the oral version: preference for human agents in speech not only makes "they" ambiguous (drivers or cattle?), but competes with the fence and gate for topic and focus. By contrast, economy and clarity are achieved in writing by the inanimate subject and passive verbs: "A gate . . . when being opened allowed the cattle to be driven. . . ."

Linguists engaged in critical language study (e.g., Fairclough, 1989) would point out that those same inanimate subjects and passive verbs can hide human agency and social structures behind an illusion that things act, and processes happen, all by themselves. A topical case in point is the quincentennial exhibit at the Smithsonian Museum of Natural History, "Seeds of change." One observer notes:

The title sums up the ironically animistic and deterministic approach of the Smithsonian: things make change—not human beings or the social structures they create and operate within. These seeds—corn, sugar, potatoes, horses, and germs—and some others, are the real agents of social transformation unleashed by Columbus' momentous voyage. "The plow brought death to the natural prairie. . . ." writes one *Seeds of Change* contributor [in the exhibit book]. "Sugar cane merits censure because it harmed both man and the environment," writes another (Bigelow, 1992, p. 37).

One does not have to accuse these authors of deliberate obfuscation in order to ask about the effect of such language on the consciousness of writer and readers alike.

Such an assertion about the power of language differences is, of course, a version of the Whorfian hypothesis—so easy to believe and so hard to prove. We miss Sylvia as a wise and warm and wonderful friend. And we also miss her as an unusually creative empirical researcher who should continue to be here to help us with just such touch questions.

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Looking for "What's Leading": A Legacy from Sylvia Scribner

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At time of her death, Sylvia Scribner and the members of her lab were engaged in exciting research concerning the acquisition of knowledge in manufacturing technologies. It was her latest project in a larger program of research on the cognitive consequences of activity in the workplace. As I read "Mind in Action: A Functional Approach to Thinking" I could see the foundational roots of this larger program clearly drawn. I would like to address these early concepts, as presented, and report on their status—some refined, some discarded—as manifested in this latest, and perhaps largest, of her projects.

In "Mind in Action" Sylvia indicated that her main enterprise was to "place the study of naturally-occurring activities at the center of cognitive inquiry. (p. 103)" She realized that the study of activity is the first step to understanding the formative role of culture and the way that human beings develop specialized abilities. That is, she

realized that so called "ordinary" activities exert a powerful influence on individuals' knowledge and ways of thinking while a given culture shapes practices and activities. In a sense, she came to explore the idea that to act is to know, and that to act in a specific way with artifacts and tools is to come to know the knowledge they represent according to their functional requirements and affordances.

Sylvia chose the workplace as the main arena for her investigation due to its "exceptional importance to youth and adults in our society," (p. 103) but I suspect that she had an additional reason. Almost universally, workplaces comprise the main arena for the transmission of a culture's "living" knowledge systems, systems that are currently defining the culture, the relevant objects (such as money) and the meaning systems which adults must be able to move through with agility in order to be considered valid participants.

However, at the time that this paper was presented, Sylvia was unclear as to *what* about any given activity exerted its powerful influence, and what exactly was transmitted, i.e., people did not simply "inherit" rote practices through doing. On page 104, she says "A practice is comprised of recurrent and interrelated goal-directed actions. Participants in a practice master its knowledge and technology and acquire the mental and manual skills needed to apply them to the accomplishment of actions' goals." Although she defined activity and practices much as, I believe, she would today, there would be greater emphasis on the role of the "goal." In her latest work, the "goal" shifted in its importance and role; it became the organizer of cognitive development which occurs during activity.

In "Mind in Action," Sylvia describes the optimal, labor saving (saving both mental and manual labor) strategies of well practiced preloaders in her dairy study and attributes their greater expertise and flexibility to the amount of experience they have had filling dairy orders. It seems as though she is proposing that repeated practice develops the optimizing skills that characterized expert performance. She indicates that other workers, with less practice at this particular task, show no ability to improvise labor saving strategies "instead of adapting solution strategies to the least-effort principle, they carried out literal instructions on almost all the problems."

I think Sylvia would now depart from her original conclusion. Even then the seeds to an alternative hypothesis were sown throughout the paper. Repeated practice

alone did not lead to optimizing; optimizing occurred among preloaders because only they performed order filling with *saving time* as their leading activity, or conscious goal. By definition, a preloader's job is to fill orders as accurately and as quickly as possible. "Speed counts - the preloader's shift lasts until all load out order forms are processed and all trucks filled. Accuracy counts - the checker sends incorrect orders back to the pre-loader for re-assembly" (page 105). Sylvia was on the edge of discovering how powerfully the "what counts" leads cognitive development. She mentions the salient goals of preloaders, but does not link these goals with the skills they developed.

In Sylvia's later work with manufacturing workers, the employees were ostensibly learning to use and understand a generic, content free computer system (MRPII) that was to change the organization of work dramatically while the basic processes of manufacturing remained the same. We found some baffling relationships that, in the end, helped to refine Sylvia's original model. First, we found little relationship between amount of experience and mastery at using the new system. Even special training offered no advantage. Second, we found that a good grasp of MRPII principles and algorithms did not mean one could use the system well in an actual factory. However, we also discovered a small group of people at one plant, and a much larger group at another plant, who had clearly developed expertise in using this system in actual settings. We re-examined the data on all subjects.

From the point of view of the workers who show mastery in actual settings, the real goal is to "coordinate" MRPII with production, which turns out, in practice to require very different kinds of skills than mastery in either MRPII or production alone. This may have been the first time in her work that Sylvia was confronted with the overlap of two domains constituting almost a third domain. Those who exhibited mastery on the job showed a facility at coordinating these two systems to accomplish real goals, sometimes in surprising ways. In the plants we studied, the main factor to developing this skill was having "coordination" as a salient goal in one's day to day activities. In contrast, those who were given procedures to execute had accuracy as their salient goal, and accuracy at procedures is exactly what was exhibited most strongly.

Both kinds of workers have comparable amounts of experience with both MRPII and production, but each have different kinds of engagement with the same tools and symbolic systems. Simply put, they have very differ-

ent goals. This work clearly suggests that the cognitive consequences of an activity may have more to do with "what is leading" than with actual actions comprising the larger activity.

During my last conversation with Sylvia we were discussing some very puzzling data from an individual's protocol. I was at the office late, attempting to make some sense of it. Sylvia listened patiently to my dilemma and then said "What's leading? Look for what's leading." In retrospect, this seems to me to be a wonderful legacy.

Toward an Activity-Based Methodology for Studying Cognition at Work

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Among studies of work conducted within the framework of activity theory, the research led by Sylvia Scribner is notable for its imaginative yet rigorous methodological solutions. Catan (1986, p. 262) summarizes Scribner's microgenetic method as follows.

Wide-ranging naturalistic observation of daily problem solving lead to the formation of hypotheses about the features distinguishing novice from expert strategies, and about the factors regulating their development. These factors were further explored in more schematized job simulations, in both naturalistic and in miniaturized laboratory situations.

Scribner's three-phase method of observation, simulation and experimentation is aimed at finding out cognitive and cultural mechanisms of skill and knowledge acquisition at work. From my viewpoint, the crucial contribution of Scribner's method is that her studies moved from complex activities in the field to the identification of critical or strategic actions and tasks, the performance of which was then manipulated experimentally.

I met Sylvia in 1986 in Berlin, at the First International Congress of Activity Theory. The following summer, we invited her to present her work at an international workshop on work and cognition, held in Karjaa, Finland. Sylvia was eager to discuss and collaborate with European

attempts at applying activity theory in research on work. The Finnish school of developmental work research is such an attempt (see the October 1991 issue of this *Newsletter*). In the spring of 1990, Sylvia and I organized together a symposium on work and cognition at the Second International Congress of Activity Theory in Lahti, Finland.

A central theme in my discussions with Sylvia was the relationship between stability and change, or between acquisition and creation. While Sylvia focused her analyses on the formation and acquisition of relatively stable skills and patterns of knowledge by individual workers, the Finnish practitioners of developmental work research focus primarily on the parallel process of identifying and resolving relatively new, ill-defined, complex, and changing problems by collectives of workers facing major organizational and technological transformations. These dual processes of individual acquisition of stable orders and collective production of novel changes, or internalization and externalization, are present in every workplace. Their relationship, however, remains almost an unknown territory for researchers.

In practical research, one tends to take one of these processes as the point of departure. This creates a dilemma. Focusing on internalization may lead to careful designs and detailed analyses of relatively well constrained cognitive tasks and performances - leaving aside the question of how those tasks are created in the first place and what may be happening to them. Focusing on externalization may lead to exciting accounts of relatively large scale change in the activity system - neglecting detailed analyses of microgenetic processes involved in the transformation. The necessity of combining these two viewpoints became increasingly evident to both Sylvia and us working within the paradigm of developmental work research. This bringing together of complementary viewpoints is an important part of Sylvia's legacy.

Sylvia's paper "Mind in Action: A Functional Approach to Thinking" is a beautifully clear early presentation of her evolving research program for cognitive studies of work. It might be read as a carefully grounded argument for the fundamental importance of experience and tacit skill. However, it goes beyond that. Sylvia points out that "the industrial world as we found it was not only made up of things but of symbols that were in significant respects peculiar to that setting." Work-related symbol systems were central to Sylvia's approach. Symbols are tools of discursive reflection. They enable workers "to free themselves from rules, and to invent flexible strate-

gies." Here we see a potential meeting point between acquisition and creation, between stability and change. As Sylvia wrote, skill implies "not only knowledge and know-how but creativity - an attribute of the work group as a social entity."

To substantiate, elaborate and develop this insight is a major challenge to contemporary research. Representatives of such currently emerging research strands as distributed cognition, situated cognition, and computer-supported cooperative work will do well to acquire and internalize Sylvia's pioneering work. This will surely enrich the parallel process of creating and externalizing new models for understanding and developing human activity and cognition.

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Steps in the Long March: From Principles to Practices

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Many of us cut our eye teeth as psychologists in the search for principles of mental functioning. It seemed so natural, and so self-evidently the goal of the psychologist's project. We were not alone. Many before us had opted to go the route of finding laws, and in the process, consciously and methodologically segregating domains of phenomena. Some domains could be studied because they were likely to produce laws or principles of function, others, while acknowledged as eventually to be reckoned with, were more interesting but unstudied because they were less likely to produce law-like phenomena. For example, De Saussure lopped off "la parole" in order to study "la langue" because the latter was more likely to produce law-like analyses. Later, as both a matter of taste and theoretical necessity, people segregated issues of "performance" from issues of "competence" on different grounds that had the same consequence. On the one hand

"performance" was noise that obscured our view of "competence;" but more fundamentally, domains of performance were unlikely to yield laws while studies directed toward uncovering competence were more likely to do so - once the noise produced by performance factors was somehow factored out.

We seem to have come a long way from our eye-teeth cutting days. I suggest that we have deintensified our search for laws, in part because the methodological abstraction necessary to do this has proved too artificial and too disengaged from our more fundamental intuitions of what people's lives are all about, and in part because the belief in an underlying coherence in diverse phenomena has been eroded (e.g., Shweder; 1990; Bruner, 1990).

I believe that we have taken a long march - from a search for laws about the organism, which was methodologically predicated on segregable, neat and studiable domains - to a search, not for underlying principles but for operating principles which are characteristic of the embedded activities of people engaged in activities in domains which are not artificial and which are therefore not so easily segregated. Put otherwise, many of us have shifted from a search for underlying principles to a search for the organization of practices.

These two papers by Sylvia are exquisite examples of way stations on the long march. Because she was a remarkably gifted writer, Sylvia could articulate, in depth, the characteristics of each of the conceptual way-stations on the long march. And, because she was so clear she could demonstrate both the possibility and the limitation of each of these points along the way.

There is a considerable distance that can be seen between these papers - from Sylvia at her desk to Sylvia shivering, without gloves, in a refrigerated room in a dairy factory. A distance that marks the difference between the graduate student Sylvia examining a wide range literature to build a speculative case and a field researcher engaged with phenomena - a distance that corresponds to the difference between Sylvia looking for the design characteristics of written language and its likely candidacy for being the kind of mechanism that one would want to examine when trying to put forth "a concept of mind which incorporates social processes as intrinsic to mental operations" (quoted in Sylvia's paper from C. Wright Mills; 1963) - and the Sylvia who understood that it takes more than a design specification to study a mind, and that a reasonable place to look for that elusive "concept of mind which . . ." is in those quotidian activities where

minds are engaged in doing. Indeed, we see somewhat of a turnaround here - where the literacy paper points unequivocally at schooling as a key factor in intellectual "difference," the work paper displays the essential limitations of schooling and points instead to principles of economy in activity and thinking as driving forces in cognitive growth. The distance that Sylvia transversed is characteristic of the distance that we have all traversed between the theoretical optimism of the 1960s to the more gritty and complicated realities of the 1980s and 90s.

Perhaps Sylvia expected this journey after all, and even welcomed it. She was quite clear-eyed about the issues. In footnote 16 of the literacy paper she puts the issue exactly.

Any approach which starts off to "demonstrate a link" between literacy and cognition is likely to oversimplify and over exaggerate the "uniqueness" and "significance" of the skills involved in literacy. In the modern as well as the ancient world, the spread of literacy is always accompanied by other significant social changes . . . With this caution in mind, however, it would still seem necessary to balance the risk of oversimplifying the effects of a single social phenomenon taken in isolation with the risk of continued avoidance by psychology of the significant dimensions of social life.

Many of Sylvia's "anticipations" about the effects of literacy were exciting but ultimately not in accordance with her own data. Similarly, Sylvia's search for alternative mechanisms - such as the head for hand principle - or more generally the "least effort" principle of cognitive development were a bit off target in a parallel way. Recent work by Michael Cohen (one of Sylvia's last dissertation students) examined the issues addressed in the dairy study with young children. He found that although the children did adopt what look like "least effort" strategies in calculation they also would invest a great deal of "more effort" in maintaining the scenic properties of the experiment (e.g., they were asked to "play shopkeeper" and would introduce effortful activities such as sweeping the shop up between customers to maintain the play scene).

In a parallel manner, many of the studies of the Laboratory for Cognitive Studies of Work which Sylvia had initiated have yielded data which makes matters infinitely more complicated, and infinitely more "local" than Sylvia would have imagined. For example, we have been studying the impact of abstract control systems in the workplace on workers' knowledge. We have found that the particular organization of practices on the job is more

important than the presence of the abstract system for determining workers' ways of thinking.

Sylvia would have been undeterred. She understood that knowledge is progressive, that it takes work to know, and that the activity will often produce false starts, over-general principles, "laws" that end up being local to an activity. She might have understood that the search for laws has ended us up in an engagement in practices that may not have general laws. But she would have continued to look for the laws - because the benefits of conducting that search were far greater than the risks of not looking at all.

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On "The Cognitive Consequences of Literacy" by Sylvia Scribner

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Like hearing about the assassination of John Kennedy, I can remember exactly where I was when I first opened Sylvia Scribner's unpublished manuscript, "The Cognitive Consequences of Literacy." And I remember both events for exactly the same reason: they stunned me, albeit for obviously different reasons. Before reading her paper (in my office at the Harvard Center for Cognitive Studies), I had never heard of or met Sylvia Scribner; I was stunned by her theoretical brilliance. Some of my reaction may have been a bit egocentric, however, because, strangely enough, I had, a few months before, written and delivered a paper on exactly the same topic. My paper was called "Oral vs. Written Language: The Consequences for Cognitive Development" (Greenfield, 1968).

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When I was inducted into the Radcliffe College chapter of Phi Beta Kappa in 1961, sociologist Robert Merton gave a talk entitled "Doubles in Science." His thesis was that often two or more scientists independently make the same "discovery" at about the same time, and that these "doubles" are not a coincidence. Simultaneous discoveries stem rather from the fact that science is cumulative and the history of science is often such that the trend of earlier work prepares the intellectual ground for a current "discovery," in itself less a matter of individual discovery than organic historical growth of a collective field. Our papers were an amazing "double": Scribner's "The Cognitive Consequences of Literacy" and Greenfield's "Oral or Written Language" were not only written in the same year, they were actually written in the same month, February, 1968!

Through an accident of history or temperament, or perhaps both, we were on the same wavelength. Both of us saw written language as a sociocultural tool affecting cognitive development and the use of oral language. Both noted the way in which only words can be used to create context in writing, whereas the nonverbal situation and nonverbal communication are possible context constructors for oral speech. Both of us drew upon Vygotsky's theory of symbols and Bruner's theory of modes of representation. Both drew upon Basil Bernstein's notion of restricted and elaborated codes; both hypothesized that the origins of Bernstein's codes lay in differential exposure to and skill with written language. Both of us even drew upon my research in Senegal, particularly the comparison of schooled and unschooled children.¹

Both of us used Piagetian theory. And both turned Piaget a bit on his head. Piaget had emphasized activity or operation on the external world as the very nature of cognitive development. We both realized that writing provided an opportunity to manipulate thought in a very concrete way. Therefore, each reasoned, the cultural tool of writing could provide an opportunity for operating on thought, one of the hallmarks of Piaget's stage of formal operations. If so, then the presence and use of a written language in a culture could potentially affect whether or not formal operations ever developed. In essence, both used Piagetian theory to draw an anti-Piagetian conclusion: that his stages were not necessarily universal, but could be dependent on culturally variable products, notably a written language.

Somehow, Sylvia Scribner and I had been metaphorically in the same place and the same time in the history of our science. Not only were we familiar with the same

sources, but we had read them through a similar lens of appreciation, criticism, and synthesis.

The major difference I saw between our two papers was that hers was so much broader in scope, so much more brilliant. Her scholarship covered philosophy, anthropology, and the history of ideas. She could relate Piaget to Levi-Strauss. I can remember wishing I had written Sylvia Scribner's paper rather than mine!

In fact, I remembered Scribner's treatment of written language and formal operations better than my own in later years. When I came to write my book *Mind and Media* (Greenfield, 1984), the idea that writing makes the manipulation of thought concretely possible seemed relevant to the possible cognitive consequences of a new cultural tool, the wordprocessor, a technology which vastly expands the possibilities for an individual to concretely manipulate his or her own thought processes; and I drew upon Sylvia's paper, rather than my own, as the theoretical foundation for this notion.

Sylvia wrote "The Cognitive Consequences of Literacy" as a graduate student, before she went to Rockefeller University to work in Michael Cole's Laboratory of Comparative Human Cognition. She saw her paper as a prelude to "a direct research attack on literacy as a mechanism of cognitive growth." She closes with a wish to go beyond my studies in Senegal, in order to disentangle literacy from schooling. "While the written language is an indispensable and inseparable feature of the school experience," she wrote, "the converse does not hold. The opportunity still remains to investigate the impact of written language acquisition divorced from the school context" (Scribner, 1968, 1992, p. 100).

Seemingly unbeknownst to Scribner when she wrote her paper in 1968, Cole, Gay, and Glick (1969) had already begun to study the effects of writing separate from the effects of schooling. Indeed, they had obtained results in Liberia that supported a theme in both Scribner (1968, 1992) and Greenfield (1968, 1972): The possession of a written language influences speakers to provide more verbal context in their oral communications. This particular research, with its initial findings, must have been one of the attractions that drew Scribner to the Laboratory of Comparative Human Cognition later that year. Ironically, though, by the time that Scribner and Cole had completed their monumental study of Vai literacies (1981), they had moved away from the kind of global literacy effects Scribner (and Greenfield) posited in their 1968 papers to context-specific effects that depended on the particular uses to which literacy was put.

Why was "The Cognitive Consequences of Literacy" not published at the time it was written? If I recall correctly, Sylvia felt the paper was unpublishable. Anyone concerned with progress in the field must ask, "Why should a brilliant woman feel that a groundbreaking paper cannot be published?" Part of the answer is that the American *zeitgeist* was not right for these sorts of theoretical ideas, presented in a format that did not fit in with standard psychological genres - as I found out when I tried to publish my own paper. Indeed, I believe that paper, "Oral or Written Language," occasioned a series of rejections from American journals and was finally submitted to the British journal *Language and Speech*, in which it appeared four years later (Greenfield, 1972). The paper received no response on this side of the Atlantic and little in England.

Compounding the problem, for Sylvia as well as me, was our female gender. It was particularly difficult for a woman at that time to publish an article outside the prevailing paradigm, without some sort of backing from a well-known male colleague. Fortunately for our field, Sylvia quickly found this kind of backing from Michael Cole, the first to recognize her genius; and they began a long and marvelously fruitful collaboration.

Nonetheless, it is sad that the paper was not published at the time it was written. In it we see Scribner's vision for the future, a broad-stroked vision, full of enthusiasm. When I reread this paper in 1992, I had the feeling that, with all her many important accomplishments, Sylvia Scribner never produced another work of the same theoretical and scholarly scope.

Nonetheless, much of Scribner's vision for studying "the possible interconnections between social inventions and cognitive development" presented in the 1968 paper has come to pass. Given the *zeitgeist* and prevailing paradigms of the time, it is perhaps unrealistic to think that our field could have advanced more rapidly, had "The Cognitive Consequences of Literacy" been widely available to Sylvia Scribner's colleagues two decades earlier. Still, I can't help wondering. Despite the fact that Scribner's own views on the cognitive consequences of literacy shifted in the course of her later career, the 1968 paper still sounds fresh and, as I am confident the collected commentaries will show, is stimulating and provocative, even in 1992.

Merton's view of the history of science is a deterministic one. Still, to whatever extent I have helped to write the same chapter in the history of social science as Sylvia

Scribner, I feel a great sense of personal pride. Merton notwithstanding, Sylvia Scribner was a unique participant in our game of science; the rules would be different today had she not played.

Notes

¹I wanted to clarify a comment made by Scribner about my concept formation findings in Senegal: "Only the school children showed a growth in the ability to state the rule that was governing their groupings." This is true in the sense that only schooled Wolof children expressed the verbal principle behind their groupings *in sentential form*, and the tendency to do so increased with age. The unschooled Wolof children, however, did verbally state the criterion for their groupings at all ages; they just formulated their rule in a different verbal format, the single word - e.g., "red."

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Comments on "The Cognitive Consequences of Literacy"

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This article, which is referred to as Scribner's earlier work on literacy in Scribner and Cole (1981), interests me

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in two ways. It is interesting in itself, because it, in intellectually appealing ways, describes how written language differs from oral language, and proposes that the acquisition of a literacy skill makes thinking conceptually more advanced and more conscious-reflective. The article is interesting also because proposed ideas regarding relationships among literacy, thought, and schooling are in sharp contrast to those ideas expressed by the same author (with Michael Cole) 13 years later. For example, whereas this earlier work assumes that literacy produces in individual thinking qualitative and generalized changes, the later monograph emphasizes that changes are localized and matters of extent in nature. Whereas the former implicitly assumes that the acquisition of literacy is tied to schooling, one of the striking results reported in the latter was that it can be acquired without schooling or systematic teaching.

Should we conclude that the earlier ideas were all wrong, in the light of findings from culture and cognition studies, including the Vai literacy project? I do not think so. I believe, on the contrary, that this earlier article includes many insights which cannot just be ignored, and that it is possible to incorporate them into what we currently know about literacy, thinking and schooling. In order to make this point, let me divide discussions in the article into three issues, that is, about uniquenesses of written language and its effects on language processing, the nature of conceptual thinking with and without literacy, and the role of schooling in the acquisition of literacy.

First, Scribner's six characterizations of written language all seem persuasive to me. Written language is not only different from oral language but also requires a different mode of processing. As she pointed out, in order to read and write we have to be analytic, for instance, to segment a spoken utterance or constituent words into much smaller units in writing. This practice of segmentation, when repeated many times, will make us more skilled at the activity—at least dealing with linguistic materials. Many recent studies have suggested that people become able to segment spoken words into phonemes only after they have acquired (and practiced) alphabetical literacy. Similarly, our recent studies with T. Ohtake and K. Inagaki revealed that morae as basic segmentation units in Japanese are firmly established only after children acquire literacy for kana, which, though called syllabaries, are in fact mora-based. Before the acquisition, some rely on syllables, some use morae, and others employ both as segmentation units on various tasks. Scribner's earlier ideas on the issue are thus congruent with recent findings, and also consistent with Scribner and Cole—if people solve the same kind of problems many times, they tend to

form more or less general, transferable cognitive skills by which those problems can promptly be solved.

Second, Scribner's formulations about the effects of literacy on conceptual thinking can be accepted only with modifications. On one hand, although conceptual thinking with literacy could be more advanced than the one without it, this cannot be attributed to transfer of cognitive skills from processing of language to that of conceptual entities, as her second hypothesis indicates. Cognitive skills developed through practicing literacy are generalizable, but probably not across domains, as many studies on expertise strongly suggest.

On the other hand, I am convinced that there can be forms of advanced scientific thinking which are almost impossible without literacy, that is, without written manipulable symbols representing word objects, as her first hypothesis denotes, though literacy is a necessary but not sufficient condition. Mathematical proof can be such a case. Proving a mathematical theorem is a series of situated actions with external symbols for exploration as well as for offloading of previous ideas. In contrast, problem solving in everyday or intuitive science is possible without literacy, as studies in everyday cognition and conceptual development have well documented (Hatano, 1990). That literate and illiterate people performed equally well, one of the findings by Scribner and Cole, is not very surprising, considering that many of their tasks did not require written manipulable symbols for successful solution and that the Vai literates in the study were close to "nonliterate" because their experience of reading and writing was rather limited.

Third and finally, Scribner's implicit assumption that schooling plays an important role in the acquisition of literacy seems tenable. As far as we know, without systematic teaching, while some people can acquire literacy, others cannot, unless it is syllable or mora-based. Learning to read kana is easy and does not require formal schooling—in fact most Japanese children are able to read kana characters before they are taught them at the first grade. However, for learning to read, and especially write, several thousands of kanji (morphograms) schooling is needed. Needless to say, the acquisition of literacy through schooling is "accompanied by other significant" achievements, as aptly pointed out by Scribner, and thus the effects of schooling cannot be reduced to those of literacy. At the same time, however, the acquisition of high literacy, which is functional in multiple contexts, unlike forms of literacy for limited use observed by Scribner and Cole, seems to be a product of schooling. Careful examinations

of the nature of literacy are needed before we generalize either from Scribner and Cole or Bruner, Olver, and Greenfield (1966).

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Reflection in Honor of Sylvia Scribner's Socio-Cultural Approach

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The Formative Effects of Societal and Cultural Practice on Mind

Sylvia Scribner was ahead of her time in formulating central research questions within a socio-cultural approach of psychological research before anyone in western psychology knew the existence of the approach of Vygotsky and his followers. In her two articles, "The Cognitive Consequence of Literacy" and "Mind in Action: A Functional Approach to Thinking," a socio-cultural approach to psychological research is sketched that has close relations to Vygotsky's, Elkonin's and Leontiev's cultural-historical approach. It is amazing to read these two articles from 1968 and 1983 which remained unpublished until this 1992 issue of the *Newsletter* because the themes they discuss are so central today. Although the terms are not explicitly stated, these themes are theoretical thinking, thinking in practice, theoretical knowledge, situated knowledge, situated learning, school learning and apprenticeship learning.

The central themes in Sylvia Scribner's work are connected to the epistemological question of how societal practice affects qualitative change in higher intellectual

functions. Her research explored the link between mind and society or the "mediating mechanism" in cultural development and social change.

I find Scribner's conceptual outline as well as her methodological research important for developing a general research approach that is sensitive to the complexity and diversity of human psychological functioning in daily living. Scribner often gives credit to the cultural-historical school (see 1985, 1990), but I find a uniqueness in her approach combining the societal and cultural aspects in searching for the diversities of mind, which transcends the approach of the cultural-historical school. As pointed out by Cole (1988), the contribution of the cultural-historical school is mainly on the epistemological level in the search for the invariance in the psychological processes of humans. Scribner's research is as much an investigation of the diversity of practice (i.e., literacy in different practices and calculating in different settings) and the effect this has on the diversity of psychological functions such as memory and thinking.

Diversities in How Skills and Functions Relate

Scribner's special contribution is in the doubleness of her project - to find the invariance of human minds but also to find the diversities of the functioning of the human intellect. In the 1983 article we can see an outline toward a theory regarding practice in cultural institutions.

The societal and cultural approach in Scribner's research becomes visible and dominant by her use of practice as the basic theoretical component. The concept of practice implies much more than practical activities and really grasps the content of what activity should mean in the cultural-historical theory, but also anchors it in the institutional contexts of society.

Scribner defines practice in 1983 as "socially constructed activity organized around some common objects."

By practice we mean a recurrent, goal-directed sequence of activities using a particular technology and a particular system of knowledge. We use the term "skills" to refer to the coordinated sets of actions involved in applying this knowledge in particular settings. A practice, then, consists of three components: technology, knowledge and skills (Scribner & Cole, 1981, p 236).

By focusing on practice Scribner encompasses both the structural and functional aspects as well as the mode of

development into the mediating mechanism between societal institutions and mental development. This concept encompasses the tool aspect and the societal traditions for doing which have developed through social interactions as well as the individual person who is acting.

The universal characteristic of human tool use, both manual and intellectual, was stressed by Vygotsky; the diversity in practices with tools is opened up by Scribner's research.

Scribner's study of literacy as well as her studies of development of skills in workplaces focus on human modes of acquiring skills and human cognitive functions inside the structures of socially developed institutions. She describes the diversities in different cultural settings where intellectual tools are used as well as diversities in skills between persons who are engaged in different goal-oriented activities for the same type of practice (literacy, calculating, computer skill). In the 1968 article the focus is the diversity of human functioning which is described in terms of different types of knowledge and different levels of generalizations in knowledge.

In the 1983 article the analyses become more specific because Scribner's methodological approach has changed from a traditional approach of measuring cognitive skills (see Scribner & Cole, 1981) to observation and experimentation with skills in real life situations. Here she demonstrates the formative role of practical activities on skill systems. The activities she chose involve work in a dairy warehouse and the skill was calculating prices. By bringing students into the dairy, she could compare skills in a workplace to skills developed in an academic setting (see also Scribner & Stevens, 1989). By analyzing the structural aspects as well as the goal-determining aspects of the practice, she was able to offer a microanalysis of how the mode of solution changed with experience.

Methodological Approach

Scribner's methodological approach can, like her theoretical approach, be characterized by a kind of doubleness or dialectics between the macrostudy of cultural institutions and the microstudy of the function of particular psychological systems by persons acting in these institutional practices. In her later studies (e.g., 1984) she used the dialectic between observation and experimentation which was further refined in her last unpublished project at the Laboratory for Cognitive Studies of Work. In this study of the development of computer skill in an industrial setting, she used three types of methods: longi-

tudinal studies of novices who were just starting to learn; cross-sectional studies of individuals with different levels of experiences in work situations (exchange between experts and novices); and experimental studies of short-term training.

Scribner's research, both in her cultural studies in Vailand and in the industrial settings, is characterized by painstaking, deep-going analyses whereby she untangles skills from the institutional practice. Particularly, she disentangles literacy from school practice, and relates literacy to other types of institutional practices: British school traditions, Vai letter writing, Muslim Qu'ran study. The skill of calculating is related to different kinds of institutional practices, such as a dairy warehouse, a work plant, and an academic setting.

I want to conclude that Sylvia Scribner through her research methodology has presented a model which keeps the rigor of experimental research and the richness of societal practice. Therefore this approach can be very enriching for other researchers who want to untangle the diversity of the formative roles of practice in societal institutions on skills and intellectual functioning.

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From Tools to Practice

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The opportunity to read carefully two articles of Sylvia Scribner's written 15 years apart afforded me the exquisite pleasure of watching a sharp active mind travel an arduous journey. Although she did not clearly realize it in her 1968 article, her trek would eventually take a daring turn and lead her to a reformulation of the basic premises of cognitive psychology. She did not start with such a radical goal in mind. But by 1983, she had reached her Byzantium, and in a confident voice, she offered a new approach to the study of cognition based on the concept of *practice*. She did not make her sojourn alone, but she was always in the forefront, leading the way. Her prescient 1983 program of study opened up new and unexplored territories that today researchers in the areas of situated cognition, distributed learning, and cultural psychology are just beginning to chart.

Sylvia's 1968 article pointed in the direction her travels would take her. In this paper, she adopted as her central theoretical concept the *tool*. She wanted to explore "the possible interconnections between social invention and cognitive development." Such a goal, while hardly in the mainstream of cognitive psychology, would not have evoked controversy at the time of her writing.

Traditional cognitive psychologists would have easily assimilated it into their framework. Neisser (1967), who now adopts a different position, brilliantly articulated in his classic on the topic the purported task of cognitive psychologists—to follow the flow of information from input to output. They should study internal processing. Tools and other cultural artifacts, according to this position, serve merely as input. In treating them as such, cognitive psychologists leave open the possibility of studying internal processing separately from tool use.

Even in 1968, however, Sylvia courted controversy. She would not allow this glib division between internal processing and the cultural tools. Just a few paragraphs after stating her uncontroversial goal, she insisted, with the glee a radical has when coming out of the closet, that the tools people use shape their nature. They "lead to significant transformations, not only in human culture, but in the mind of man." The mind then does not simply use tools to accomplish tasks, but is in turn changed by their use.

This position provided the vehicle by which Sylvia could move to the broader, more encompassing vistas of her 1983 paper. Here, Sylvia borrowed heavily from Activity Theory. Unlike traditional cognitive psychologists, activity theorists direct their energies toward investigating goal-directed activity. Rather than studying only the processes occurring in people's heads, they explored what people do as they accomplish naturally-occurring tasks. Or to put it another way, rather than studying the internal machinery of the mind, they investigate how people use this machinery to accomplish naturally-occurring tasks. The title of Sylvia's 1983 paper, "Mind in Action," could not be more appropriate.

In her variation on the activity theme, Sylvia introduced the concept of *practice*. She wanted to study a special use of the cognitive machinery. As she cogently stated, practice refers to "a socially-constructed activity organized around some common objects. A practice involves bounded knowledge domains and determinate technologies, including symbol systems. A practice is comprised of recurrent and interrelated goal-directed action." Clearly, not all human action involves practice, but much of it does. No better example could be found of practice in adult life than the daily routines of the job, be they the simple chore of loading a milk carton or the complex job of designing a skyscraper. Sylvia, being Sylvia, chose the Dairy as her domain of work. I suspect that she was attracted to the Dairy because it was both deceptively simple—nothing to study here, the skeptic might suppose—and rich in both political and social consequences.

How does the study of practice relate to an investigation of the "possible interconnections between social inventions and cognitive development"? How did Sylvia travel from "there" to "here"? The key to an answer rests with Sylvia's radical and decisive claim that tool use changes the mind. With this declaration, Sylvia asserts that psychologists cannot study mental processing without considering the object of the processing. They must look at processing as embedded in the world and view the cognitive processes from the perspective of this larger framework. They cannot pull asunder the machinery of the mind from the tools the mind uses to accomplish a task no matter how hard they push and pull or how cleverly they undertake the task. The two are inseparable.

But Sylvia missed an essential point in her 1968 article. Just as the nature of mental machinery depends on the tools its uses, so does the tool itself. People use tools in different ways, and the manner by which tool use shapes

cognition depends not only on the tool, but how it is used. In the 1968 article, Sylvia discussed literacy as if it were a tool in the abstract. The mere presence of the word has magical effects, she speculated. She listed a host of transformations literacy might perform on thinking. For instance, she admiringly turned to Havelock's investigation of Plato to advance the trenchant psychological claim that a low level of literacy might engender a poverty of good philosophical or abstract thinking. Nowhere in her discussion does she appear to recognize that words can be used in different ways and that literate people engage in the task of writing for different reasons. Havelock's claim might be incisive, but situationally-specific. Her treatment of the written word as a tool abstracted from its use led Sylvia to speculate that literacy should have a general and profound effect on thinking, independent of the how, when, and where of its use.

By 1983, Sylvia had learned her lesson. She had learned the hard way. She travelled to Africa, only to find that a general effect of literacy remained elusive. Effects could be found, of course, but they reflected how people used the tool of the written word rather than the mere possession of the tool. Her work in the Dairy tells the same story, with a delicious twist.

The Dairy provided the preloaders with tools to help them with their job. Most importantly, workers known as preloaders received "load-out order forms" each morning. These "written words" of drivers' needs provided a permanent record, thereby decreasing the mnemonic demands on the preloaders' memory. More importantly, the code on the load-out form could be thought of as an algorithm describing the actions the preloader should take. A preloader could therefore automatize what might require effortful thought without this tool. A code like "1-6" would translate into an automatic response of putting one case of milk on the truck and then removing six bottles. It is easy to conceive how management might devise this coding scheme for the load-out form with the aim of automatizing preloaders' behavior.

College students or workers in the Dairy unskilled at preloading adopt just such a strategy. They take a cultural artifact, here provided by management, and use it to what they and management conceive of as their advantage. Skilled preloaders are not as compliant. They sometimes ignore the algorithmic possibilities of the code. When they do so, they transform the provided cultural artifact into something different. Treating the code on the load-out form in merely an algorithmic fashion can produce physical inefficiency. The experienced preloader would rather

expend additional mental effort, sometimes ignoring the load-out sheet as a tool describing action, and giving new meaning, if you like, to the "written words" on the load-out form. Instead of translating "1-6" into "get one case and take out six bottles," they take a visually easily recognizable and available half-case and add two to it.

Culturally-provided tools may not only be used in different ways, then, but may sometimes be completely transformed. The skilled preloaders reject the algorithmic possibilities of the code because it is not sensitive to their needs or the situation they find themselves in. When the drivers write "1-6," they cannot predict that a half-case will lie nearby as the order is read. Nor can they be expected to consider the preloader's concerns. The drivers, after all, have entirely different responsibilities. Even as simple a tool as a code for loading milk cartons can only be understood in the context in which it is used.

Clearly, it is not enough to understand the possible interconnections between social inventions or tools and cognitive development. Social inventions are used in different contexts, by different people with different histories. One cannot merely discuss "social inventions and cognitive development." One must add into this formulation the way the tools are used, the context in which the tools are used, individual differences in the people using the tools, the history of the use of the tool and the users experience with the tool, and a multitude of other variables. In other words, one must begin to examine, to use Sylvia's term, practice.

If I could propose a principle similar to Sylvia's "law of mental effort," I would say: "Keep it simple." I suspect that when Sylvia began her explorations of the mind, she followed this principle. Even as early as 1968, she realized the journey would not be easy. The mind somehow could not be stripped of the tools it uses to function in the world. But in an attempt to make her sojourn as simple as possible, she hoped that tools at least could be treated in an abstract way. By 1983, she realized that this straightforward path could not be followed. Psychologists often hope that as they try to discover the mysteries of the mind, they can streamline their journey, avoiding the need to engage fully the chaos of the foreign territories around them. The adventuresome traveller will, however, depart from the beaten path to explore more fully their surroundings. Sylvia, in recognizing the need to study practice in everyday contexts, stepped out into this larger world. As with travelling, she described a truer version of the world than those who remained safely on well-travelled paths.

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Scribner: Rigor and Creativity

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Sylvia Scribner's 1984 address "Mind in Action: A Functional Approach to Thinking," on her innovative study of novice and expert dairy workers, breaks new ground. She overcomes three long-standing dichotomies in the study of cognition: that of manual as opposed to intellectual labor; that of field-based as opposed to laboratory-based approaches; and that of creative as opposed to routine work activities.

Scribner approaches the first of these dichotomies (manual against intellectual labor), by carefully defining the concept of "practice" and developing it into a tool to study cognition in the workplace. She presents the thinking of workers as requiring a "mastery of both knowledge and symbol systems." The way in which domain-specific knowledge interacts with symbol systems is clearly illustrated in the paper; it leads the reader to the recognition that this familiar dichotomy between manual and intellectual labor needs to be re-examined. Of particular interest is Scribner's discussion of the dairy workers' large repertoire of solution strategies which apply mental effort to solving problems requiring manual effort.

Scribner tackles the second dichotomy (the tension between the field-based methods of the anthropologist over the laboratory-based methods of the psychologist) with similar flair. In *Culture and Thought*, Cole and Scribner (1974) first introduced the notion that there could be a productive synthesis between these two traditions. In "Mind in Action," Sylvia advances the synthesis by examining the development of skill systems within the specific environment in which they are acquired. By combining observation and simulation, she contrasts novice dairy workers with those more experienced, with ingenious results.

Of particular interest to me is the comparison of the solution strategies of one dairy "preloader" (a person experienced at the job) with the office-worker (a novice at the job). The former relies on visualization techniques to solve the problem; the latter relies on verbal techniques, in the form of counting, to solve the same problem.

Interestingly, the difference in these approaches raises an additional issue—that of the use of private speech in adults. Counting is frequently used by children working on a classification task or solving a puzzle. Overt counting, however, has not been studied as an adult problem-solving method. Although we all count in demanding situations, it is more often a covert rather than an overt device. Recent research with adult students of literacy (Ramirez) and second-language learners (Frawley and Lantolf) highlights the importance of thinking aloud throughout the life span. As Scribner shows in her own data, novices faced with a new task rely upon this useful, if slow, technique.

The power of this combined methodology—observation and the simulation of tasks encountered in the field situation—continues to be impressive. Few researchers have been able to combine these two ways of examining human, thoughtful activity with the ease and ingenuity that characterizes Scribner's work. She was able to implement her own objective, to "bring some rigor to the study of naturally-occurring activities." In her view, rigor was not defined as simplification, not "the kind of thinking exemplified in the use of a single algorithm to solve all problems of a given type." Her fine-grained analyses, as we see when she compares experts with novices, reveal that effective, human problem-solving is characterized by flexibility. As did Dreyfus and Dreyfus in *Mind Over Machine*, Scribner stresses the flexibility of expert thinkers as against the rigid, algorithmic approaches so dear to those whose governing metaphor of thought is the computer.

Finally, the last dichotomy Scribner overcomes in this paper (creative as opposed to routine work activities) is also of great interest to socio-cultural scholars. She views domain-specific knowledge as a means through which expert workers overcome rules and "invent flexible strategies. Skill in this model implies not only knowledge and know-how but creativity . . ." In raising this issue she provides an important refutation to those who have tried to limit Vygotskian notions to the transmission of existing knowledge. She shows that effective work requires all of human capabilities, including creative approaches to

routine tasks. In "Mind in Action" Scribner reveals her own ability to unite disciplined inquiry with creativity.

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Comments on Sylvia Scribner's "The Cognitive Consequences of Literacy" and "Mind in Action: A Functional Approach to Thinking"

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The two papers on which Michael Cole has asked us to anchor these comments frame a series of interconnected issues that Sylvia pursued throughout her career. Long term pursuits aren't necessarily great—it is possible merely to repeat oneself, for example, or to subsist by illustrating a single basic point with a variety of examples. In contrast, Sylvia's work reflects *her* passionate struggle to change her theoretical understanding through theoretically motivated empirical research. She acted on her belief that a broad theoretical position should lead to empirical research intended to develop, challenge and in the end to reformulate her theoretical position, which in turn should inform new research. She had a sustained, complex agenda and a great capacity to learn from her own work. Sylvia, along with Mike, Jim Wertsch and others pioneered a Vygotskian, activity based perspective—a difficult, creative, courageous way to contribute to the development of psychology. She carried out a long series of research projects for which each new inquiry offered the possibility for growing into a larger vision. Those I knew best included early cross-cultural research on logic as well as literacy among Vai and Kpelle people in Liberia; the project on uses of literate and mathematical skills in interrelated jobs in a Baltimore dairy; and the recent research on complex work practices in different industrial settings.

Sylvia carried out extensive research in Liberia, including the Vai literacy project with Mike. This study of several kinds of literacy, in circumstances where literacy practices evolved in other ways than through schooling, spoke to the issues raised in the 1968 paper on the "Cognitive Consequences of Literacy" in toughly critical and—worth noting—nonliteral, oblique, telling ways characteristic of all her research. The results of this long and incredibly difficult field project were so unsettling of common assumptions about the cognitive consequences of literacy that they led her, in collaboration with Mike, to rework basic assumptions about the meaning of "literacy," and to raise questions about relations between literacy and schooling.

Sylvia also produced a series of memorable papers based on research in Liberia on syllogistic reasoning. These are not mentioned in the 1968 and 1983 papers, but their argument was part of the larger project of moving from an evolutionary to an activity-based understanding of thinking, learning, reasoning, literacy and work. The logic experiments were intended to explore the everyday uses of formal logic in "nonwestern cultures." Along with Ed Hutchins' book on Trobriand Islanders' uses of formal logic this work moved a lot of people to adopt a more critical stance towards a style of social evolutionary discourse and its correlative modes of inquiry going back to Levy-Bruhl and continuing in the social sciences through various channels including the cross-cultural work of Vygotsky and Luria. Her work called into question long-standing claims about the proper interpretation of failures to solve logic problems, and at the same time, it cast strong doubt on the value of exploring the uses of formal logic through puzzles and similarly constituted exotica in experimental research. She did this by demonstrating the varied, correct, matter-of-course uses of logical principles in Liberian people's defenses of their *wrong* responses to formal logic puzzles. She came away from the Liberian research convinced that she should carry out research in a language and culture whose nuances she could hope to address, and with a view of literacy and logical reasoning as ongoing activity, and with a desire to explore closely similar activity in a variety of contexts—another vision-expanding leap beyond earlier work. The dairy project followed.

The second paper, discussing this work, marks dramatic changes from her earlier work—changes that are so deep that they had to have been difficult and hard won (which is what passionate scholarship produces, in part). Four struck me particularly: In the conclusion of the 1968 paper she draws together evidence for the crucial charac-

ter of schooling for cognitive change and development. By the time she wrote "Mind in Action: A Functional Approach to Thinking" (1983) she was arguing that formal school algorithms were not as powerful as improvised and flexible strategies for problem solving in the work settings she explored. This was not itself a critique of schooling, but involved a more powerful claim: that significant, powerful learning occurs elsewhere/everywhere. And she proceeded to investigate more and more complex forms of work and learning throughout the rest of her life. Second, she moved from rather formal analysis of the differences between oral and written language (this analysis is characteristically rich and critical) in 1968, to a characterization in "Mind in Action . . ." of literacy as open-ended activity of many kinds. Further, her understanding of literacy shifted away from a focus on the acquisition of symbol systems to a conception of the mind's activity as part of *doing* complex work. Finally, it is remarkable—and typical of her, and a source of her depth and breadth as a researcher—that she could not resist what she called in the 1968 paper "speculation" (read theoretical analysis) from the very beginning of her career. She gradually shifted from a slightly apologetic tone in introducing this key aspect of her work, along with an expression of confidence in the rigorous precision of experimentation, to a uniquely rich approach to research through the interplay of observation and simulation experiments that led her to question the traditional divisions assumed to divide them.

This very short list surely gives notice of Sylvia's creative and comprehensive trajectory, though there is much more to be said about the development of her work, and also about how she engaged in her life as a scholar, colleague, and friend. She carried this off with high style and great wit, flashes of which come through even in these sober academic papers: those computers "lost in thought," the vivid picture she paints of the unanticipated hazards of midsummer fieldwork in a cold storage locker, and the brilliant as well as funny suggestion that learning at work is about "mastery of the concrete."

As I write this I am sitting at a sidewalk cafe in Porto, in Northern Portugal, watching three guys unload cases of Superbock beer from an open-sided truck, thinking about Sylvia and the dairy project preloaders, wishing she were here to help me think through my new research project as she has done on other, notable, occasions—of special value given the (sometimes startlingly) parallel directions in which our research developed. I think about the many pell-mell conversations we have had about our work and our lives since we met in Monrovia, Liberia in 1975 and

that continued in many other settings over the years. One such occasion occurred late in the evening in New Orleans the last time AERA met there, when it took us an hour to stroll three blocks from dinner to the hotel because, in her enthusiasm, Sylvia pulled us to a halt every time she had something especially exciting to say. She was a delightful person to talk with, to think with. She wrote wry, telegraphic poems for her friends that reflected the quality of attention and care, and time and energy, she gave in friendship. I miss her, her wisdom, wit, and warmth, far more than I can say.

Sylvia, the Technical, and the Symbolic

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Reading these two pieces, I miss Sylvia all over again. I miss her clear voice, discussing complex issues lucidly and logically; the themes of her breathtakingly original work: concept development, intellectual tools mediating social practices, everyday activity, the self; her attraction to formal schemes of analysis and her dedication to the explanatory power of theory.

Sylvia's thinking in the 1968 paper printed here led her to the work on literacy in practice among the Vai and later to look at the function and development of thinking as part of other purposive activity. Sometime after that paper, Sylvia seemed to have discovered Activity Theory and through it she found oral and written language to be more socially constrained than she had supposed. She discovered the fact that, like language, physical action is a link between objects and thought.

The intersection of the two papers included in this *Newsletter* with Sylvia's latest thinking can be found in the concept of looking at the use of symbol systems at work. Just over a year ago, Sylvia and I, along with King Beach, were working on one project in a series of studies at the Laboratory for Cognitive Studies of Work investigating the introduction of new technology into a workplace. In general, the series sought to develop conceptual modes of workplace learning. In this particular project, Technical and Symbolic Knowledge in CNC Machining, we were interested to know how computers—tools that have re-

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cently centered our cultural repertoire—affect the working procedures and mental activity of industrial machinists. The themes in that work tie together many that are expressed in the two reprinted papers.

For example, as we examined the transition workers made from using their hands to accomplish a task to using a symbol-base system of representation to accomplish the same task, we touched upon a number of interesting questions. We looked at the origin of concepts such as programming in everyday experience and in formal classroom instruction. We looked at the nature of the interface between the old knowledge systems of machining and the new and whether it was additive, displacing, transforming, complementary, or something else. We looked at whether features of programming language were internalized. We also asked questions of the method that integrated an ethnographic description with quasi-experimental and simulation approaches to the analysis of cognitive processes. Finally, we tried to develop new and valid ways of analyzing the data we collected which, of course, had no structural precedent.

As in Sylvia's earlier work, we first established certain basic understandings about both the study participants and the technology with which we were dealing. Through observations and conversations we found that machining is a highly complex set of skills involving concepts of math (geometry, trigonometry), physics (metallurgy and mechanics), tool and machine construction, health and safety, and workplace and production demands. These, as well as programming skills, are often learned entirely on the job. We learned that the computerized machine tools not only disrupt the usual feedback systems of the machinist but they also require more mental planning and imaging to run than do traditional machines. These kinds of findings created a rich set of possibilities to probe as we tried to characterize the changes that the technology affords.

As we connected our understandings with related work in cognitive studies, we saw that with computer-controlled machining experience, machinists made different use of written symbol systems as they thought through a job. Among other things, they talked about their work differently, using programming referents semantically as well as structurally (i.e., thinking in more linear fashion). In solving problems, however, the machinists base their thinking on their practical experience. In sum, we found continuities, discontinuities, as well as transformations between the old and new knowledge systems. We concluded that the changes engendered by computer-based machine tools have implication for thinking about training

in the future, where the computer-based machine can be regarded as a powerful new machining tool rather than a formal system in itself.

One aspect of change that Sylvia was interested in including in our analysis had to do with workers' sense of self as they came to master new technologies. We looked for not so much the detachment of abstraction that Sylvia described in connection with objectified language and thought, but a sense of mastery and control that generalizes to one's hopes for the future: objectified action, perhaps.

While Sylvia very much enjoyed discovering the formal scheme that could describe the behavior she was studying she was also careful to document the parts of the scientific process that aren't always discussed—the forgotten mittens, difficulties getting access to working environments, the problems of developing tasks that get at the phenomenon in question. I can't say our own study was smooth sailing, but we tried to document it in a way that did not "clean up" the "noise" in the world we were studying. At the same time, we tried to highlight the findings that contributed to the development of the theory or model.

A final theme I see in these papers and in her last work at the lab, related to the gritty reality of doing field science, has to do with Sylvia's respect for the knowledge of ordinary people. It has to do with seeing social invention in commonplace activity and with discovering scientific truths in the everyday. Happily, others are joining this tradition in taking their own work forward.

From Mental Capacities to Activities in Context: The Evolution of Sylvia Scribner's Cultural Psychology

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Good ideas are hard to come by. Their development takes long participation in the world, and, even if you are lucky to get some, they are only useful after they have stood the test of being dipped back into that world and

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changing it for the better. There are some good ideas in Sylvia Scribner's prescient papers on literacy and working intelligence. We can notice from their limitations how they were embedded in the problematic world of which she was a part, and we can notice from their successes, and the ways in which the successes have fared over the years, how they have resisted for the better the world from which they emerged. The purpose of these memorial remarks is to cite the world that gave her problems to work on, to celebrate the ideas that she developed in resistance to the problems, and to wonder how we can honor her past and our future by dipping her ideas back into the world.

Make it New York City, early 1968. It is the McLuhan age, and alphabetic literacy is being heralded most everywhere as a non-racial dividing line between kinds of persons: primitive and modern, poor and middle class, rural and urban, and, perhaps only a little less rigorously, those over 30 and their electronic offspring. It is also a time when academic experimental psychology was gaining hegemony over the interpretation of our children, and, when applied to the children of the poor, this hegemony took the form of a theory of cultural deprivation. Even Arthur Jensen was writing, however badly, about the influence of social class on I.Q. scores. It was only natural that the literature on literacy and kinds of persons would be married to an account of school children and their development, or lack of development, of higher psychological processes. A back-to-back reading of Goody and Watt's "Consequences of Literacy" (1963) and Martin Deutsch's *Disadvantaged Child* (1967) shows them to be amazingly similar in their arguments and claims; together, they made the case that culturally deprived cultures have culturally deprived kinds. Only a few months later, as a beginning school teacher of African-American children, I authored such a marriage with a paper on "culturally induced dyslexia." It was in the air.

If early 1968 was exactly the time to write papers on literacy and higher psychological functioning, the later half of 1968 was a time for noticing that political and economic realities were what really counted in the organization of apparent differential abilities across social groups. SDS took over Columbia, Kennedy and King were murdered, and New York City settled in for the racially volatile school strike from which it has yet to recover. Only a few months later, Nixon was President, and Congress took seriously Jensen's new work on race and I.Q. as an excuse to cut aid to education. Whatever they were psychologically, levels of literacy were clearly political.

Sylvia's paper on "The Cognitive Consequences of Literacy" was written in the style of early 1968. It shares

the enthusiasms of the time, and the limitations. Despite its title, the paper examines no literacy system, never mind in its cultural context, and common-sense about literacy is substituted for the detail. Fifteen years later, in the paper on "Mind in Action," she reminds us that "the concrete details will tell you more about the intellectual intricacies of work tasks than sentences of fluttering generalities." In both her Vai literacy and her factory work, Sylvia would deliver important detail, but, in her earliest work, she was limited to problems as they were defined, re-searched, and solved, badly in all three cases, by those who came before her. In 1968, Sylvia was yet to hear of the trilliterate Vai, the hyper-literate Hanunoo, the fifteenth century court phonologists who invented the Korean alphabet, or the ancient Vedic scholars who preferred memory for its accuracy over printed texts, all cases that raise disruptive questions about Graeco-Roman literacy as a uniform technology of the mind that leads to history, science, democracy, and higher forms of rational thought. Sylvia did not yet know that later that same year, even Jack Goody, to this day only half attentive to his critics, would soften the title of his "consequences" paper by writing about the "Implications of Literacy."

We are fortunate that the past 24 years have delivered us to the materials we need to complain about the unexamined parts of Sylvia's "Cognitive Consequences" paper. That Sylvia helped to deliver some of the materials herself suggests that *she might have known better all along*. She did not need the second half of 1968 to teach her any political lessons, for they had been well learned in her decades of work for labor unions. She may have needed the Vai materials to set her theoretical language free from the constraints of her time, but by early 1968 she had already developed the definition of her problem in ways that would open psychological theory to cultural and political considerations:

If conceptual systems help shape the mental life of man, man's mental products should be predictably different in cultures which possess or fail to possess the particularly important tool system of the written language. If a comparative study should reveal this to be the case, we would have no grounds for inferring that the mental capacities or laws of thought are different in adults of more or less technologically advanced societies. We would have grounds, rather, for inferring that the existence of a written language system (probably along with other technological systems) is related to changes in the way man utilizes his mental capacity (p.91).

It is interesting to see how people in different settings do things differently, and it is interesting to see how such

differences have consequences for what in this culture get called psychological processes. That was Sylvia's program. People are interesting, and what they do and how they think are worthy of analysis. Such a descriptive effort does not have to be exclusionary, deprivationist (although note the use of the fail in "fail to possess"), or racist. That having been said, it would take Sylvia the next 12 years of her life to work out the methodological dilemmas posed by actual cases of people utilizing their mental capacities differently from what we might have expected, in her case, the Kpelle handling syllogisms and the Vai handling their literacies. By 1983, the same sensitivities are at work, the same point being made, but the theoretical agenda has shifted from a language of mental capacities and laws of thought to a language of activity and participation:

Instead of conceiving of literacy as involvement with written language that is the same everywhere and involves some fixed inventory of capacities, we began to think of literacy as a term applying to a varied and open set of activities with written language (pp. 104).

This is a shift that makes a difference, for it forces the analyst to locate the individual mind as a fast action nexus for processing patterns of human interaction that reach far beyond the person into the institutions that organize the materials with which and about which we do our thinking. It is no longer enough to treat the mind, either theoretically, or more importantly, methodologically, as if it were separate from the world in which it exists; neither mind nor society is an independent variable. There was no way, in 1968, for Sylvia to know how much her call for including the social world in psychological analysis was going to push her into a theory of interaction. Fortunately, she had an excellent guide, namely, an understanding that all people - those with modernization, literacy, and a game called syllogisms as well as those without, those with middle class, white faces as well as those without - must be understood in terms of their work, in terms of what they do and the contexts and consequences of that doing for the people around them. That such an agenda led her to insist on a reform of psychology is her gift to us all.

Long and principled participation in the world got Sylvia Scribner some good ideas, and it is our job to dip them back into the world. Psychology has made great strides since 1968. The Laboratory of Comparative Human Cognition where Sylvia worked with Michael Cole through most of the 1970's is no longer a lone champion for situated cognition and cultural psychology (as they are now called). The word has spread, but there is much methodological hand-wringing and empirical work left to

do. Most importantly, there is the job of reorganizing schooling and on-the-job training to allow those who are still left out of American culture to gain access to practice and participation. Imagine a world in which researchers are not asked to explain what is wrong with the thinking of those who have been left out. Imagine a world in which a psychology of thinking would get us explicit instruction on how to reorganize the sequencing of activities in ways that would aid, rather than stigmatize, the thinking that people can do. This is the world for which Sylvia was trying to build a psychology. For her it was an intellectual battle. For those who follow, it is both an intellectual and an institutional battle.

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Counter Currents in Sylvia Scribner's Work

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Sylvia Scribner's papers published in this edition sample two very different phases of her research work: the psychological implications of literacy and research on cognition in practice. Read together they demonstrate how her research findings challenged and transformed her own conclusions and position concerning the impact of literacy practices on psychological functioning. We see no rationalizing of negative findings, and no comfortable adherence to routines of research that merely turn the academic mill. Her research is critically reflexive. That alone sets her scholarly achievements apart from the crowd. But more than this. Her orientation to the different topics reveals powerful theoretical continuities that voice an innovative agenda for understanding the development of psychological functioning. The accomplishment of her arguments, their wit, craft and consequence, consistently subverts more orthodox positions within developmental research. These short notes identify some key inversions

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of conventional wisdom that position her work as innovative developmental research.

Not surprisingly for someone who made critical contributions to burgeoning socio-cultural literature, cognition and development are not analytically bounded by the individual. However her contribution goes well beyond general statements intoning the importance of the social location of developmental processes. She directly addresses psychological functioning as part of a trajectory of development that is societal and not merely social. The elegant descriptions and modelling of communities of working practices demonstrates development as a transformationally inventive process. Development is treated as no mere reduplication and internalization of cultural givens but as inventiveness through improvisational innovations.

Her pursuit of development as an inseparable process of appropriation and innovation also mounts a concerted attack on the *a priori* acceptance of categories of analysis drawn from dislocated research in psychology. In focussing on the functions of externalization, the trajectories of human activities both across and between life spans, it becomes impossible to assume the structure of human activity analytically and to predefine the components that make it up. Such a move was clearly foreshadowed in her approach to the analysis literacy practices where counsel was given to resist definitions of "what mastery requires" in favour of focussing on "what mastery contributes" to psychological functioning. One of the consequences of working such an inversion is to bring into analytical attention participants' understandings concerning the accomplishment of their minds in action. The ubiquity of variation and flexibility within even the most "Taylorized" of jobs affords the space for improvised solutions that orchestrates the unsung expertise of ordinary working lives. Such flexible expertise is wrought in bridging the gaps between institutionalized expectations and the necessities for smooth performance in getting your acts together. This also marks a further inversion of psychological focus from individual skills to practices as objects of study that are just as much a concern for the worker as for the research worker. The move from novice to expert, dependent to interdependent participant, is the accomplishment of practices as participants' concerns.

However, the methods adopted in Scribner's work do not treat those participants' accomplishments as transparent, as merely revealing the workings of an inner minds via externalized protocols of problem solving. Hers is a situated analysis of cognition in practice where what counts as

data also counts in practice. Inevitably such a focus creates research practice that is able to encompass a reflexive relationship between theoretical generalizations and the common senses of human activities. A mode of research is developed that is capable of being appropriated and used in the transformation of the very domains from which the data is gathered. The choice of experimentally modelling performance conditions is just one mode of argumentation in developing reflexive research practices.

The situated nature of such an enterprise also foregrounds the interdependence of principle and practice, of the concrete and abstract, the general and the local. Variations in locally realized solutions to apparently equivalent demands in working performance no longer represent an analytical embarrassment. They provide the resource for participants to generate principled achievements in the face of indeterminate local circumstances. Equally they are an analytical resource for understanding the nature of minds in dialogue with culture.

Her written work may well have been crafted in solitary performance but her voice remains part of the continuing dialogue with those concerned to explore the situatedness, the functionality of variability, and intellectual flexibility in local practice, as the basis for a generalizable understanding of culturally grounded accounts of mind in practice.

Biliteracy and Thinking

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The most basic definition of literacy is simply the ability to read and write. By extension, then, biliteracy would be the ability to read and write in two languages. However, as Sylvia Scribner helped us understand, when we consider that literacy is acquired or learned by diverse human beings in a variety of complex contexts, including home, school, work, and other settings; that it can be learned at different ages, and taught in any number of different ways; that it comes in different forms that are used for a variety of purposes, and that these purposes may differ from, say, one cultural group to another, or that, in

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the case of biliteracy, it may involve a language that one does not speak, matters become considerably more complex.

In this paper I want to describe some of our work on biliteracy, especially those situations in which children attempt to become literate simultaneously in two languages, a phenomenon that occurs primarily, at least in this country, within classrooms and schools.¹ Our research has focused on Latino children in the United States. Inspired and informed by Scribner's efforts at "unpackaging literacy" (Scribner & Cole, 1978, 1981), our studies could be described as attempts at "re-packaging literacy" in pedagogically useful ways by paying special attention to the relationship between classroom practices and bilingual children's ways with literacy. In particular, we have emphasized the importance of "cultural resources" (e.g., the children's and teachers' bilingualism) in mediating and supporting children's literacy learning in either Spanish or English (e.g., Moll & Díaz, 1987).

Our most recent efforts, combining anthropological research in households with teaching or formative "experiments" in classrooms, has helped us elaborate further this connection between cultural resources and teaching practices (Moll & Greenberg, 1990). We have studied, for instance, how households function as part of a wider, changing economy, and how families obtain and distribute their material and intellectual resources through strategic social ties or networks (e.g., Vélez-Ibáñez, 1988). In terms of our analysis, the most important function of these social networks is that household members can share or exchange what we have termed "funds of knowledge": those historically accumulated bodies of knowledge related to the social and labor history of the families and of other participants in the household networks. Akin to Scribner's (1986) analysis of "thinking-in-action," we have used the study of household dynamics, especially the development and uses of funds of knowledge, to highlight how people use each other, and their cultural resources, as mediators of intelligent actions (Moll, Tapia, & Whitmore, in press).

A related goal in our work has been to determine the implications of our household studies for classroom instruction. Our primary strategy has been to create household analogs: that is, classroom "activity systems" in which teachers and students use their funds of knowledge and develop strategic networks to connect to the expertise found outside the classrooms, thus transcending the intellectual limits of traditional school learning for the children in our studies (Moll, 1992; also see Miettinen, 1991). In

our terms, we attempt to develop interrelated zones of proximal development, where, "social processes and cultural resources of all kinds are involved" in the children's construction of their (academic) future (see Scribner, 1990, p. 92). In these contexts, biliteracy represents a particularly powerful means for thinking, for gaining access to what Olson (1987) has called, "the valued resources of the culture" (p. 7). In our classrooms these valued resources include not only the teachers' and students' social networks and their funds of knowledge, but literate resources in both English and Spanish.

Two examples may suffice to illustrate how biliteracy becomes an intellectual tool in these contexts. One type of classroom activity has been to generate theme studies based or related to household knowledge. For example, some of the classrooms have studied, among other topics, the theme of construction, including the planning and building of structures. As part of the theme study, especially to help the students specify their topics, the children and the teacher may first accumulate a set of books and articles related to their theme. These materials are in both Spanish and English, showing the students how bilingualism serves to "amplify" their resources for thinking; and conversely, how monolingualism can be an annoying constraint on their ability to do academic work.

Clearly, biliterate students have access to not one, but two literate worlds to draw upon. Similarly, when developing, say, questionnaires as part of their inquiry, they can develop a version in English and one in Spanish, facilitating access to the knowledge and opinions of not one, but two social and cultural groups, and the recording of data or related writings may be in either language. As well, when guests from the community come to the classrooms to share their funds of knowledge, their presentations may be in either language, or in both, for that matter. An important consequence of these activities, we believe, is that both students and teachers start defining their local communities and households as important *cognitive resources* for doing serious academic work (see, e.g., Moll & Greenberg, 1990).

A related activity occurs when the literature itself is the primary object of study. Here the purpose is not only to derive meaning from the readings, but to discuss and analyze the readings in depth. One such example involved the children (third graders) collecting and reading different versions of the same fairy tales, including versions in Spanish and English (see, Whitmore, 1992). An outcome of the literature study was the development of a chart, generated by the children, specifying the characteristics of

the different stories and of the fairy tale genre, regardless of language. Interestingly, because this was a genre well known to all the children, it greatly facilitated the participation of non-fluent bilinguals in the activity. For instance, even if a child did not know Spanish very well, she could use her knowledge of genre to predict meaning in the Spanish readings. Knowledge of genre, in a sense, represented a common context for the transfer of knowledge and of strategies for making meaning from one language to the next, and supported the children's nascent second language reading abilities.

In these contexts where reading for meaning is emphasized, and where children are encouraged by the teacher to actively take "risks" as learners, children often seek out biliterate experiences, thus negotiating for themselves the challenge of second language learning, and consciously start taking advantage of their personal and cultural resources for learning. We routinely find Spanish speakers using their literate knowledge of Spanish to attempt to write in English; and we also find English speakers doing the same in producing or reading Spanish text; and we also notice that some children's reading exceeds their oral fluency in their second language, questioning the common assumption that progress in reading is directly dependent on progress in the spoken language.

In all, within these classroom contexts there are multiple paths to becoming literate in one or two languages, and the possibilities for using literacy in two languages as an authentic intellectual tool appear endless. As Scribner (1986) commented about the higher cognitive processes involved in practical problem-solving, thinking is always interdependent with the characteristics of the environments. However, she wrote, "properties of the environment do not enter the problem-solving process deterministically or automatically; they assume a functional role only through the initiative and constructive activities of the problem solver" (p. 23). And in classrooms, as in households, as in factories, these "initiative and constructive activities" of individuals are always mediated through other human beings and through the use of the resources of the culture.

Notes

¹I do mean to imply that children develop literacy or biliteracy solely in classrooms; not only is life outside the classroom of great importance for the development of literacy, but children may become literate before or without formal schooling. Rosi Andrade, Joel Dworin, and Kathryn Whitmore have contributed greatly to the work summarized in this paper.

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Sylvia Scribner's "The Cognitive Consequences of Literacy"

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In this paper a remarkably mature scholar - although still a graduate student - outlined the research goal that was to drive her own work for the next two decades: "To lay an empirical base for studies on the interaction-effects of specific cultural institutions and specific cognitive processes," in particular the institution of the school. She noted: "While the written language is an indispensable and inseparable feature of the school experience, the converse does not hold. The opportunity still remains to investigate the impact of written language acquisition divorced from the school context - a step which . . . may further *unravel* the complexities between culture and mind." This goal was the motivating force for one of her greatest achievements, the study of three types of literacy among the peoples of West Africa, which she carried out with Michael Cole a decade later.

The hypotheses that Sylvia set out in this early paper were (1) that literacy moves thinking to a new conceptual level, and (2) that literacy moves thinking from the spontaneous unmediated to the conscious (as outlined in her table). In the latter she followed Vygotsky's argument that spontaneous concepts exist prior to the scientific concepts taught in school. Her distinctions are worth emphasizing:

The primary distinction. . . between the two levels of conceptual thought is that in one the referent content of the concept is an object or some aspect of an object or material reality, while in the other the referent concept is another concept. . . First-level concepts are formed through commerce with physical and social reality mediated by oral language. In the formation of this kind of concept, the word directs attention to properties objects have in common and it functions as a name or label for this "commonness." On the second level, the word directs attention to the semantic properties of other words (verbal concepts) or, to put it a little differently, to some attribute or aspect of a concept (1968, p. 95).

These distinctions were novel when she wrote and are still underappreciated today in studies of conceptual development.

I first encountered Sylvia's work - before encountering her in person - in her 1973 article in *Science* (co-authored with Cole) on the "Cognitive Consequences of Formal and Informal Education." In that elegant piece, they played on the alternate string to that emphasized in this paper, suggesting that school itself—with its institutional arrangements and cognitive demands—was responsible for establishing an abstract mode of thinking in its pupils. In a day when the education system was in crisis, reforms were rampant, and the genetic basis of intelligence was being touted (today's situation is not in this sense historically unique), this clear analysis of how school instills in pupils a new kind of thinking was both original and persuasive, despite the lack of solid empirical data to support the argument. That data would come later. Indeed, in the literacy book it emerged that schooling was the primary catalyst of abstract thinking, just as she and Mike proposed in 1973.

Yet in this early statement she was cautious about positing "levels of thought" that might shed invidious light on some individual thinkers. "What is clearly needed, it appears, is some differentiation of levels of conceptual thought that will permit us to remain loyal to observed differences between modes of thinking without denying to any normal human thought the generic capacities for generalization and abstraction." In the later schooling piece as well there was the concern that the more abstract stance of "school thought" could divorce the child's thinking from problem solutions worked out in the everyday world, what Sylvia came to think of as "practical intelligence."

This concern reflected the deeper dilemma that all who contemplate levels of thinking, in the individual, or in groups, must face. How can one accept the evidence that there are levels of thought, not just in the course of development from infancy to adulthood, but among groups of adults as well without devaluing one or the other? The cognitive development theories that dominated at the time she wrote (and for some years thereafter) posited universal structural change, resulting in developmental levels of thinking that were assumed to be universal across the species. Comparative studies, such as those carried out by Sylvia and Mike called these conclusions into question, but in doing so raised the tougher issue of how to view and to value thinking that was not reflective of the levels considered highest and best by Western theorists.

Sylvia's proposed solution, the best possible at the historical moment in which she wrote, drew on the observations and theories of anthropologists and linguists, as

well as the newly uncovered writings of Vygotsky. She anticipated the answer that Luria and Vygotsky posed based on their work with the conceptual thinking of Siberian peasants (not yet published when she wrote in 1968), namely that conceptual "deficiencies" were the result of lack of opportunity to share in the literate practices of the school. Sylvia based her research strategy on the point that literacy and schooling were theoretically independent factors, although almost always found together and thus confounded in practice. As this programmatic paper indicates, her initial bet was on the contribution of literacy *per se*, drawing a line between literate and non-literate thinking, analogous to the line that Vygotsky drew between spontaneous and scientific concepts.

There is much more here that reveals the thrust of Sylvia's mind and future work. Given the maturity and theoretical sophistication of this paper, one should not have been surprised at her not always repressed impatience with many of her colleagues - and her students - as they struggled with the ideas related to hers, but with far less depth of scholarship and clarity of thought, or with ideas that to her mind were trivializations of the deep questions to be addressed. In 1968 Sylvia could draw freely on the writing of major thinkers in anthropology and psychology who had delineated the basic questions concerning the relation between language and thought. One has the sense that since then - in some ways such a short time ago - the task has grown harder. The themes that were displayed in the work of Bruner and his students, Levi-Strauss, Goody, Bernstein, and most of all Vygotsky, have since been obscured by a cacophony of voices, most overwriting these messages from diverse perspectives, others amplifying parts and distorting the whole. Sylvia's clear call for a sustained program of research that would delineate the effects of becoming literate, for the individual and the society, has been largely neglected within the field in which she cast her lot, cognitive developmental psychology. Literacy has caught the attention of educators and policy makers, but their concern for achieving literacy for all citizens in our technological society, sometimes appears to be less interested in the individual than in the state. Sylvia, of course, was concerned with the individual within the culture of literacy. That she did not achieve final closure on these questions did not dismay her; she often noted that biologists may spend a lifetime studying the habits of mollusks, while those who study humans seem to expect to uncover final truths about the mind with a few well-placed experiments. Sylvia did not share this illusion or the particular hubris that lies behind it, but to the end she devoted herself to the struggle to answer the important questions raised in her earliest work, along the way

devising new methods appropriate to the task. Fortunately, there are now many who share her vision and can carry forward the work projected here.

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Sylvia Scribner: A Mind in Action

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Many lessons can be learned from the work of Sylvia Scribner—an unforgettable role model for me. One of them can be captured in the following quote:

We went to Vailland hoping to prove that literacy, with or without schooling, promoted higher mental abilities that humanists have long supposed it to do. Our expectations were dashed. Nonschooled literacies among the Vai were not like schooled literacy. We found no *general* effects of literacy as such and no higher skills common to all three literacies (1983, p. 104).

Sylvia Scribner's was a mind in action. Her hypotheses on the effects of literacy were not passing thoughts. They were the fruit of reading, comparison of theories, and consideration of much past research. Goody and Watt (1963), she pointed out, had identified profound differences between ways of acting and knowing in literate and non-literate societies. Bruner, Olver, Greenfield, et al. (1966), however, observed in cross-cultural comparisons that school children from different cultures reasoned in ways that were much more similar to each other than schooled and unschooled children within the same culture. Thus, she cogently argued (Scribner, 1968), it could be that what mattered was not the culture as a whole but children's experiences with literacy. Perhaps differences attributed to "development" in industrialized societies—such as those between concrete and formal operations—are in fact the result of literacy learning. If literacy makes language the object of thinking and if formal reasoning involves taking language as the reality to be operated on, could it not be the case that literacy was causally connected to formal thinking?

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Scribner's argument was much more complex than this simple outline can reveal. To her, mind and culture are so indissociable that social scientists view psychological processes as mediating mechanisms in cultural development whereas psychologists try to understand how social functions work as mediating mechanisms in psychological development. She had considered the evidence on how language becomes internalized and later is used by individuals to guide their actions. She then advanced the hypothesis that culture operated in yet another way: written language provided thinking with a way of examining itself. Literacy would move thinking to a new level—a level of abstraction in which the world of things no longer mattered because manipulations were carried out on words.

This was an alternative hypothesis to the widely accepted Piagetian view of development as independent of cultural acquisitions. It must have been the product of much work. Yet when the "expectations were dashed," Scribner and Cole neither closed their eyes nor packed in their bags the conclusion that culture does not matter for intellectual development. They developed in the course of their work another approach to understanding literacy—not as a system of representation that makes words into objects but as a part of purposeful acts. This new approach brought the notion of skilled action to the foreground.

Scribner later researched skilled action in the work setting. Variability and flexibility were characteristic of her research. Observations in the field led to hypotheses which were tested in experiments and new field observations.

Scribner developed more than a set of hypotheses about skilled work in a dairy factory. She discussed her findings in the light of current views of "higher" levels of thinking and questioned the prevailing assumption that intellectual growth is a move from concrete to abstract. In her own words:

In contrast to the conventional psychological model of learning which assumes a progression from the particular and concrete to the general and abstract, skill acquisition at work seems to move in the direction of mastery of the concrete. . . . Learning at work consists of adapting this prior knowledge to the accomplishment of the tasks at hand. Such adaptation proceeds by the assimilation of *specific* knowledge about the *objects* and *symbols* the setting affords, and the actions the work tasks require. Domain-specific knowledge reveals relationships that can be used to shortcut those stipulated in all-purpose algorithms. . . .

Optimizing thinking stands in sharp contrast to the kind of thinking exemplified in the use of a single algorithm to

solve all the problems of a given type. Algorithms describe how *computers* solve problems. Variability and flexibility describe how *skilled* workers solve problems (1983, p. 109).

Thus Sylvia Scribner left us new hypotheses for the study of thinking in action, which I want to explore briefly now. This new perspective holds that flexible processing of information, a more advanced form of thinking, involves domain-specific knowledge that allows for the recognition of significant relationships in that domain. What developmentalists treated in the past as "mere learning of contents" was assigned a major role in thinking about those contents. Systems of knowledge, such as numeration and classification systems learned in connection with mathematical and scientific activities, help us understand relationships which would not be evident otherwise. Scribner's milk packers, for example, used a base-ten system (from experience with counting and writing numbers) and also a base-four system learned in their activities as product assemblers. The "mere learning" of how cases were organized, what they looked like when half or a quarter full, the number of units in multiple cases, etc. allowed for the performance of a "mental math virtuoso": someone who could use 25 different solutions for problems that had the identical units-time-unit-price format.

Scribner was cautious about how far her theory could be extended. She confined it to thinking-in-action or practical thinking. Hoyles (1992), a mathematics education researcher, has just crossed the boundaries between practical and academic thinking and brought Scribner's ideas to bear on an analysis of adolescents' reasoning solving mathematical problems on a spread-sheet. Spread-sheets display information in a visual format that makes it easy to point at the information. In this context students "see" patterns that are by no means obvious outside the spread-sheet environment and that help them be more flexible in their analysis of the problem they are trying to solve. The challenge of finding ways of integrating specific knowledge and reasoning stands now for all of us interested in skilled problem-solving. I believe we can find in Scribner's methods suggestions for how to test her theory of thinking-in-action in the domain of academic problem solving.

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Scribner on Writing

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A scribner is, of course, a writer. Whether that contributed to Sylvia Scribner's interest in writing is not clear. What is clear is that she thought, following such social theorists as C. Wright Mills, that cultural products, such as writing, must have a place in the cognitive processes of individuals. Her 1968 article "The Cognitive Consequences of Literacy" advanced two hypotheses. One was that literacy moves thinking to a new conceptual level and the second was that it does so by making thought processes more conscious. Putting flesh on these bones has, indeed, been difficult, sufficiently difficult that it is not clear that Sylvia continued to hold them as plausible.

How would one recognize a new conceptual level? Scribner and Cole hoped to find differences in syllogistic reasoning. Results were disappointing. Members of traditional societies reasoned as well as anyone; the problem was in getting them to take the premises seriously. In that, they were not much different than the undergraduates studied a decade earlier by Henle. Schooling had an effect on such tasks but it appeared that this may be a product of the fact that the tested items were similar in form to the very activities common in classroom discourse. If so, they seemed to reflect specific local practices rather than general cognitive principles.

The irony is that just about the time that Sylvia moved away from these cognition-literacy hypotheses, the data began to roll in that they are indeed true. The work on phonemic awareness by such writers as Bertelson, Reid and many others has shown that it is exposure to an alphabetic script which brings such segments into consciousness. Other work by such writers as Reid, Ferreiro and many others has shown that exposure to writing is

responsible for bringing words (not, of course, names; words are syntactic elements) into consciousness. My own work suggests that literacy is responsible for bringing sentences and statements into consciousness; to a clear distinction between what was said and what was meant by it. These effects seem to be a product of merely learning to read a particular historically evolved script.

The implications of literacy do not end here of course. For the interesting fact about literate culture is the peculiar archival functions written records can play. Becoming literate is not merely a matter of learning how to decode but also of how to access and use and more importantly, interpret, the archival products of the culture. Learning to read does not turn one into a grammarian or a logician or a philosopher but it does provide the basis for developing into any of those. One becomes a grammarian or a logician by introspecting language in terms first of the categories explicitly represented in the script and later in terms of the grammatical and logical theories evolved along those lines in that culture. Those theories are products of a literate tradition and they are comprehensible only in terms of that tradition. The logician is concerned with the relation among statements (not beliefs). The enterprise is possible because of a concept of a statement as opposed to a paraphrase or an intention. Further, it is an enterprise which depends critically upon the distinction between literal and metaphorical meaning. "The road is a ribbon of moonlight" does not imply that it can be cut, for example. Never mind that the distinction is not rigorously enforceable; the interpretive practices of intending that an utterance be taken as a metaphor or as literally true, as loosely or technically speaking, practices evolved in a long literate tradition in the West, temper the comprehension processes of children to the extent that these distinctions have been mastered at home or at school. It is a simple mistake to assume that the legacies of literacy accrue to an individual simply because they learn to read and write. But it is equally a mistake to overlook the fact that writing has put and continues to put an indelible stamp on that culture, cognition, and consciousness. These are not mistakes that Sylvia ever made.

No Nestling in Small Niches: Seeing Big Ideas in Little Places

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When I had the good fortune to meet Sylvia Scribner in the early 1970s, I was awestruck by the powerful blend of personal and intellectual qualities she brought to her work and collaborations with colleagues, students, and friends. The rich gifts she possessed and shared with so many of us permeate her work and continue to inspire her many followers. The two unpublished manuscripts at the center of this special issue serve as excellent examples of the profound and enduring impact her ideas have had on the intellectual life of our community. Of the many qualities evident in these papers are two which have meant the most to me: (1) Framing research on culture, cognition and behavior - especially detailed observation of naturally occurring behavior - within major theoretical ideas and intellectual traditions; and (2) Drawing implications of advances in theory for progressive social action, e.g., improving education and the organization of work.

In "The Cognitive Consequences of Literacy," a germ of the seminal Vai project of Scribner and Cole can be seen, years before their research began on separating the cognitive effects of literacy and schooling:

While the written language is an indispensable and inseparable feature of the school experience, the converse does not hold. The opportunity still remains to investigate the impact of written language acquisition divorced from the school context - a step which the pioneer studies of Vygotsky, Piaget and Bruner suggest may further *unravel* the complexities between culture and mind (1968, p. 100).

The enormity of the eventual and enduring impact of the ideas (and almost uncanny prognostication of the Vai project) in this early manuscript is evident: The manuscript broadened the conception of literacy by placing it in a rich intellectual framework of impressive breadth and power. This helped Scribner and Cole to observe and understand their empirical studies of literacy in sharp relief against the backdrop of this intellectual framework, and thus enabled their substantial theoretical advances. These ideas served as an early beacon that guided a line of research that has revolutionized the concept of literacy for broad communities of scholars and practitioners alike. By

the end of the Vai research, Scribner had elaborated a new theoretical framework which she called a "practice framework of cognition."

In "Mind in Action: A Functional Approach to Thinking," Scribner again creates a brilliant theoretical framework from which she illuminates and analyzes new perspectives on cognition in a crucial, but largely unexplored, domain of human activity, work:

To discover the functional properties of thought in action requires that we take a look at the actual phenomena under natural conditions. That is what my enterprise is about. I am attempting to place the study of naturally occurring activities at the center of *cognitive inquiry* (1983, p. 103).

Her manuscript goes on to provide early but persuasive and influential illustrations of how cognition situated in the workplace is structured in ways that reflect the particular social and material organization of that work. Entire lines of empirical research and theory on cognition and activity in work settings continue to emerge and develop which owe a profound intellectual debt to these ideas. From her "practice framework" emerged important methodological principles whereby "the practices themselves need to become the objects of study," principles which not only brilliantly guided her own subsequent research but that of myriad students and colleagues around the world.

The pervasive theoretical insights which informed first Sylvia's own research and later the work of her worldwide audience are a remarkable contribution. The analytical components underlying these contributions are readily apparent in reading her work. But what has impressed me even more has been her capacity to see theoretical ideas at work beneath the fine details of naturally occurring behavior. Perhaps this apparent perceptual expertise is akin to the chess master's direct perception of potential moves (cf Note 11 in her 1968 manuscript). Perhaps this ability rather reflects her "mastery of the concrete," which her 1983 manuscript (p. 22) suggests is at the core of work-related skill. In any event, it is clear that she had an extremely well-developed capacity for seeing big ideas amidst the little details of naturally occurring behavior.

A second rare talent she brought to her work is also responsible for its enormous impact. She had the ability to turn the lens around, as it were, and use specific examples of behavior she observed to illustrate new theoretical principles that might underlie improved practice, whether

in education or in the workplace. She had the knack for demonstrating William James' adage that there is nothing as practical as a good theory. Her ideas have had considerable impact—whether in education or the workplace—on how practitioners have come to see and understand their own activities.

Neither of the manuscripts discussed here was composed for an audience of practitioners or policymakers (as were some of her presentations). But the success with which the "dairy" manuscript grounds important theoretical developments in the analysis of concrete examples of behavior illustrates her well-honed ability to move from the concrete back to general principles and their practical implications. As a result, her research has been effective at pointing out important new directions not only for researchers but for practitioners as well. Educational practice has benefitted enormously from her research on literacy and cognition. Her later, but sadly unfinished, program of research on cognition at work will, over time, also have enormous practical impact on future reorganization of work and workplace training. It has already had great impact on a burgeoning community of workplace researchers. She has left us, her students, colleagues and followers, a legacy and a collective challenge to emulate her extraordinary capabilities to see big ideas in small places, and to use these as a stage from which to project practical applications. Let the good work continue.

Putting Mind Back into Action

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The expansion of research on human cognition as we presently know it was made possible by the separation of thought as an object of scientific inquiry from the worldly projects pursued by human beings in purposeful and collective activities. When the study of memory was domesticated by Hermann Ebbinghaus in 1885 and brought into the protected and scientifically acceptable haven of the experiment, thinking was shaped in such a way that "pure" cognition could be attended to. The memorization of meaningless syllables under strict control allowed for exact measurement and law-finding. On the horizon scholars saw a science of the mind with a rosy future that would

follow the adoption of methods of research that had been so successful in the natural sciences. No longer would we have to worry about the factors in everyday life that contaminate rigorous research. The fact that people very seldom memorize anything remotely similar to syllables, but rather use external tools such as paper and pencil when they must remember something important, and that the world is inherently meaningful could be disregarded. When all there was to know about "pure" cognition had been learned, this "theoretical" knowledge—so the argument went—would be brought to bear on more "applied" problems.

Most scholars of today interested in mediated action and in overcoming the dualist perspective on mind and action have been involved in a process of unlearning some of the lessons that have been collectively acquired during this century. There was, many felt, something strange about this dualist understanding of the relationship between mind and action. The replacement of the mindless behaviors studied during the heyday of behaviorism with abstract and disembodied mental information processing machineries offered no solution to this dualism but rather was a move into the other, historically quite familiar, position, idealism. However, when unlearning one feels the need to relearn and this takes guidance in the zones of proximal development where researchers tread. Sylvia Scribner was undoubtedly a person who was most important in this reorientation and whose works in a very concrete sense filled the role of providing orientation in uncharted waters.

Already in the 1960s Sylvia Scribner started formulating some of the basic ideas of the perspective on literacy that she was to explore extensively in the work together with Michael Cole and which has been summarized in what is now a classic: *The Psychology of Literacy* (1981). Her approach to literacy bears evidence of this striving to see mental activities as social in nature and as inseparable from human action in general. Thus, instead of asking what reading and writing do to the human mind, she formulates her questions to address the issue of what it means for humans to participate in literate practices in terms of the repertoires of mental and practical skills available. Thus, reading and writing are not perceived as activities that somehow *per se* mysteriously raise our intellectual powers and make us into abstract thinkers. Rather, the productive issue to pursue became one of unraveling what kinds of social activities that are mediated through literacy, and what participation in such practices means for human cognition. Thus, the cognitive consequences of literacy have to be captured through

human practices and not as something that resides in script or in reading and writing as such.

Some in our trade have the rare ability not just to study reality but also to enter into a *dialogue* with it. The world is not merely there for observation and registration. Rather it speaks back and the theoretical significance of whatever is observed expands in unpredictable but highly informative ways. Some of the classics that have impressed me the most had this talent. Bartlett had his subjects read and remember stories, and he managed to show us that there is a world of difference between on the one hand memory, conceived as a deposit for past experiences, and remembering as a situated human activity on the other. To equate the two is to commit a category mistake. Wertheimer helped us see that there is a crucial difference between rote knowledge and understanding. Donaldson allowed herself to listen to what the children in Piagetian interviews said, and she found out that what is said, meant and understood is as much indicative of the hidden assumptions and prejudices of the interviewer as of the child's cognitive structures.

Sylvia Scribner had the unique talent of conversing with reality as she scrutinized it. What came out of her work into literacy and her studies of working intelligence in the context of a dairy was so rich precisely because she seemed to be continuously able to focus on the functional relationships between physical and mental action. Again, abstract thought, and the ability to symbolically manipulate the environment, was not something which could be understood as such. Rather, the practical task to be solved and the cognitive work it took to get it done in an efficient manner were shown to be productively interrelated. For instance, the way in which a particular mode of calculating is functional, or - to borrow a quotation from Bartlett that she often used - the mode in which it is "fitted to the occasion," cannot be understood without looking at the practical problem to be dealt with. Knowledge and flexible problem solving are cultivated in many corners of society, and the assumed supremacy of the algorithms taught in formal schooling is more a myth than a proven fact. The formulation taken from her work on dairy workers that "skill in the dairy was not content free" is a profound conclusion when read against the background of the history of research into cognition. It helps us to reintroduce into cognitive research those dimensions of human life without which our studies risk becoming vacuous, studies of abstractions and alienated individuals performing artificial tasks rather than people engaged in purposeful action.

A feature of Sylvia Scribner's work that in my opinion gave it an exceptional quality has been her ability to see generalities in particulars, to make theory bear on observation. By consistently retaining the social and functional integrity of the situations she studied, she convincingly showed that the classroom, the work place *and* the experiment are all contexts for human action which have to be understood in terms of social practices. What is theoretical/mental and what is practical/concrete cannot be defined out of context. At this level her work inspires and empowers those that continue this line of research and it carries important social implications that will need further exploration.

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Comments on Sylvia Scribner's "The Cognitive Consequences of Literacy" and "Mind in Action: A Functional Approach to Thinking"

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I have been asked to comment on two unpublished papers by Sylvia Scribner. One is a paper written in 1968, "The Cognitive Consequences of Literacy," and the other is a paper presented at the Biennial Meeting of the Society for Research in Child Development in 1983, "Mind in Action: A Functional Approach to Thinking."

It is quite interesting to compare the two papers because of the time lag of 25 years between them. We may notice how Scribner had changed, as well as how she had been consistent in her commitment to viewing the cultural aspect of human cognition. Before discussing the two papers, however, we must understand the academic atmosphere of the years during which the papers were written.

The year 1968 was the time when "cognitive psychology" was just beginning to burst out: a monumental work

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by Bruner, Olver, and Greenfield, et al., *Studies in Cognitive Growth*, was published in 1966, and Neisser's epoch-making book, *Cognitive Psychology*, was published in 1967. We may add another influential book by Lenneberg, *Biological Foundations of Language*, published in 1967. These three works were enthusiastically accepted as the guidelines for the "cognitive revolution" to take place: Bruner's indicating the importance of cultural aspects of cognitive development; Neisser's indicating a new direction of integrating computer science, experimental psychology, and linguistics, all dealing with human cognitive processes; and Lenneberg's indicating the importance of the biological evolution of cognitive mechanisms, especially of the brain. Among the three paths suggested, Scribner definitely took the first one.

In her 1968 paper, "The Cognitive Consequences of Literacy," Scribner rigorously explained possible influences of literacy on human cognitive growth, first from theoretical discussions on the cognitive effects of acquiring writing, then later, from cultural-historical observations mainly by anthropologists such as Levi-Strauss, Diamond, and Havelock. General hypotheses she set out were: (1) literacy moves thinking to a new conceptual level, moving from the physical world of things to manipulation of word objects, and (2) literacy moves thinking from the spontaneous to the conscious level, making the act of thought itself an object of thought. She presented these hypotheses for both anthropological investigations as well as developmental questions on "literate thought" and "non-literate thought." Thus she clearly showed the importance of anthropological studies as a powerful methodology for studying cognitive development within one culture.

We may see now that Scribner was rather naive in her beliefs in literacy itself as a cultural facilitator of human cognition toward logical, reflective, and abstract thought, and also that she was rather optimistic on the positive influences of schooling in enhancing children's cognitive development. However, we should note that what we now know about the effects of literacy and schooling are mostly due to her later work, particularly, the Vai project, which was summarized in Scribner and Cole's *Psychology of Literacy*, published in 1981. Thanks to this work, we now know that we must more carefully examine what contexts of cultural practices are indeed involved in the use (including 'instruction') of literacy in social communities. The 1968 paper may be viewed as a pioneering work relating anthropological studies with the critical inquiries on human cognition.

Now let us look at her later paper, "Mind in Action: A Fundamental Approach to Thinking," (1983).

The major topic in the 1983 paper was her famous study on work in a dairy analyzing product assembly carried out by pre-loaders, and pricing delivery tickets by wholesale delivery drivers. Details of the study have been reported in a number of her other papers, too, but the 1983 paper explained, quite enthusiastically, the background and motivation of this kind of study as a new and important methodology for studying "thinking-in-action."

Scribner explained her motivation for this study as follows:

First, she wanted to test a new method of studying naturally-occurring activities: observation of work tasks within occupations, then moving to experimentation in the work settings, and also simulation of the work in other settings using a variety of subjects such as experts in other jobs and extensively trained college students. She explained: "Observation is not opposed to experiment, but may be the forerunner of it. Description is not opposed to explanation but may function as a first approximation to it" (p.108).

A second purpose of this study was to examine the formative role (or educative role in the broadest sense) of practical activities. Cognitive skills qualitatively change in the course of participation in socially organized practices; the problem-solving process is restructured by the knowledge and strategy using external symbols and physical objects available in the work environment.

A third purpose was to increase our knowledge about the nature of "thinking-in-action." The most important feature of "thinking-in-action" is, of course, its "domain specificity," i.e., it depends on specific knowledge about the workplace, tools, and symbols involved in the task. However, problem-solving strategies there are also quite variable and flexible, adapting to changing conditions in the task environment.

The 1983 paper clearly demonstrated how promising this line of investigation is to see the real human cognitive processes that have been overshadowed by traditional cognitive science in laboratory studies and computer simulations. Indeed, her study of dairy work has stimulated (and is still stimulating) a number of important studies of cognition in practice, cooperative work (including Computer-Supported Cooperative Work, CSCW), and re-examination of classroom activities in terms of the diversities of everyday activities.

Reviewing the two papers, we see Scribner was always a pioneer of new and so important studies, introducing new interesting topics of study, and a new methodology to investigate them, yet consistently viewing humans as cultural beings to be investigated only within cultural contexts.

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To the Students of Sylvia Scribner's Writings

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I am addressing this to the people who will be "studying" Sylvia's writings in the dictionary sense of the word "study". . . .acquirement of knowledge through reading, reflection, observation and experiment . . . the development of the legacy she has left us. I am thinking of those who will no longer be able to actually sit with Sylvia in a learning situation . . . a situation in which she learned equally with the others there, as she frequently remarked to me. . . they have only the writings now.

I am privileged to be going through her papers in the preparation with others of a book that will bring her written work together in one place. I am impressed over and over again with her creativity, with the clarity of her writing and the depth of her thinking. Because of those qualities I have confidence in the value her writings will have for the students of those writings.

Others who are contributing to this issue are analyzing the contributions made in her scientific activities.

Some have written of the special societal meaning of those contributions. For me that meaning lies in her integrity as a thinking person sensitive to the societal significance of human activities; sensitive to injustices; always seeking ways in which she could do something to obtain redress of grievances and to prevent further inhuman excesses. She was particularly concerned when they were carried out in the name of science.

I remember two instances in which her outstanding lucidity of thinking and writing served such purposes: when a leader of the psychological community gained a great deal of publicity by the statement that chemical treatment might be used to control societal aggression, it was Sylvia who wrote the countering press release in the name of a group of psychologists who disagreed with this misuse of scientific information. This press release was printed as she wrote it in the *New York Times* the next day. Again, when a group of psychologists formed a society to encourage social responsibility in psychology, she wrote the statement that was subsequently adopted as she wrote it for dissemination by the society.

I had the privilege of working in the same institution with her for only a short time. Now that that institution is beset with societal problems about which Sylvia had a clear understanding, I miss her daily in efforts to combat the racism and sexism she abhorred. The significance of her loss is brought home in the many ways I frequently find myself thinking how much I would appreciate a discussion with her about some scientific problem, pressing political issues, and above all, about how to pursue the task of being a responsible human being.

The Developmental Line of Sylvia Scribner

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As one reads the two papers published in this edition of the *LCHC Newsletter*, one cannot help but be impressed

by Sylvia Scribner's continuing efforts to understand human cognition and activity. By 1968 Sylvia was already a mature and important scholar, and ideas such as those outlined in "The Cognitive Consequences of Literacy" were having a major impact on research in several fields. The power and originality of these ideas comes through when one considers how fresh and relevant they seem to today's debates. However, after arriving at these ideas Sylvia did not follow the comfortable path of simply reworking familiar territory. Instead, she continued to criticize and refine her formulations until the end of her life. Her practice of constantly challenging herself and others yielded outstanding intellectual results, but perhaps more importantly, it provided a model of what it means to continue to grow as a person and to contribute to human society.

Since I view the two papers under discussion here as two points in a developmental trajectory, I shall begin by focusing on the line of reasoning common to both. A basic claim in these two papers and in Sylvia's other works is that human activity, including cognitive activity, can be understood only by taking into account the historical, cultural, and institutional contexts in which it occurs. She brought an impressive array of disciplinary and intellectual perspectives to bear on the issue of how human activity reflects, reproduces, and challenges particular sociocultural settings, and the result was something more along the lines of a contribution to an integrated human science than a contribution to a single discipline such as psychology or anthropology.

Sylvia made her contributions to this broad set of issues by carrying out careful, and often ingenious analyses of concrete human activities. Of particular importance to these analyses was how cultural tools are employed. Her ideas on these topics were often inspired by the writings of Vygotsky—a point that is very clear in the 1968 paper. As she outlined in her 1985 landmark chapter "Vygotsky's Uses of History," Vygotsky approached the history of human mental processes by examining the set of cultural tools, or mediational means these processes employ. Much of her 1968 paper is devoted to explicating and extending this basic claim by examining the forms and functions of literacy that "literacy, a skill by which the individual appropriates a social product (writing) for private use, is a pivotal mechanism in cognitive growth" (p. 86), Sylvia went on to review several conceptions and misconceptions about literacy and to synthesize a complex body of research literature about thought systems in oral and literate cultures.

This kind of sociocultural situatedness Sylvia outlined in her 1968 paper is concerned with the broad patterns of historical, cultural, and institutional settings. In her 1983 paper she was still focusing on sociocultural situatedness, but she was doing it in a somewhat different manner. Her concern continued to be with how cultural tools, especially symbol systems, shape human cognition. However, she was dealing with more specific and concrete actions and their cognitive correlates, all of which are situated within the broader sociocultural settings that had provided the focus of her earlier work.

There is a strong thread of continuity that runs throughout Sylvia's writings over the 15 years between the two papers, but there are also some important changes. Perhaps most important among these is that Sylvia moved from focusing on the broad historical, cultural, and institutional frameworks in which mental functioning occurs to emphasizing how it is shaped by specific activity settings. The two emphases are certainly compatible; one could characterize it as a move from a "macro" to a "micro" perspective and view the two as necessarily complementary. However, there is also an important element of progress involved. Specifically, Sylvia made this shift in emphasis in response to critical questions she continued to pose to herself and to her colleagues over these years. These questions had to do with the concrete forms of activity that occur in broadly defined sociocultural contexts.

The point is that it became increasingly clear to Sylvia that one could not understand the psychological correlates of institutional, cultural, or historical contexts unless one examined the specific forms of activity, or practice that occurs in them. Given Sylvia's emphasis on how cultural tools shape forms of activity, this point also had great relevance to these cultural tools and their psychological correlates. The mere presence of a cultural tool in a sociocultural setting does not automatically guarantee an impact of a certain sort. Instead, its impact can only be understood by taking into account the patterns of practice in which it is embedded. Indeed, one of her most important insights was that it is only in particular forms of practice that cultural tools such as literacy and other symbol systems could possibly have their social and psychological impact.

This line of reasoning is clearly in evidence in the two papers under discussion in this issue of the *Newsletter*. In "The Cognitive Consequences of Literacy" the distinction she drew between two levels of conceptual thought is a distinction between two uses or functions of concepts: "in one the referent content of the concept is an object or some

aspect of an object or material reality, while in the other the referent concept is another concept" (p. 95). This parallels Vygotsky's (1987) distinction between everyday and scientific concepts, as in Vygotsky's case the different patterns of practice are viewed as reflecting different institutional contexts. Namely, formal schooling is viewed as being essential to the rise of concepts for which the referent is another concept and for scientific concepts.

In the writings Sylvia produced subsequent to 1968 (e.g., Scribner, 1977) one can see this line of reasoning emerging with ever increasing force, and in the masterful volume she published with Michael Cole (Scribner & Cole, 1981) it comes into full flower with regard to literacy. In that volume they argued that the psychological correlates of text production and comprehension can be understood only if one considers the particular practices in which this production and comprehension are embedded. Indeed, it may not even make sense to talk about text production and comprehension in any monolithic way; they take on quite different forms when they occur in different activity settings.

By the time Sylvia wrote her 1983 piece she had pushed this line of reasoning an important step further. Through an ingenious analysis of a seemingly simple, everyday work setting she managed to document some ways in which cultural tools are themselves shaped by particular activity settings. This constitutes an extremely important contribution to our understanding of how cultural tools and forms of practice are related. Building on a perspective that recognized the power of cultural tools to shape human activity, Sylvia moved on to outline ways in which this process of shaping could only occur and could only be understood in terms of the activity settings involved, and she arrived at a point where she documented the power of activity settings to have a reciprocal impact on cultural tools. This constitutes a kind of full circle in our understanding of a complex interaction.

However, in the spirit of Sylvia's unending intellectual and personal growth, it is perhaps most important to recognize that this formulation is best understood as one step in an ongoing inquiry. Let us hope that we can pursue the next steps with the strong intellect, the courage, and the commitment to making this a better world that characterized everything that Sylvia did.

Notes

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Reflections on an Evolving Psychology

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Upon receiving this invitation to comment on Sylvia's papers, I was not only honored but also eager to voice my reactions to them. As a student working in Sylvia's lab, this is not the first time I have been invited to edit, elaborate on, extend or revise her work; in fact, she assigned this task to me many times! She was always collaborating with various individuals from many disciplines and spent hours rewriting, reworking and refining her written expression of evolving concepts. In many of her papers, presentations and reports, she refers to her students' and colleagues' concurrent studies because they were truly integral. To me, the two papers we are reviewing reflect these qualities, particularly Sylvia's flexibility with the interpretation of psychological phenomena; however, they also point to a strong consistency in her work—rigorous empirical methods coupled with a broad and encompassing view of human capacities.

The interesting thing about these two papers is the progress that they mark in Sylvia's intellectual accomplishments. She began with a hypothesis on the cognitive consequences of literacy which led her to empirical investigations resulting in unexpected outcomes, reflecting

deeper and more complex conclusions than the expected outcomes would have rendered. Her first paper explores the notion that literacy enables the individual to externalize thought, affording a meta-conceptual perspective, i.e., thought about one's own thought. Thus, the acquisition of literacy is "a pivotal mechanism in cognitive growth." Sylvia distinguished between the abstract concepts of objects evidenced in preliterate societies and the traditional Western abstract concepts of concepts. She referred to contemporary studies on concept formation and the isolated effects of schooling, urban and rural environments, suggesting that literacy, an essential goal of formal schooling, effects conceptual abstraction of the Western literate tradition. Her next step would be to isolate literacy from schooling.

In her 1983 paper, she refers to the complexities of the findings from studies conducted in Vailand. In lieu of a direct link between traditional Western, abstract concepts and literacy, the results reflected complex relationships between the means of acquiring literacy and the consequences of those different acquisition modes. In fact, Sylvia began to shift from a previously deterministic view of cognitive development (higher mental functions are derived from internalizing culturally invented conceptual systems, i.e., conventional time, written language, etc.) toward espousing cultural practice as a pivotal mechanism in cognitive growth. Instead of investigating the developmental path from concrete to abstract (or general to concrete, for that matter) she directed her research toward cognitive consequences of activity.

In the Dairy studies, Sylvia began to articulate some "laws" of intellectual function, postulates that guide an individual's operations in culturally organized activities. In the 1983 paper Sylvia discusses a significant difference between the way experts and novices approach the dual system of encoded quantities (by case versus container) vis a vis filling orders of odd lots. Implicit in the "literal" and "optimizing" strategies is the expert's automatization of ad hoc mathematical operations for reducing physical labor. Sylvia's subsequent studies were inspired by these findings and lent support to individuals' "universal capacities" for, yet culturally mediated manifestations of cognition.

When I first came to Sylvia's lab in 1987, she was conducting studies in the stockroom of an electronics factory where on-the-job training was under observation. In conjunction with Pat Sachs, extensive investigations of job activities and training procedures ensued, and their results advanced the "law of mental labor" that Sylvia

described in the 1983 paper. Specifically, analyses of expert and novice workers revealed salient differences in the organization of tasks to be completed toward inventory management. While novice teams approached work orders linearly, experts grouped like tasks across an entire series of work orders and divided the work between themselves, eliminating redundancy. Furthermore, experts had developed many labor saving strategies by planning ahead mentally before setting out to do a set of physical tasks.

Among the tasks within a work order is the activity of counting parts by weighing them on various scales. King Beach, Joe Glick and I are still analyzing the transcripts of the training on this task, and we have returned to the plant for further interviews on how the scales are used. We have found some compelling instances of intellectual manipulation of the scales for labor saving purposes in this data.

Furthermore, Sylvia's work toward advancing activity theory has inspired us in the lab to pursue investigations of the consequences of different categories of activity. In our most recent studies, a technology that effects inventory control has been observed to reorganize work activities in several manufacturing plants. This technology is really an ideology of manufacturing encoded in software. It is a formal system of logic; however, the logic is based on the assumption that space is limited and inflexible, as opposed to the traditional, parallel assumptions of cost. The new technology results in greater efficiency because time and quantity are managed to meet specific customer demands instead of production budgets. Successful implementation of this technology relies heavily on workers' integration of its formal principles with the physical activities that transpire in the plant. In a way, we have come full circle in the sense that we are looking at the cognitive implications of a formal system, like literacy, for those who encounter it; however, the insight we have gained from Sylvia's work prevents us from expecting uniform outcomes across all the individuals we interview in plants using this technology. Instead, we investigate the individual's acquisition mode and how the individual engages in activities with the system to know what the cognitive consequences of such a system are in various categories of activity.

In closing I must add that this exercise has inspired me to re-read some of Sylvia's writing that I have taken for granted as well-internalized in my intellectual schema. I realize that our work here in the lab is a movement on a trajectory that Sylvia directed for a long time; her work is our history, and as we continue or even establish new

directions, Sylvia's work will always be reflected in our inquiries.

Sylvia Scribner at LCHC

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It should be abundantly clear from the two essays and many commentaries that precede these comments that Sylvia Scribner was an unusually powerful and original thinker. Her ideas were a stimulus to the thoughts and actions of her colleagues during her lifetime and they continue to accrue influence now that she is no longer with us. In reading through the commentaries, I have been impressed both by the high degree of convergence of different commentators about the important themes of her work and the diversity of ideas about how her ideas can best be built upon.

I see little point in reiterating what others have said. Instead, I want to pick up on a few central themes noted in many of the commentaries and to provide an account of the socio-political, intellectual and institutional circumstances which formed the context for the changes in theory and methodology that distinguish her early article on literacy from her later article on mind-in-action.

In the winter of 1969-1970 I was a visitor at The Rockefeller University. I was considering the possibility of remaining as a member of William Estes' laboratory, whose research program was focused on the development of mathematical models of learning and memory. It was a transition period in my life. My major task was to analyse data gathered in rural Liberia for the book that appeared the following year called *The Cultural Context of Learning and Thinking* (co-authored with John Gay, Joe Glick, and Donald Sharp). At the same time I was attempting to figure out the implications of that work for research on ethnic group/cultural variation in the United States.

It was, as Ray McDermott reminds us in his comments, a period of heightened political selfconsciousness and ideological conflict. Several years of civil rights activism had made social and economic inequality a major

item in the agendas of federal, state, and local government, but few were under the illusion that the problems were being solved effectively. Disagreement centered on the reasons why the "war on poverty" was not being won.

With respect to domestic issues, social scientists were divided in their diagnosis. During most of the 1960's, the predominant opinion was that a combination of environmental factors associated with economic poverty accounted for poor school achievement, which in turn perpetuated the poverty which had given rise to it in the first place (Riessman, 1962; Hellmuth, 1967; and many others). It was this line of reasoning which gave rise to compensatory education programs that were intended to break the cycle of poverty by providing "culturally disadvantaged" (or "culturally deprived") children with a head start.

It was not long before this "argument from nurture" was challenged by its perennial other, the "argument from nature." In 1969, Arthur Jensen published his claim that half a decade of Head Start Programs had failed and that the failure had occurred because I.Q. and school achievement are predetermined by genetics. Jensen's arguments were used to justify changes in government policies that were referred to by the cynical concept of "benign neglect." Both arguments, and the policy of neglect, are with us in various forms to this day, so the dispute is by no means of purely antiquarian interest. But what concerns me most is adherents of both environmentalis and genetic arguments shared the common conclusion that poor performance on standardized tests of intellectual functioning reflected some kind of general intellectual deficit. The more radical environmentalist notion that the evidence for a general intellectual deficit might arise from the very scientific practices which had generated the data had very few adherents. Yet precisely this possibility was suggested by the research that my colleagues and I had been conducting in Africa.

In a wide variety of studies, Gay, Glick, Sharp, and I had demonstrated that presumably absent or atrophied cognitive skills were manifested when people were engaged in culturally indigenous activities of understood importance or when the experimental procedures were modified suitably in terms of content, instructions, and social circumstances. At the end of *The Cultural Context* we suggested that

the approach that we have used in this book can fruitfully be applied to the problem of subcultural differences in cognitive behavior in the United States. In particular, we want to emphasize our major conclusion *that cultural differences in*

cognition reside more in the situations to which particular cognitive processes are applied than in the existence of a process in one cultural group and its absence in another (p. 233, emphasis in the original).

In order to implement the research program implied by this conclusion, we proposed a methodological approach we called experimental anthropology, in which the indigenous organization and performance of events became the criterion against which to judge the results derived from specially constructed events called psychological tests and experiments.

While I was in the process of deciding to whether or not to make Rockefeller University the institutional location for embarking on the research program suggested by these ideas, I was contacted by Sylvia, who was then completing her graduate work at the New School while working in a community mental health program. She had heard about my work from a colleague and contacted me to elicit my commentary on her paper on literacy. I gave her some of my recent writings in exchange for her paper and invited her to attend our weekly seminars, at which we discussed questions of theory, methodology, and methods. We discussed the possibility that she might obtain a post-doctoral fellowship to spend a year at Rockefeller, assuming that I accepted a job there and did not return to California. Later in the spring of 1970 I decided to remain at Rockefeller University and I obtained grant monies sufficient to offer her a position as a senior researcher. Thus began a collegial relationship which lasted until her death.

In mid-February, 1970, I received a letter from Sylvia that states her view of the relationship between our respective approaches to the question of culture and cognition at the time. She wrote,

I have read your paper carefully, however, and am very much impressed with the line of experimentation, the data and your conceptualization of the findings. As I have said, I am embarrassed at the armchair speculation and loose formulations in my paper but it seemed to be a necessary step in the clarification of my thinking. And I feel the nugget is sound and very much in keeping with your approach. From my speculative route and your empirical one, we seem to have arrived at similar constructs. We agree that on the "input" side we are dealing with cultural systems and technologies—not mentalities and capacities—and on the "output" side we are dealing with certain specific mental skills, such as the intentional structuring of cognitive tasks—not "intelligence." In any event, I am still vitally interested in working in this area.

As a reading of Sylvia's paper on literacy reveals, the term "specific" in her letter had for her a somewhat different significance than it had for me (e.g., is, "intentional structuring of cognitive tasks" a specific or a general mental skill?). But there was no question that we shared a common interest in the question of how cultural systems and technologies on the one hand, and mental skills on the other are related to each other. Moreover, one of the major intellectual issues we jointly addressed over the years (one not resolved to this day, judging by divergence of views expressed in the commentaries presented above) was how best to characterize the specificity or generality of the cognitive consequences of participating in different cultural systems mediated by different technologies.

Sylvia's research at Rockefeller was conducted within the framework of the attempt to follow up on the earlier work in Liberia that had demonstrated the ways in which variations in the content and procedures used in laboratory-style memory tasks influence the process and product of deliberately remembering lists of words (Scribner & Cole, 1972; Cole & Scribner, 1974).

Most of this work was conducted in New York City among children, but Sylvia wanted very much to get a taste of cross-cultural research. We arranged that she spend a period of time in Liberia where she carried out additional studies of memory development as well as studies of syllogistic reasoning (Scribner, 1974; 1975; 1977). This latter topic was of great mutual interest because my colleagues and I had been seeking to replicate Luria's work in Central Asia (I was translating the first article-length report of his research at the time that Sylvia and I met) and Sylvia was interested in following up on the work of her New School mentor, Mary Henle, who had done important studies of syllogistic reasoning.

In the beginning we were preoccupied with empirical studies pursuing the implications of cross-cultural, developmental experimental research focused on variations in procedures, the age of the subjects, their experience of school, and their exposure to urban life. Our joint interest in the study of literacy was by no means forgotten and seemed to raise similar questions in a different form. However, the research money we had at our disposal did not allow us to enter into the broad based study of the kind that we both believed necessary. As a means of pursuing the more general issues that interested us, we spent a good deal of our time exploring issues of general psychological theory as they pertained to questions of the relationship between culture and mind.

It was in this context that we wrote an article in *Science* speculating on the reasons underlying the superior performance of schooled populations on cognitive tasks that had appeared not only in our own work but data collected by many other investigators. Our conclusion fit well with line of argumentation advanced by Sylvia in her paper on the consequences of literacy: Repeated encounters with content and purpose of cognitive tasks motivated by factors beyond the confines of the classroom constituted, in effect, a massive "learning to learn" experience. Such tasks, by virtue of their removal from contexts of everyday use, required children to discover or create mnemonic or problem solving structures that seemed pointless in and of themselves. As a consequence, children became skilled at the kind of "intentional structuring" that Sylvia had written about previously.

But this article did not resolve the underlying question of whether or not such "intentional structuring" was a generalized cognitive skill, or was localized in the kinds of problems encountered in classrooms and modelled in experimental procedures. And, importantly, how could one decide between these viewpoints given standard psychological methodologies and assumptions about what count as data?

We explored these questions in a number of publications, some written collaboratively, some written individually. In *Culture and Thought* we reviewed the extant literature on cultural variations in thinking with a special eye toward the methodological difficulties of cross-cultural research. In the last chapter of that book we contrasted the conclusions about cultural deficits that psychologists would reach from a study of the failure of adult Kpelle rice farmers to take their listeners perspective into account when performing in a standardized experimental task with ethnographic observations of the subtle control of listener's information in traditional discourse settings. In an article in *Ethos* we compared the kinds of evidence used by anthropologists and psychologists to draw inferences about cognitive processes. We reviewed Basil Bernstein's work as a means of coming to grips with similar issues dividing sociologists and psychologists (Scribner & Cole, 1974). Sylvia wrote an especially trenchant article addressing these issues titled "Situating the experiment in cross-cultural research" (Scribner, 1976) which I especially recommend to readers unfamiliar with it.

In 1973 we had the opportunity to address the problem of literacy in a serious way, and after some deliberation, we grabbed it. In our earlier work Liberia, my

colleagues and I had conducted one experiment among the Vai people of northwest Liberia, a group well known in the region because they had invented their own writing system. What immediately intrigued us about the Vai was the opportunity they afforded for distinguishing between the cognitive consequences of formal schooling and literacy, since Vai literacy was an indigenous practice that predated formal schooling historically and was acquired independent of schooling in the present. Our one pilot study turned up a small, but statistically significant, difference between Vai literates and nonliterates in their ability to recall lists of words (Cole, Gay, Glick, & Sharp, 1971, p. 226).

Work I had been conducting in Mexico at the time was again revealing clear effects of the consequences of schooling on cognitive test performance and it seemed obvious that some way needed to be found to see whether literacy, or literacy in the context of formal schooling, was giving rise to these effects. It seemed clear that we needed to mount a serious attack on the methodological ambiguities surrounding all of the research on schooling effects: were they merely another manifestation of the common observation that "practice makes perfect" so that the superior performance of people asked to complete tasks similar to those they had practiced for years in school was a trivial result? The challenge was to find ways to ground comparisons of schooled/literate/non-schooled/non-literate people in such a way that we could simultaneously assess the consequences of schooling and literacy as forms of experience while assessing the ways in which our modes of observation were contributing to the conclusions we were reaching.

It was with these complex goals in mind that we undertook the research on Vai literacy that resulted eight years later in *The Psychology of Literacy*, which contained our resolution to the theoretical, substantive, and methodological issues which we had been working on since our initial contacts.

I think it important to note that the work I have been describing and the changing nature of our ideas about culture, cognition, and the ways in which they needed to be studied did not occur in an institutional vacuum. During this same period the academic institution called the Laboratory of Comparative Human Cognition came into being and matured, such that Sylvia's independent line of work on the development of logical reasoning and our joint work on literacy were part of a larger, collective, effort to overcome the incoherences induced by the historically accumulated divisions between academic disciplines and their procrustean methodologies, as well as the institu-

tional barriers to collaboration among people of different ethnicities, genders, and nationalities. In the early 1970's a remarkable group of people came to Rockefeller University as a faculty and staff at LCHC. Anderson J. Franklin conducted research on the intellectual development of African-American children using a combination and observational and experimental techniques growing out of the lab's developing cross-cultural methodology. William Hall mounted a major comparative study of language and cognitive socialization in middle class and working class homes and schools of Anglo and African American children. Ray McDermott, an anthropologist skilled in the use of ethnographic methods of interactional analysis, joined with Ken Traupmann, Lois Hood/Holtzman and me in a project that directly addressed the special nature of psychological tests as environments for thinking and the equally special nature of the school situations from which such tests are derived.

Each of these research projects constituted an independent strand of LCHC activity. However, everyone recognized the inter-dependence of the various projects and it was at the weekly LCHC seminars that various projects that constituted LCHC research programs came together to address problems of common concern. It was in this context that we invented the tradition of articles authored by LCHC, the first of which appeared in 1976. Sylvia's broad expertise and tireless dedication to the work of the laboratory made her a major contributor to these efforts. These articles addressed such issues as the role of content knowledge in producing age and social class variations in memory performance (LCHC, 1976), the nature of the intellectual barriers creating incoherence between anthropological and psychological approaches to cognition (LCHC, 1978, 1979) and the possibility of creating a synthetic, comprehensive approach to understanding the role of culture in cognitive development (LCHC 1982, 1983, et passim).

Recognizing that in addition to conducting research on the many theoretical and methodological problems associated with comparative research implicating cultural variations in thinking the members of LCHC mounted a pre- and post-doctoral training program in comparative cognitive research intended to foster the development of a new generation of researchers who could not only avoid errors of the past that we were confronting, but could invent and implement new approaches to guide research in the future. Again, Sylvia was a major contributor to this training effort. She was extremely generous with her time, advising both students formally assigned to her and those

who simply needed a sympathetic and knowledgeable person to talk to.

This account of the context of Sylvia's work during the 1970's and her contribution to that context would be seriously incomplete were I to omit her important role in promoting LCHC's deeper understanding of the work of Russian cultural-historical psychologists. Among all LCHC members, Sylvia had the deepest knowledge of Marxist social theory and its applications to psychology. As a student of Luria's I had some familiarity with Vygotsky's writings, but I found them extremely difficult to assimilate. Sylvia, on the other hand, had studied Vygotsky's translated writings carefully and made them an important part of her thinking, as her article on literacy clearly indicates.

When, along with Vera John Steiner and Ellen Souberman, we undertook the publication of selected writings by Vygotsky, Sylvia played a very important role. The consequences of our involvement in editing Russian cultural-historical writings (I was editing Luria's autobiography at the same time that the Vygotsky material was being worked on) had a profound effect on the work of many of those associated with LCHC. Its influence on *The Psychology of Literacy* is obvious, but perhaps even more profound is the following observation. In 1976, the first year in which we published the *LCHC Newsletter*, the only trace of influence from Russian cultural-historical psychology was a single article written by a student of Luria's, Abramyan (1977). In recent years, the *Newsletter* has often been identified closely with the cultural-historical school of psychology, and especially the name of Vygotsky, who has become a virtual cultural icon. Sylvia's contribution to the development of the cultural-historical approach continued up to the time of her death. Her research group produced a special issue of the *Newsletter* on "reading Vygotsky" in July, 1987, and her article on mind in action reveals her pursuit of the logic of a cultural-historical approach to mind into subsequent generations of Russian scholars.

In attempting to bring these too-extensive, yet hopelessly brief remarks to a close, it occurred to me that one of the most pervasive characteristics of Vygotsky's style of thinking was to view developmental change as the emergent result of the convergence and intermingling of two streams of history. Looking back over my interactions with Sylvia and my sketchy chronicle of the context of Sylvia's work from 1970-1983, I find it attractive to think of the way in which our two histories intermingled with

each others' and with those of a remarkable group of colleagues. I know that my own development was transformed in this process, and I believe that Sylvia's was too. Only time will tell, of course, but it is nice to think that the emergent products of these interactions, which one can see continuing to develop along a number of lines, will prove of benefit to those of us who worked with Sylvia and our students and their students. Who knows?

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