Literacy, Schooling, and Cognitive Skills

The Psychology of Literacy. SYLVIA SCRIBNER and MICHAEL COLE. Harvard University Press, Cambridge, Mass., 1981. xiv, 336 pp., illus. $25.

Interest in the relation between culture and cognition has spawned numerous cross-cultural studies using psychological tests of cognition. The results indicate cross-cultural diversity in performance and are fairly consistent in finding that individuals with greater experience of schooling and literacy perform better than those with less schooling or literacy.

One of the primary aims of cross-cultural research is to "unpackage" systems of variables that in industrialized societies are highly correlated (for example, amount of schooling, age, economic status). To date, however, cross-cultural cognitive researchers have generally been satisfied with pointing to schooling or literacy as influences on cognitive skills, without differentiating schooling and literacy. More important, they seldom investigate how either type of experience would influence cognitive processes. Usually researchers simply note that schooled subjects perform better than nonschooled and speculate that literacy may be the mechanism.

Since Plato's day, literacy has been a focus of interest as a means of changing modes of thought. The invention of literacy has been suggested to have had profound historical cognitive effects. The possibility of remembering information word for word, rather than remembering the gist, may have arisen with the possibility of checking recall against written records. Written lists have been held to promote systematic classification skills. The development of logical thinking and analytic communication has been attributed to the invention and widespread use of the phonemic alphabet, which allowed recording of words unambiguously and thereby permitted critical examination and comparison of statements. The need for the text to carry the message (rather than relying on the social context to clarify meaning) is said to promote more explicit statements and formulation of definitions and logical principles. The development of literacy is thus considered to have a profound effect on the thought of those who use this technology, transforming not only their written thoughts but also their reasoning, memory, and classification skills outside of the context of reading and writing.

The Psychology of Literacy is a report, by two of the foremost scholars in the field of culture and cognition, of an extensive series of studies attempting to unravel the generality and etiology of the relation between thinking, schooling, and literacy. To examine the effects of literacy separately from those of schooling, Scribner and Cole made use of a natural experiment provided by the Vai people of Liberia. The Vai-speaking people have developed an indigenous script that is widely used but not learned in school. Their phonetic writing system consists of a syllabary of approximately 210 characters with a common core of 20 to 40.

Approximately 20 percent of Vai men are literate in Vai script, 6 percent are literate in English, and 16 percent are literate in Arabic. (Women are generally not literate in any script.) English is the official national language and is learned in Western-style schools. Arabic is the religious script and is learned in traditional Qur'anic schools emphasizing rote memorization or reading aloud of religious passages, often without comprehension of the language. Vai script is used for the majority of personal and business needs such as writing letters and keeping personal records. Vai script is taught outside of any institutional setting, by a nonprofessional Vai literate who teaches a friend or relative over a period of a few weeks or months. The Vai script, though widely used for important purposes, does not involve contact with new knowledge or expository writing concerned with examining ideas.

Scribner and Cole's research strategy was to compare the test performance of Vai men who were literate in the various scripts with each other's performance and with that of nonliterates to determine whether literacy substituted for schooling in producing widespread effects on test performance, and whether this was an effect general to all of the literacies. The groups compared consisted of men who were nonliterate, or literate in Vai script (the group of central interest), or literate in Arabic (to test generality of literacy effects across types of literacy), or literate in English and schooled (to provide a replication of previous research examining schooling effects).

The tests given consisted of two types. The first set of tests correspond to the usual tests of abstract thinking, memory, taxonomic classification, and logical processes that are used in experimental and developmental psychology. These are often assumed to tap general underlying mental abilities or to indicate level of intellectual development. The results of these tests showed fairly consistent schooling effects, consistent with (but not as strong as) the results of previous research. The most robust of the schooling effects had to do with facility in explaining the principles involved in performing the various tasks. Effects of the nonschool literacies were spotty and infrequent, indicating that literacy does not produce "general" cognitive effects. Nonschool literacy did not substitute for schooling in predicting performance on these tests. Apparently, then, schooling's widely observed effect on cognitive test performance does not derive from equipping children with written language.

The second set of tests was designed to test specific functional skills inferred to be promoted by the particular literacies. The results consistently supported the idea that specific activities involved in the use of a particular literacy facilitate the development of closely related cognitive skills.

For example, in a referential communication test, in which the object was to describe a board game in its absence, Scribner and Cole expected Vai-script literates (whose letter writing requires communication to be explicitly stated in the text) to be more complete in their description than Arabic literates and people not literate in any script. The schooled English literates were expected to be highly successful in this task as well. The groups ranked as follows: schooled English literates, Vai-script literates, Arabic literates, and nonliterates.

Another test involved integrating auditory information: listening to meaningful sentences broken into syllables that were presented at a slowed rate. Since Vai script is written without word or phrase division, the authors suspected that Vai-script literates might have skills in integration of syllables into meaningful linguistic units. Indeed, Vai-script literates were better at comprehending and remembering such sentences than were all other groups. When the sentences were presented word by word instead of sylla-

ble by syllable, however, Vai script literates had no advantage over the other literates. This is consistent with the hypothesis that literacies have effects on cognitive tests that are specific to skills involved in their use.

Scribner and Cole demonstrated specific consequences of Arabic literacy with a memory task resembling learning of the Qur'an (learning a string of words in order, adding one word to the list on each trial). On this task, schooled English literates again ranked first, but here the Arabic literates performed better than either the Vai-script literates or the nonliterates. On other memory tests, however, Arabic literates showed no superiority in performance, suggesting a very specific literacy-related effect rather than a general improvement of memory.

Results of these and other tests indicate that components of reading and writing skills may promote very specific language-processing and cognitive skills, but that literacy does not inevitably lead to widespread skills in memory, classification, and logical inference. Scribner and Cole explain these results in terms of a "practice account of literacy," which though incompletely developed appears to be the beginning of a promising theoretical approach to cognitive processes. By practice, they mean "a recurrent, goal-directed sequence of activities using a particular technology and particular systems of knowledge" (p. 236). Their concept of practice involves socially constructed ways of using technology and knowledge to accomplish tasks. With any particular literacy, the skills developed will be determined by the way literacy is used, in reading and writing that script for specific purposes under specific circumstances.

For social scientists interested in the relation of culture and cognition, this book provides a landmark research program and a model for future efforts. The studies are carefully executed, involving an appropriate variety of methods (experiments, ethnographic observations, interviews, and surveys). The research program considers other background variables that often covary with literacy and schooling, such as modernity and age, to control for their possible effects. The authors have done an admirable job of explaining the rationale and results of the research in nontechnical terms. Nevertheless, the number of regression equations and the complexity of the series of studies may render the book slow reading for those unfamiliar with such methods. The results are methodically presented and cautiously interpreted in building the theoretical framework. *The Psychology of Literacy* provides us with the message that it is important to consider the function of a skill and the conditions in which it is practiced, rather than to assume that a skill observed in one situation represents a general ability.

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Seismology

Seismic Waves and Sources. ARI BEN-MENAHEM and SARVA JIT SINGH. Springer-Verlag, New York, 1981. xxii, 1108 pp., illus. $90.

The great successes of seismology as a quantitative science since 1950 are often, and with justification, attributed to the introduction of modern instrumentation and digital techniques. Workers in the field are equally dependent, however, on the articulation of the major body of theory by which elastic wave excitation and propagation in the earth may be described. To appreciate the developments in this field that have occurred in the past 25 years, one need only compare the massive new compendium by Ben-Menahem and Singh with *Elastic Waves in Layered Media*, the pioneering work by Ewing, Jardetsky, and Press (1958). The new book offers over 3400 numbered equations of no small length in 944 pages of text, along with another 150 pages with 12 mathematical appendixes.

The authors have produced a comprehensive, consistent account of every aspect of the subject. Beginning with the customary invocation of classical continuum mechanics, subjects are unfolded in a branching tree whose heavily laden boughs contain every fruit known to the profession. A great encyclopedia of completed, worked-out derivations and problems lies in the hand of anyone who wants to know "how to solve it." The material on vector and dyadic fields, reminiscent of the approach of Morse and Feshbach, provides a series of consistent, complete, and cumbersome representations that are subsequently used in formulating solutions to the specific problems. The following chapters on plane waves in layered media are probably the least inspired in the book, being a relatively conventional account of the best-known aspects of seismic wave propagation. The full working out of seismic source representations that follows, however, brings into one equation-filled chapter the full machinery that has developed over the past 20 years for the mathematical representation of the various point sources in the separable coordinate systems. The subsequent chapters on normal modes, generalized rays, and the asymptotic theory that relates the two form the heart of the book—over 450 pages devoted to the detailed working out of the different representations and approximations for the elastic wavefield in a layered spherical earth. Many important developments based on the Watson transformation and rainbow expansion appear here. A chapter on seismic wave attenuation offers a full advanced-level discussion that, though somewhat disjoint from the rest of the book, is a welcome part of it. The chapter on atmospheric and water waves seems to be of less importance in the scheme of things.

The mathematical appendixes alone would justify the acquisition of the book by a research worker. Concise accounts are given, inter alia, of dyadic calculus, generalized spherical harmonics, causality, and Airy functions.

The book is a valuable companion for the research seismologist or advanced student who wishes to solidify an acquaintance with some aspect of theoretical seismology. The logical organization of the book and the consistent use of notation make it possible to trace a result back to its fundamentals. The book would lie on the shelf next to Morse and Feshbach's *Methods of Theoretical Physics* and Abramowitz and Stegun's *Handbook of Mathematical Functions*; it forms, in effect, a seismological extension of the former.

The format is well designed and pleasing, and I have never seen a book of this nature in which it was so difficult to find minor errors.

In a book of this size, one wonders whether every page is equally worthy of inclusion. Frequent "extra cases" are tacked on that contribute nothing new, numerical tables giving data such as surface wave perturbation parameters are of little interest, and some of the discussions contain too many intermediate steps and explanatory words.

The completeness of the book, in its classical treatment of elastic waves, by no means eliminates the need for a monographic treatment that would emphasize simplicity and transparency of approach. Indeed, the completeness of the machinery in the book is a deterrent to the student seeking a clear delineation of the subject.

The bibliographic lists at the ends of each chapter are useful though not particularly complete—a shortcoming with respect to several excellent treatments