

was in widespread use throughout Europe at the time.

In the early 20th century, U.S. educator John Dewey called for "progressive education", which would foster learning through social interactions, not isolated study. And later, Swiss psychologist Jean Piaget argued that children construct categories of thought about the world — from the nature of solid objects to printed words — that often clash with adult versions of the world.

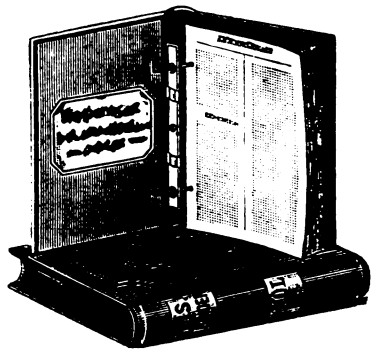
These ideas met reading theory head-on in the 1970s with the advent of artificial intelligence research. Digital computer models suggested that reading depends on "hypothesis testing" about a text's meaning rather than visual processing of parts of words.

Each beginning reader reveals his or her hypotheses about a text through "miscues" or errors made while reading aloud, according to much of the research — generally referred to as psycholinguistics — conducted by Goodman and other whole-language theorists over the past 25 years. In studies of small groups of elementary school students tracked throughout the school year, miscues follow general patterns that reflect a child's anticipation of what is to follow in a story, Goodman says. Young readers continuously monitor what they read and revise its meaning when necessary, he adds.

In his 1986 book *What's Whole in Whole Language: A Parent-Teacher Guide* (Heinemann), Goodman describes miscue research and his notion of reading as a "psycholinguistic guessing game" in which the reader constructs meaning based on prior expectations and cultural background.

Other psycholinguistic research, such as a 1985 study of third and fourth graders conducted by Yetta M. Goodman of the University of Arizona and Sandra Wilde of the University of Oregon in Eugene, indicates that beginning readers who regularly write and read their own stories without specific spelling corrections by teachers nevertheless become good spellers over time. Whole-language proponents refer to this instructional technique, which includes extensive collaboration on stories among students, as "invented spelling."

"Innovative [whole-language] practice



is leaping ahead of research," Goodman notes. Perhaps one in 10 U.S. elementary school teachers now takes a whole-language approach, he estimates.

Goodman rejects Marilyn Adams' cautious endorsement of phonics integrated into programs with whole-language techniques. Adams reviewed only studies that broke reading into words and phonemes, while "systematically excluding" psycholinguistic research, he charges.

Investigators have yet to develop a generally accepted measure of reading ability, says Jerome Harste of Indiana University in Bloomington. The focus on decoding of individual words should expand to examine the number of books actually read by nascent readers, what children talk about while reading and what they plan in their lives as a result of reading, he maintains.

"We have to go beyond the kinds of studies summarized by Adams," holds Harste, an education professor and whole-language proponent.

But beyond the theoretical differences of the phonics-oriented and whole-language research camps, many teachers employ some combination of these instructional methods with young readers, Harste notes. Phonics rarely takes center stage in reading classes — it shares the spotlight with the reading of quality children's literature, writing exercises and testing for overall reading comprehension, he says.

Indeed, most code-oriented researchers express no misgivings about many whole-language techniques and concede that a fair number of youngsters figure out the alphabetic code with little or no phonics instruction. Still, the lack of such instruction creates an ever-widening gap between good and poor readers, they assert.

Educators must remember that language revolves around phonology, a small system of meaningless sounds that can convey an infinite number of meaningful messages in numerous languages, argues psychologist Alvin M. Liberman of Haskins Laboratories in New Haven, Conn. "In teaching children to read and write, our aim must be to transfer the wonders of phonology from speech to script," Liberman contends. "This can be done only if the child comes to understand the alphabetic principle."

Teachers who build a love of reading and writing among their students through the whole-language approach allow the "wonders of phonology" to blossom naturally rather than wither under a phonetic assault, Goodman responds.

For now, perhaps all reading researchers can agree on at least one point. In the diplomatic words of Marilyn Adams, "Reading may be the most politicized topic in the field of education." □

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oped a "schema" (abstract framework to hang these facts on) for a particular subject.

Second, developing such abstract frameworks seems to me to be the *point* of education. Too bad the researchers found little evidence of schema formation!

Third, my recollection begins from a time long prior to my entering school. May not excellent memory be a predictor of higher grades, rather than the other way around?

Barbara Szabo  
Borrego Springs, Calif

## Virtual reality via PC

In "Looking-Glass Worlds" (SN: 1/4/92, p.8) one gains the impression that virtual reality is available only on expensive computer systems. An article in the February AMIGAWORLD, however, suggests that the public may soon gain access to these strange interactive programs using only personal computers.

Last October, at the "Amiga '91 Cologne Show" (in Cologne, Germany), Commodore's booth demonstrated an experimental product, "Virtuality," from the British company W. Industries, that involves the Amiga personal computer and a "space-age helmet containing dual miniature LCD displays, stereo headphones and a motion sensor" with additional sensors for the arm and fingers. As in your article, the user/wearer can move through and manipulate the computer-generated, three-dimensional objects and stereo sounds. Although the computer graphics appear rather simple at this stage, it shows that virtual reality is not limited to large, high-tech research institutions. And think of the consumer programs: Landscape design would include real "walk-throughs," while shoot-em-up games would be awesome!

Richard C. Hertzberg  
Cincinnati, Ohio

## Consensus and correctness

It seems to me that the fundamental assumption that several network elements arriving at the same answer produces a *correct* answer is optimistic at best ("Neural-net neighbors learn from each other," SN: 1/11/92, p.23). The machines' answers were judged correct only because the researchers knew the correct answers before they started the tests. This merely puts the "teacher" in the backward-propagation procedure in a different place, but doesn't eliminate it.

Certainly humans often learn by techniques other than backward propagation, and far too often the "consensus" technique leads to disastrous answers, much less merely incorrect ones. Humans can usually find a way to check their "consensus" answers, if only by the results of acting on them. Nowhere in the article does it tell us how these machines check their answers independently, with no researcher to look over their shoulders, as it were.

K.A. Boriskin  
Bellingham, Mass.

*The machine's answers were judged correct by the elements in the network, not by comparison to a preassigned value, as in back propagation. In this network, there is no independent verification of the answer. However, the researchers are able to see whether the network's answers are correct, which they were.*

— E. Pennisi