

Decoding Words on a Page

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When most of us read, we probably don't think about the complex neurological processes that go on behind the scenes. Subtle and rapid eye movements, invisible without eye tracking technology, relay information to the brain, setting in motion a chain of events that helps the reader internalize, encode, and finally understand the meaning of the words on the page in front of them. During his award address at the 2014 APS Annual Convention, APS William James Fellow Keith Rayner, University of California, San Diego, explored these critical processes and the fundamental contributions they make to our ability to read.

Edmund Burke Huey, a renowned psychological scientist who devoted much of his career in the late 19th and early 20th centuries to studying the science of reading, believed that "to completely analyze what we do when we read would almost be the acme of a psychologist's achievements, for it would be to describe very many of the most intricate workings of the human mind." Rayner has taken that philosophy to heart in his own work.

Rayner and the members of his lab use eye movements to study the reading process. "Where readers fixate, which words they skip or regress to, where they land in words, and how long they fixate on words provides a great deal of useful information about moment-to-moment processing in reading," he explained. They studied the reading habits and techniques of different groups of people, including Chinese readers, young readers, and elderly readers.

Their research has shown that skilled college-age readers of English typically look at words for about 250 milliseconds, make regressions (e.g., look back at words) 10% to 15% of the time, and skip about 25% to 33% of words. Poor readers, in contrast, spend more time on words, regress more, and skip fewer words.

In Chinese writing, however, there are no spaces between words: The characters stay inside equally spaced boxes and can be combined to make different words. Rayner and his students used these disparities to compare and contrast the two languages — and found more similarities than differences.

"We found that the fixation [length of time spent on a word] was about the same, the regression rate was about the same, and the probability of skipping was about the same," Rayner said. "The more we learn, the more similar Chinese and English readers seem."

While English and Chinese readers show many similarities, Rayner and his team found significant differences between younger and older readers. Examining second through fifth grade students, the researchers found that young readers have long fixation times and many regressions.

"This probably reflects difficulty decoding the words they encounter," Rayner noted. And "although children did show signs of being less developed readers, they interestingly did not need longer to encode

words.”

Research suggests that children’s reading patterns start to resemble the more sophisticated, skilled patterns of adults when they reach fourth or fifth grade — but only when the text isn’t too difficult. These findings suggest it is particularly important for elementary- and middle-school teachers to select appropriate material for their students so they can progress steadily rather than risk slowing their reading comprehension development.

Similar to children, elderly readers have longer fixation times and more regressions, leading them to read more slowly, said Rayner. That decline in reading speed seems to begin in our late 30s to early 40s. However, these same readers do “as well as, if not better than,” skilled college-age readers on comprehension tests, indicating that elderly readers still process the information they’re being given well — they just take longer to do so.

“They may adopt a ‘riskier’ reading strategy in which they guess what the next word will be much more than the younger readers do,” Rayner added. “We don’t know whether this is conscious or not.”

Rayner and colleagues have created a model called the E-Z Reader model that simulates the data patterns of Chinese, beginning readers, and older readers, and hope to collect more information about the differences and similarities among the three groups with this technology. They are also interested in examining how deaf readers process information from text. Although most deaf readers graduate from high school reading at an approximately fourth to fifth grade level, some are much more skilled, and Rayner’s team has been examining why that is the case.