Literacy acquisition

Some general findings from recent research

Basic alphabetisation and reading

- Learning to read involves "tricking" the brain into perceiving groups of letters as coherent words.
- To achieve this and to link the letters with sounds, **explicit practice** is needed.
- The more complex the spelling of a language (e.g. English) , the more practice is needed.
- Though many bright learners can learn to recognize whole words, most learn reading more efficiently by **starting with small units of one or two letters**.
- To understand a sentence, the mind must read it fast enough to capture it within the time limit of the working memory. This means that one must **read at least 45-60 words per minute to understand a passage**.
- When the spelling rules are simple and instruction is sufficient, **people can learn reading in their own language in 4-6 months**. Reading in languages with complex spelling patterns, like English, takes longer to learn.
- Those who do not get extra practice at home may require more teaching hours to become fluent.

Reading and the brain

The skill of reading has to be acquired because the brain is not genetically programmed for reading. Multiple neural circuits are involved in reading, including those that partly control the processing of the sight of fast-moving objects.

For reading to be acquired the learners must have:

- neural circuits sufficiently mature to connect sounds to letter groups and word meanings
- phonological awareness, that is, must have sufficient knowledge of the patterns of a language to perceive separate sounds, syllables, and words
- sufficient working memory available to understand a message
- vocabulary knowledge for comprehension
- context knowledge for interpretation.

Working memory and speed of reading

To understand a sentence or a meaningful unit, people must hold it in their working memory long enough to examine it and make sense of it.

However, working memory is very limited. In rough terms, this means that about seven words can be maintained for about 12 seconds. Since many sentences are of that length, people must be able to read a sentence in about 12 seconds to be functionally literate.

This frequency amounts very roughly to one word per 1 to 1.5 seconds, or 45 to 60 words per minute.

Unless people read at this speed, they cannot keep an entire sentence in memory; by the time they reach the end of a sentence, they have forgotten the beginning.

To avoid cluttering the working memory with failed attempts, people must also read accurately. For example a 5 percent inaccuracy rate in reading is associated with comprehension test scores of only 75 percent.

Reading involves a paradox. *Slower readers read less material but use up more working memory.* They must make more effort to read, muster more attention, and may still lose part of the message. People who read haltingly are probably functionally illiterate. They may puzzle out some phrases, but they cannot read or understand the volumes of text needed to learn.

Certainly, speed and accuracy are not sufficient for comprehension. As with liturgical languages, children may read fluently and understand nothing. Vocabulary knowledge, inferences, comprehension of text structure, and self-monitoring are important for spoken and written communication, and explicit instruction is needed in these skills. But working memory seems to be the only gateway to comprehension – it is essentially impossible to read haltingly and comprehend much material.

Developing word recognition skills

To get around the limited working-memory span, the brain has the tendency to create larger chunks of frequently occurring stimuli and then process these very fast and automatically.

Beginning readers use these pathways to link letters to sounds and decode words. Involvement of the speech area creates the tendency to sound out a text subvocally in order to decode it. Though it is possible to read letter by letter, processing in these two areas challenges the limits of the working memory. Novice readers who make conscious decisions about letters can only read small amounts of text and may have to read a message repeatedly to understand its meaning.

Fluency is achieved when an *instant word recognition* pathway is activated.

A reader must analyze and correctly read a word several times before the pathway is activated. Then an exact neural model of that specific word is formed, reflecting its spelling, pronunciation, and meaning, and is permanently stored in the brain. This neural region responds very rapidly to the word and sees it as a pattern.

This is how reading is automatized. The added advantage is that automatic behaviours are not easily forgotten. Therefore, *automatic readers do not normally lapse back into illiteracy.*

Sounds within words

It is much easier for someone who knows a language to read fluently in it. This is because people identify letters faster if they are inside words than if they stand by themselves (a phenomenon called “word superiority effect”).

Also readers have the benefit of context and can guess words they may not read fully.

Therefore, students benefit from learning to read in their mother tongue or one that they know well, even if they will rarely read in that language later.

Fluent reading in a language with simple spelling (such as Afrikaans or Zulu) facilitates reading in a language with more complex spelling (such as English).

Once the automatic pathway is activated, reading speed rises fast, and comprehension may follow suit. With sufficient practice, the intermediate stages do not last long. Proficient readers read effortlessly and anticipate what kind of text will come on a page. Looking at the left side of a page, peripheral vision records outlying material. More recently seen and more frequently used words are recognized faster, and errors are smoothed over without people noticing. So, people can make sense out of grossly misspelled words with missing letters.

The amount of practice required to activate the automatic pathway depends on the consistency between letters and sounds. So, in the phonetically spelled European languages, middle-class children read basic text fluently before the end of grade 1 and may teach themselves to read in kindergarten. When taught efficiently in languages with simple spelling, students progress at similar rates and show small individual differences.

By contrast, in languages with complex spelling, rates of progress are slow, and individual differences are wide and persistent. Such languages require more practice for automaticity and also faster reading for timely comprehension.

The irregularities of English present special problems and learners must learn lists of frequent words in early grades. Overall, English-medium students require 2.5 or more years of literacy learning to master the recognition of familiar words and simple decoding that is learned in one year for languages with simpler spelling rules. Spelling complexity therefore implies that it may cost more to learn reading in some languages than in others. Learners studying in English need more time and better language command in order to decode.

Reading benchmarks and norms

Benchmarks of reading competency exist in some countries, and they approximate the speed needed for the working memory to retain a sentence.

In the United States, suggested reading norms are 30-70 words per minute for grade 1 (oral), 60-100 words per minute for grade 2 (silent), 90-120 words per minute for grade 3,110-140 words for grade 4,140-170 for grade 5, and 160-190 words per minute for grade 6.

The Chilean nongovernmental organization (NGO) Educando Juntos has proposed goals of around 34 and 64 words per minute for grades 1 and 2, respectively. A Cuban expert suggests 30 words per minute at the end of grade 1 as a reading speed for a "normal" child..

A study from Spain reported averages for the grade 1 and grade 2 of about 50-55 and about 75 words per minute, respectively. Among the low-income Spanish-speakers in the United States, a speed of just 30-60 words per minute in Spanish in grades 1 and 2 is used as an index of disadvantage. These at-risk students were typically reading at about 35 words per minutes in grade 1, and around 60 in grade 2. A European cross-national study defined fluency operationally as the reading speed of 2.25 seconds per word (27 words per minute), which children attain before the end of grade 1.

The science that links reading to comprehension leads to a *quantitative model of reading efficiency that has a simple and transparent monitoring indicator.* This in turn makes it possible to establish goals and benchmarks for the early grades. In each country and for each language, parsimonious ways must be found to teach reading. Teacher training and supervision should be directed toward achieving this goal. Communities may be easily trained to recognize the signs of fluent reading and hold teachers accountable to this standard.

Reading issues affecting the poor

In English and other languages that have complex spelling and unclear vowels, learners must look at larger chunks of writing and find words with a likely pronunciation. Extensive language knowledge and phonological awareness are important advantages, and the poor are slower to acquire reading skills. For example, British low-income children show delays in letter identification and learn to read about a year later than middle-class children. In

languages with simpler spelling like Spanish, beginning readers tend to focus on syllables and do not have to depend on knowing the words in order to decode them.

Overall, however, the more limited phonological awareness and language use of the poor create early disadvantages that do not disappear in subsequent grades without intervention. Complex language knowledge is needed to get past decoding and understand the message, as well as to understand expressions used in school and other institutions.

An important early literacy activity is to build vocabulary and phonological awareness. A few hours of language games, such as clapping to count syllables, learning rhymes, or deleting initial letters are invaluable aids in reducing inequity.

Does poverty or malnutrition prevent people from learning to read?

People who were malnourished as children may have more limited working memory capacity and shorter attention spans, may have limited vocabulary and may not comprehend well. They may need more hours of instruction and practice. It may be worthwhile to focus on fluency first and build vocabulary afterward so that the children can retain a sentence in working memory.

However, the evidence suggests that with sufficient instruction even poor students should decode material in their textbooks and attain fluency by the end of grade 1.

Barriers to fluency

- limited hours of instruction
- inattentiveness by the teacher
- lack of trained teachers
- insufficient practice due to a lack of textbooks
- lack of reading practice at home
- spelling complexity, especially when a local dialect deviates from the official language
- limited knowledge of an official language, particularly one that is spelled irregularly as in English
- over ambitious teaching methods, such as whole word instruction and early writing composition ("text production") with critiques and analyses as early as grade 1 (prevalent in Latin America)
- vision problems and unmet need for eyeglasses
- dyslexia, though relatively rare outside the English-speaking world

Teacher diligence or indifference towards the poor may determine reading achievement. One issue is that the less competent or less interested teachers often teach the lower grades and poorer people.

An additional issue plaguing low-income children in poor and crowded schools is *lack of feedback for error correction,* an essential learning tool. Learners need someone to hear them read and correct them.

An intriguing implication from the reading automaticity research is that learners who have become largely fluent readers before they drop out may read and understand text later on and improve their skills. In countries with high dropout rates, the challenge thus is to make students automatic readers before they drop out.

Phonics versus "Whole Word" methods

Normal as well as dyslexic students learn to read faster through methods that break down words into small segments (phonics). Composing words from letters or syllables is particularly helpful for languages with simple spelling where letter combinations consistently represent the same phonemes.

In the early 1980s and before the biological aspects of automaticity were understood, some educators in the United States hypothesized that children learn to read naturally, as they learn language. This idea engendered a grass-roots movement among teachers in the 1990s, many of whom were tired of drilling. The "whole word" approach came about partly because of spelling irregularities in English and the difficulties of teaching many of the words by breaking them down into sounds (phonics). In this approach, students do not learn sound-letter correspondences. Instead, they are expected to perceive words as patterns while teachers read aloud and figure out the ones they do not know from the context. They must pay attention to meaning, discuss ethical concepts of the books that they choose, read in pairs, write their own concepts in long sessions of sometimes primitive writing, and create art about what they read. (The entire method is often known as the "whole language" approach.) The sound-letter correspondences are given as instructions specific to the text rather than general rules. Concepts are to be discovered rather than presented, because discovery promotes higher-order thinking. For example, students may be asked to search a text for all the words with the /o/ sound and then group them according to their spellings. Many areas in North and South America as well as in New Zealand adopted this method in the early 1990s.

The whole word (and language) approach **seems to improve students' attitudes towards reading**, but the discovery road to reading requires **much time, individualized instruction, and teacher expertise**. It tends to favour those who are better prepared. It may be effective for middle-class English-speaking children, whose parents can support their efforts, but even for the irregularly spelled English language, phonics has proved to be more efficient.

A meta-analysis in 1989 found no evidence that whole language programs produce stronger effects than phonics and may potentially produce lower effects. Many other studies followed with similar findings in light of the increasing concerns over functional illiteracy in the English-speaking world. In New Zealand, where 20-25 percent of all six-year-old children have received expensive and intensive remedial reading since 1991, it was found that more intensive instruction with the same method led to little improvement. A seven-year British study concluded that children taught to read through *synthetic phonics* were 3.5 years ahead of expected performance for their age in reading words, 1.75 years ahead in spelling, and 3.5

months ahead in comprehension. There was evidence also that phonics helped closed the reading gap between children from poor and better-off backgrounds as well as between boys and girls. In 2000, the U.S. National Reading Panel, constituted to resolve the long-standing reading issues problems in the United States, solidly endorsed phonics for the teaching of English. Since then the whole language method has gradually fallen in disuse in the English-speaking countries.

Though appealing and inherently sensible, the whole language approach puts low-income learners at risk for failure. Poor children may well be able to recognize complex visual patterns of script,, but limitations in vocabulary, phonological awareness, and working memory may prevent them from creating the necessary analogies between language and reading. “Constructivist” textbooks progress directly into stories without the introductory large-print letters and syllables that primers commonly have. Furthermore, some schools choose to teach without textbooks, and then the students may not have enough reading materials from the environment. Poorly educated teachers may lack the sophistication needed to create the context interpretation and analogies for children, particularly when classes are large and individualized attention difficult. Spending much class time on guesswork, artwork, and early text production may be lead to multiple difficulties for poor students.

Nevertheless, the whole language approach is very popular in Latin America (often referred to as “constructivismo”). As a result, students in middle-income countries such as Venezuela and Panama spend years trying to acquire skills that children in Spain learn in about six months. Third graders in Brazil may spend entire class hours writing one-line answers to simple questions, while still reading haltingly. The result is low performance and higher expenditures for school systems that must accommodate repeaters. For example, the 2004 overall grade 1 repetition rate in Uruguay was 16.9 percent, and in low-income areas it was 25 percent. In this middle-income country with a simple phonetic script, 35 percent of second graders could read only syllables. Less efficient reading methods cost governments and other stakeholders time and money.

Some educators consider phonics-based methods mechanistic exercises that stifle creativity and inquiry. However, fluent reading is likely to enhance these desirable qualities in students. Since research has shown that with intensive practice skills improve in only a few weeks, the more mechanistic stage of education should last at best a few months. Getting the mechanics right is thus not necessarily a distraction from creativity, and accomplishment may actually reinforce students. Ideally, literacy programs should combine phonics instruction with student selection of texts and authentic learning tasks as children learn the basics.

How should textbooks be designed to facilitate reading acquisition? Yes. There should be an emphasis on regularity and practice. More effective textbooks were found to use more regular words so that the learners learned the main rules of the correspondences between letters and sounds before the exceptions were introduced. These books also had more text and used the same words many times. They used high-frequency words thought to be part of the learners’ vocabulary. And the words were relatively short so that most of the learners could sound them out without putting too much stress on their short-term memory.

Policy Implications

It is reasonable to set a country-level goal that by the end of grade 2, almost all students should read fluently – that is, at about 45-60 words per minute.

Sixty Words per Minute for All

The ingredients necessary to produce fluent reading include the following:

- Teach sound-letter correspondences, starting with the smallest units possible in a language.
- Use language games to raise awareness of individual sounds and the start and end of words.
- Teach reading in a known language to take advantage of the word superiority effect.
- Give lots of practice and feedback, and ask each learners to read aloud for one minute every day.
- Provide textbooks
- To increase the hours and opportunity of practice, textbooks should be available for students to take home, not just for reading in class
- Devote most of the class hours in grades 1-2 to reading and math and use time well.
- Teach vocabulary so that learners can comprehend as speed increases.
- By the end of grade 1, learners should "crack the code" and read haltingly. By the end of grade 2, they should read frequent words with the speed of about a word per second, though they may stumble upon unknown words. Their intonation should be appropriate to meaning of the text, indicating that they are maintaining sentences in their working memory and are making the adjustments required by the meaning. Interesting stories in simple language are likely to help struggling students persevere.

Adapted from :

Helen Abadzi. 2006. *Literacy acquisition and the biology of reading*. In: Abadzi, H. 2006. ***Efficient learning for the poor: insights from the frontier of cognitive neuroscience***. Washington, DC: The World Bank, pp. 36-49