

READING AND WRITING INVENTION AND EVOLUTION: A LEARNING MODEL FOR BEGINNING READERS

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ABSTRACT

Reading and writing play important parts in human lives in this world both for adults and children, either in academic or non-academic setting. These literacy activities have brought about massive impacts on human cultural and biological nature. Because they are too fabricated in our lives, we tend to neglect how difficult are they for children to acquire in the first place, especially for children with certain dyslexic conditions. And because we merely take them for granted, few people, even language instructors or teachers, know how reading and writing systems were created and evolved, and how they are processed in the brain as opposed to verbal skills of listening and speaking, how first language and foreign language reading are differently processed and acquired in bilingual brain, how pictographic or sign-based writing system like the Chinese characters and syllabic or phoneme-based writing system like the Roman alphabets are (not) differently processed in our brain. Knowing how reading and writing were invented, evolved, and processed in the brain would tell us how to most effectively acquire these skills. This article employs a library research in the fields and literature of reading and writing system invention and evolution, and in neurolinguistics in order to satisfy the curiosity raised above. The article also suggests as the implication of their invention, evolution and neural process a model of literacy instruction that is based on phonics-reading approach as opposed to whole-word reading approach for both early first and second language reading instruction.

Keyword: Literacy skills, neurolinguistics, bilingual brain, phonic-reading approach, whole-word reading approach, sign-based writing system, phoneme-based writing system

Introduction

Reading and writing are language skills that involve and make use of letters, words, and sentences, to say the least, through hand-writing or printing to decode or encode ideas on pages, paper or digital. They are the typical communication types in academic world for getting and sharing scientific information and knowledge. This literacy skill allows conversation and share of wisdom between our deceased ancestors, us living people, and our farthest future children later. More importantly, reading and writing have caused and brought a great deal of impacts on both human culture—from completely oral society to literate society (Givon, 2002), and biological nature—formation of visual word form or letterbox area in the left occipital lobe of the brain (Dehaene, 2009), since the beginning time of their invention and their evolution until today, and are still dictating the direction of our intellectual change in the future. Thus, reading and writing roles and relationship are more than meet the eyes.

Knowledge about reading and writing processes is not unbeknown, actually. For example, we now are aware that reading and writing are difficult skills to master by children, and not few people, even big names like Albert Einstein, Pablo Picasso, and John Lennon, have problems with them, which can be caused by either acquired or developmental dyslexic

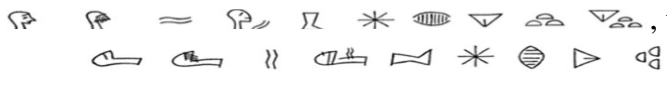
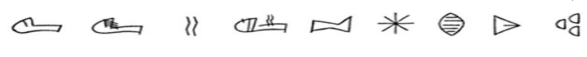
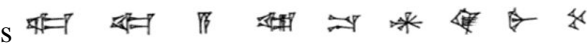

condition, since these skills cannot be naturally acquired; quite different from speaking and listening which, universally, normal children can acquire naturally. More such knowledge is surely necessary for reading and writing instructors in particular and all language-related professionals in general for creating effective language learning model. Neurolinguistics, a linguistics branch that explores how the brain understands and produces language and communication through their probing methods of neuro-imaging and brain activity measuring using CT scan, MRI, fMRI, PET, EEG, and MEG provide more confident concrete empirical findings about reading and writing processes (Ahlsen, 2006). As reading and writing is too big of a topic to address than this current article could allow, this article limits to describing, firstly, the origin of reading and writing as related to their processes in the brain. Then, it describes briefly the reading and writing processes in the bilingual brain. Finally, it presents a reading and writing instructional model of phonics reading approach applicable for first and second language reading instruction which is strongly supported by neurolinguistic research findings, as opposed to whole-word approach.

The Invention and Evolution of Writing

The birth and evolution of almost all writing systems had evolved in general stages of pictographic, ideographic, syllabic, and alphabetic stages (Dehaene, 2009). Pictographic or logographic writing first appearing on strokes on a bone, in clay, on a cliff or a cave wall in ancient Sumeria or Mesopotamia (present-day Iraq) and Egypt around 5000 BC, “simplified picture of the sun to stand for the word *sun*, the picture of an ox for the word *ox*, for example, that cohabited with a rich set of nonfigurative shapes such as series of dots, parallel lines, checkerboards, abstract curve” (Dehaene, 2009: 235). This emergence of pictorial symbols were also essentially related to number symbols as shown on clay objects bearing abstract shapes of cones, cylinders, spheres, half-spheres, and tetrahedrons, which were used for counting and calculation in the Middle East, and for calculating time cycles in a calendar system of pre-Columbian South America. In brief, the coding of abstract ideas such as number or time played an essential role in the emergence of writing in companion with hieroglyphs of animals, objects and tools, body parts, body and simple geometric shapes.

In the evolution of writing, the pictograph stage was so brief, because the function was too limited to be used for expressing abstract ideas. Chinese writing system combined pictographs to represent abstract ideas; for example, the pictographs for *sun* and *tree* were combined to represent the concept of *east*. This method of combining pictographs to represent the words for ideas is known as an ideographic system. Another factor that had transformed pictographic to ideographic system was that the scribes should create the pictographs as quickly as possible for everyday use. A faster and simplified writing system known as *demotic* (literally, scripture of the people) was soon introduced. In all countries writing was widespread, stylization led to a quick move away from pictography to a simpler set of conventional symbolic characters of ideograms.

Convention and simplification are two essential factors in the evolution of writing. In Sumerian, the first conventional characters whose pictographic origins are obvious

 , then went through orientational change  , quickly evolved into abstract symbols  , largely because they had to be traced in soft clay with wedges in the cuneiform characters. Later on, proto-Sinaitic writing  adopted a small set of conventional pictures to represent the consonants of Semitic language. During their adoption


by the Phoenicians and the Greeks, these shapes were further simplified and rotated by 90 or 180 degrees to $\text{A B C D E F G H I J K L M N O P Q R S T U V X Y Z}$, under the influence of changes in the direction of writing. They ultimately became the letters of Roman alphabet $\text{A B C D E F G H I J K L M N O P Q R S T U V X Y Z}$. Each of them, such as the letter A, can be seen as the end point of a cultural evolution that tended toward greater simplicity while maintaining a core shape that could be recognized easily by our inferior temporal neurons (Robert Fradkin in Dehaene 2009).

The transition from pictographic writing to syllabic and sound-based writing were essentially related to visual puns, known as the rebus principle (Encarta Encyclopedia, 2009). It involves the use of a pictogram to represent a syllabic sound. This procedure converts pictograms into phonograms. For the Sumerian scribes, the word for “life,” pronounced *til*, was illustrated by an arrow, which was pronounced *ti*. This kind of transcription of meaning progressively gave way to writing sounds. In Sumerian, the drawing of a plant, pronounced “mu”, was first adopted to denote “mu”, a year, then “mu”, a noun, then grammatical words like the possessive mu, “mine”. Finally, it became the conventional sign for any mu syllable, even when it appeared within another word (Dehaene, 2009). Very similar logic governed the evolution of Chinese characters, composed of subunits that include both meaning and phonetic markers. For instance, the character for “sunshine,” pronounced qing, is made up of the characters for “sun” and “green”; the first is an obvious semantic marker, while the second, pronounced qing, indicates proper pronunciation.

In brief, a mixed writing system combining meaning and sound was independently adopted by various cultures. The reason why writing systems mixed meaning with sound throughout the world probably lies at the crossroads of multiple constraints: the way our memory is structured, how language is organized, and the availability of certain brain connections (Dehaene, 2009). Our memory is poorly equipped for purely pictographic script, where each word has its own symbol. It would be impossible to memorize a distinct sign for each of the 50,000 words in English lexicon. Even in present-day China, scholars must learn several thousand signs. As recently as the 1950s, the rate of illiteracy in the adult Chinese population was close to 80 percent—before radical simplification and massive investment in education by mixing their pictographic and ideographic writing with phonic markers brought this figure down to about 10 percent.

The first traces of an alphabetic system called Proto-Sinaitic, dated from 1700 BC and were uncovered in the Sinai peninsula (Dehaene, 2009). In this system, signs no longer referred to meaning, but to speech sounds alone, and in fact solely to consonants. In this way, the inventory of written symbols was dramatically reduced: two dozen signs were enough to represent all the existing speech sounds with perfect regularity. This scribe’s new language belonging to the Semitic family, which today includes Arabic, Amharic, and Hebrew, emphasized peculiarly in consonants within which vowels can vary. In Hebrew, for instance, the root *gdl*, which expresses the general meaning of “big,” can be declined as *gadol*, big (masculine); *gdola*, big (feminine); *giddel*, to raise; *gadal*, to grow; *gdil*, to enlarge; and so on.

The choice of a shape for each consonant was also guided by a very simple and mnemonic idea: each shape stood for a word that begins with the corresponding consonant. This clever idea is known as the acrophonic principle (literally, “using the sound at one end”). Thus the consonant “b” was represented by the outline of a house, called *beth* in most Semitic languages. It gave its name to the letter *beta* in Greek. Likewise, the glottal stop, a consonant unique to Semitic languages, that leads the word *aleph* (ox), was represented in Proto-Sinaitic writing by an ox head. This shape, stylized and rotated, became the letter *alpha* (α) in the Greek alphabet, and then roman letter A. If we turn over a capital A, the head and two horns of the

original ox can easily be recognized. . The acrophonic principle is the sole reason why Greek letters have curious names (alpha, beta, gamma, delta, etc.) In fact, they are the distorted Semitic names of the two dozen images that gave Roman letters their shape, name, and the pronunciation of their first consonant. Each of the letters that are routinely used in the modern Roman alphabet thus contains a small, hidden drawing dating back four thousand years. An “m” symbolizes waves (mem or mayyuma), an “n” is a snake (nahasu), an “l” a goad (lamd), a “k” is a hand without stretched fingers (kaf), an “R” is a head (res).

The first introduction of vowel notations was contributed by the Phoenicians. Phoenician script, following on the tracks of the Hebrew and Ugarit alphabets, introduced the representation of vowels by adding symbols called *matreslectionis* (“mothers of reading”). Initially, the *matreslectionis* were simply consonants converted into vowels. The Semitic word for panamuwa, initially written with the consonants PNMW, was progressively distorted in spoken language into panamua, then panamu. Because the word was still written PNMW, the final consonant W came to be the transcription of the sound u. Similarly “j” (jodh) became the official transcription of the vowel i—the same kind of speech distortion that makes us pronounce the capital Slovenia, Ljubljana, as liubliana.

It was the Greeks who finally refined and created the distinctive vowel alphabet as we know now. Because the Greeks could not pronounce the glottal stop indicated by an apostrophe which is the first letter of the aleph (depicted by the letter A), unwittingly, Greek speakers dropped this first sound and incorrectly pronounced this letter aleph as vowel. Thus, the letter “A” came to denote the vowel *a*, even though this letter initially depicted a consonant in Semitic languages. A similar story accounts for the letters *iota*, *omicron*, and *upsilon*, all of which were Semitic consonants converted into Greek vowels.

Although these adjustments were slow, a new principle was under way. For the first time in the history of mankind, the alphabet allowed the Greeks to have a complete graphic inventory of their language sounds. Writing had been stripped of its pictographic and syllabic origins. The Greeks had discovered the smallest unit of spoken language, phonemes, and had invented a notation that could transcribe them all. By trial and error, cultural evolution had converged onto a minimal set of symbols. These were compatible with our brain, both because they could be easily learned by the letterbox area, and because they established a direct link to speech sounds coded in the superior temporal cortex. The history of writing system tells important information about our biological constraints and thus reading and writing evolution (Dehaene, 2009).

How (Fast) Do We Read?

Reading starts from the eyes. However, according to Dehaene (2009), our eyes impose a lot of constraints on the act of reading. The structure of our visual sensors forces us to scan the page by jerking our eyes around every two or three tenths (3/10) of a second (only ten or twelve letters per saccade: three or four to the left of fixation, and seven or eight to the right). Reading is nothing but the word-by-word mental restitution of a text through a series of snapshots. While some small grammatical words like “*the*,” “*it*,” “*is*” can sometimes be skipped, almost all content words such as nouns and verbs have to be fixated at least once. These constraints are an integral part of our visual apparatus and cannot be lifted by training. One certainly can teach people to optimize their eye movement patterns, but most good readers, who read from four to five hundred words per minute, are already close to optimal. Given the retinal sensor at our disposal, it is probably not possible to do much better. Thus, Woody Allen describes this situation perfectly: “I took a speed reading course and was able to read War an

Peace in twenty minutes. It involves Russia.”

Whole-Word Reading and Phonics Reading

The most widely used kind of model for reading is a dual-route model (e.g., Coltheart, Patterson, & Marshall, 1980; Ellis 1984 in Ahlsen, 2006), which posits two main strategies for reading: (1) whole-word reading, and (2) Phonics reading or grapheme-phoneme conversion. Whole word reading means that visual representations of whole words are read, either from the visual word form directly via the semantic representation of the word. Grapheme-phoneme conversion means moving from letters to phonological representations.

Proponents of whole-word approach, Jean Piaget is one (Dehaene, 2009), posit that we should teach children to direct associations between written words and their corresponding meanings. The technique involves the child’s immersion in reading, and the hope is that he will acquire reading spontaneously like a natural language. Whole-word reading denies the need to teach the systematic correspondence between graphemes and phonemes, this knowledge will appear by itself as the result of exposure to the correspondences between words and meanings. This technique refused drill, which was thought to turn children into automata who could only drone out silly sentences like “Pat the cat sat on the mat.” They also believe that children found it more fun to discover phrases than words, spelling rules, or boring letter-to-sound decoding. They would be empowered if they could “build their own learning environment” and spontaneously discover what reading was all about. For the supporters of the whole language-approach, the child’s autonomy and the pleasure of understanding were what counted most, over and above the accuracy with which individual words could be decoded (Stenberg, et al. 2001).

Whole-word approach reading principles proponents are based on at least the four pillars of reading, which the phonics reading approach proponents find erroneous (Dehaene, 2009): First, reading time does not depend on word length; The same time is needed to read short and long words, regardless of number of letters. This first pillar is believed to be wrong by phonics reading proponents. Even though word length has no impact on adult readers, it does not mean that our brain does not pay attention to letters. In young children, however, the process is different. During the first few years of reading acquisition, reading time is strictly related to the number of letters in a word. This word length effect takes years to vanish. The massive impact of the number of letters on young children’s reading time provides clear evidence that reading is not a global, holistic process—especially during the early years.

Second, recognizing a whole word can be faster and more efficient than recognizing a single letter. Phonics proponents believe to be the contrary; performance in reading a word hidden in visual noise is directly related to the rate at which its components letters are recognized. A related factor concerns the number of relevant neurons. Many neurons work together at several lexical, semantic, and phonological levels, to discriminate “head” from “heat”, for example, to make reading process faster.

Third, we are slightly faster at reading words in lowercase than in UPPERCASE: Lowercase reflects the unique visual patterns created by ascending and descending letters such as “f,” “l,” “g,” and “p” shapes that create a contour-specific signature for each word. This contour disappears when the word is written in uppercase letters, which are all the same size, and our reading speed thus decreases. However this theory doesn’t work. If we really use contours to recognize words, we should not just be slower, we should quite simply be unable to recognize uppercase words. It should also be impossible to read WoRdSPrInTeDiNMiXeDcAsE, which destroys familiar contours. But we know that these

manipulations leave words amazingly readable.

Fourth, typographical errors that respect the overall contour of a word are more difficult to detect than those that violate it. Whole-word proponents gave the examples of the vocabulary word “test,” and pseudo words “tesf” and “tesg.” If we look for the target word “test” we find it more difficult to detect an error in “tesf” than in “tesg”, where the ascending letter “t” has been replaced by a descending letter “g”. Again, while this is an undisputed fact, its interpretation has nothing to do with global word shape. It can be entirely attributed to the confusion between individual letters. The “f” in “tesf” is quite similar to the “t” in the target word “test”, while the “g” in “tesg” is strikingly different. It is letter similarity that leads to the confusion between the two letter strings, not whole-word resemblance.

The dispute between whole-language learning and phonics instruction plagued schools and education policymakers around the world. In the US, culminated in 1987, state of California, passed bills favoring the whole-language approach over basic decoding skills. In a matter of few years, reading scores in California plummeted. Most schools return to the systematic teaching of letter-sound correspondences. Whole-language approach today has been officially abandoned (Dehaene, 2009).

Reading and Writing Process in Bilingual Brain

An important finding on reading and writing process in bilingual suggests that phonological processing of Chinese characters recruits a neural system involving left middle frontal and posterior parietal gyri, cortical regions that are known to contribute to spatial information representation, spatial working memory, and coordination of cognitive resources as a central executive system. The peak activation of this system is relevant to the unique feature of Chinese that a logographic character has a square configuration that maps on a monosyllabic unit of speech. Bilingual Chinese children apply their L1 system to L2 reading and that the lack of letter-to-sound conversion rules in Chinese led Chinese readers to being less capable of processing English by recourse to an analytic reading system on which English monolinguals rely (Tan et al 2003). Furthermore, reading in L2 engages the identical cognitive neuroanatomic substrates employed in reading in L1 (Nakada, 2001). The physiological acquisition of literacy in L1 has significant effect on the acquisition of literacy in L2, even when L1 and L2 utilize dramatically variant coding systems, as is the case for Japanese and English. Thus, the L1 and L2 reading process overlap in the identical neural area of the brain.

Three General Steps for Reading and Writing in Phonics Approach

The facts about the invention, evolution, and neural process of reading and writing have been contrary to the whole-word principles thus bring the practice of reading instruction to return to phonic reading. Normally, reading by children is started with logographic or pictorial stage at about age five or six. They attend to the shape, color letter orientation, curvature and other physical appearance of words as pictures that have direct association to meaning. Therefore, it is a common error that happened when beginning readers read the word “chinchilla” Coca-Cola. It suggests that the child’s brain at this stage is attempting to map the general shape of words directly onto meanings, without paying attention to individual letters and their pronunciation, which is called a sham form of reading. At the visual level, they can learn to recognize and trace letter shapes. The Montessori method, which requires tracing sandpaper letters with a fingertip, is often of considerable help at this early age.

Leaving pictorial stage, a child’s learning process embarks to phonological stage. In this stage, the child begins to raise phonemic awareness. During the development of grapheme to phoneme conversion procedure, the child attends to smaller constituents such as isolated

letters and relevant letter groups such as “ch,” “ou,” “ay”. Children slowly decipher words sequentially, one letter at a time, as a result, reading time increases with the number of letters in a word. This discovery of phonemic awareness is not automatic. It requires explicit teaching of an alphabetic code. At the phonological level, preschoolers benefit from playing with words and their component sounds (syllables, rhymes, and finally phonemes). The phonological stage is then followed by orthographic stage. In orthographic stage word length gradually ceases to play a role. In this reading stage, we all read words using a parallel procedure that takes in all letters at once, at least in short words.

Conclusions

Reading and writing no doubt play a pivotal role in human evolution and cultural development. The studies of reading and writing origin and neurolinguistics research seem to be in concert to claim the close letter-to-sound associations in reading process and acquisition. Whole word reading common in mature adult readers is not appropriate for beginning readers since such approach would activate the wrong brain area and cognitive development and delay the letterbox or visual word form area development responsible for reading ability. L1 and L2 reading process overlap in this identical reading area in the brain. Thus reading and writing instructional strategy for L1 may apply well for L2 instructional model. Phonics reading model involves and train the right neural reading area and enhance the development of this area, the essential neural condition for successful reading acquisition common in the skilled reader brain. Phonics reading procedure model initiates with pictorial stage, to phonological stage and followed with orthographic stage is very much in line with the reading and writing invention and evolution.

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