

Are there Age-Related Psychophysiological Barriers to the Acquisition of Literacy?

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Abstract

This paper was presented at the International Literacy Year Colloquium in October 1990, in Washington, D.C. It addresses some of the psychophysiological issues facing adults in acquiring literacy. The paper addresses three possible neurological barriers for adults. These barriers are:

1. The brain may be more developmentally prepared for reading acquisition at an early age;
2. The changing mechanisms of information storage may affect consolidation of letter patterns; and
3. Diminishing attentional resources may affect reading comprehension.

The question is then raised whether greater returns may be reaped from investing in literacy for younger illiterates instead of older adults illiterates.

1. The Problem

Speaker asks the audience: “How many of you learned to read a foreign language, in a new script, after reaching adulthood?” Approximately half of the people raise their hands.*

Speaker asks the audience: “How many of you who learned a foreign language as adults can read its script half as fast as you read English?” No one raises a hand.

This is the problem I address today. I argue that the acquisition of sophisticated literacy skills by adults, even by young adults, is quite difficult. The causes could be neurological, but I have found practically no research on this topic. Despite the millions of dollars spent each year on adult literacy activities, little cognitive or psychophysiological research exists to uncover the source of difficulties that may be partly responsible for the many failed literacy campaigns. To make sense of what we may be facing, I have developed some hypotheses that I present. To illustrate my concerns about age-related difficulties in the acquisition of literacy, I share with you the literacy adventures of Greek relatives and friends, as well as my own.

2. Adult Women Struggling with Literacy

My father's older sister, Aunt Sophia, never went to school because her mother died and the family faced great poverty when they fled from Turkey to Greece in 1917. Her daughter became a primary school teacher and tried to teach Aunt Sophia to read. At the age of eighty, my aunt merely puzzles out newspaper headlines, though she lives in an urban environment with written materials all around her.

Some of my maternal aunts had a maid, Maria, who also never went to school, and who tried very hard to become literate as an adult. My aunts were teachers and gave her a lot of encouragement. For a while, her achievement was the talk of the family. Maria became very ambitious and wanted to read about “Mr.” Plato and “Mr.” Socrates, but somehow she never got beyond the word attack stage. Despite living in Athens, with street signs in constant view, she eventually forgot even the letters she had once learned.

Mrs. Niki, the mother of a friend, had a few years of primary school, but claimed to be illiterate. I asked her to read aloud on one occasion and realized why. She would identify the first two or three letters of a Greek word, which is phonetically spelled, but would then make up plausible

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words—usually wrong—rather than read the rest. It was as if reading the remainder took longer or was more tedious than finding suitable words. Since she guessed from limited information, she could not make much sense out of what she read.

The only adult woman that I knew who became functionally literate as an adult was the maid who raised me. Sophia was a refugee from Turkey, who attended first grade before her mother died and left her homeless. She had fond memories from that one year in school, possibly because she performed well during her brief period of opportunity. When I went to primary school, she got into the habit of reading my schoolbooks. When she read aloud, she did the same thing as Mrs. Niki: she read the beginning of the word and made up the rest. She, however, read most of the word and made up just the ending, so she was able to make sense out of what she was reading and was reinforced enough to persist. As a child, I laughed at her mistakes, but years later in amazement, I watched her open a newspaper, put on my father's eyeglasses, and give my mother a summary of the town's social events. When Sophia died in 1978, she was literate, but the reading comprehension she acquired as an adult was built on childhood training she had cherished.

3. Learning to Read Foreign Scripts as an Adult

My own experiences have much in common with those of the illiterate Greek women I have known. Foreign languages are my hobby, and I have studied about fourteen. I learned to read six scripts after age eighteen, notably Hebrew and Hindi, in which I am fluent. Despite my lengthy experience with reading in general and a twenty-year dalliance with these two languages, my reading skills in them do not begin to approximate those of Greek or English. I learn the letters of a phonetic or syllabic script in two or three days, and I easily read words by deciphering one letter at a time, but I quickly reach a plateau and *cannot easily progress to recognizing whole-word patterns. Some letters and/or combinations are integrated more easily into patterns than others*, but I see no consistency in either shapes or sounds. With more practice, I recognize the patterns of short words or the first few letters of a word. Then, like the Greek women I knew, I find it easier to guess the rest of the word than to decode it. After I finally learn to recognize a word as a pattern, the slightest alteration—such as a plural—throws me off; the pattern looks completely unfamiliar, rather than the known pattern with a slight change.

When I see a Greek text even for a few milliseconds, I read it effortlessly; the letters “fly out” at me. In contrast, I may look at scripts I learned as an adult for several seconds and just see a jumble of letters. To read, I have to make an effort and sound them out in my mind. Therefore, my *speed remains rather low and reading is tedious*. The best I have been able to do in Hebrew and Hindi has been to attain the speed necessary for reading aloud relatively smoothly.

I also make many *errors*. I am very likely to concentrate on part of a letter and mistake it for a similar looking one, therefore incorrectly reading the word and making no sense of it. I am much more likely to make mistakes when I try to recognize the entire word rather than to decode each letter. For example, I misread the Arabic *jeem*, *ha*, and *kha* letters about 30 percent of the time when I try to read fast. I also often reverse the order of the letters when I look at a whole word. These errors do not seem to be similar to the semantically related errors that experienced readers make when they read fast.

Limited *perceptual constancy* is another problem. I can get used to reading regular book print, but I have trouble identifying the letters of computer printouts, typewriters, decorated store signs, or handwriting. The first and second graders I observed in Morocco had much less trouble identifying letters in various media, even though I had read Arabic longer than they had.

The most disheartening problem I have encountered, however, has been an *inability to maintain the speed and ease* I acquire with practice. Some years ago, I completed an advanced Hindi course (Parichaya), during which I read literature and passed lengthy essay examinations. At the end of the course, I could scan a text and instantly recognize many words. I could read aloud smoothly, though not as well as three teenagers who rattled off the texts. My satisfaction turned into dismay,

however, when three months later, I entered an Indian store and started to read a sign that said “juice sold here.” I looked at the sign for several seconds, unable to decode it as a whole. Then I misread one letter and could not get the meaning for a while. After all the intensive work, my speed was back to the plateau it had reached before I started the Parichaya course. My speed in reading Hebrew, which I started at eighteen, plays the same tricks. When I am invited to a Seder, I practice reading the Agadah a few days in advance so that I can take turns reading aloud. After the Seder, my performance sinks again to its usual disgraceful level.

These experiences have led me to hypothesize that a few years of childhood practice consolidate reading skills to an extent impossible for adults. I once met a thirty-year old woman who left Greece after she finished primary school. Being from a Jewish Ladino-speaking family, she had little contact with the Greek language after the age of twelve. Yet, she had no trouble reading the Greek magazines I lent her. After a brief period of finding the script “strange,” she began to read effortlessly. Conversely, I suspect that even under optimal circumstances, it may be impossible to acquire, as an adult, the speed a child acquires. I watched a Greek high-school classmate, who has spent the last twenty years studying and working in Israel, hesitate for about two seconds when asked to read aloud a sentence in Hebrew; yet, he had spent more years of his life reading Hebrew than Greek.

These personal observations may be quite relevant to the results of literacy campaigns. Literacy teachers maintain that they can teach illiterate adults the values of letters and basic word-attack skills, but few claim that their students learn complex reading comprehension. Relapse into illiteracy is a notorious characteristic of literacy courses. Many explanations exist that, on the surface, do not seem neurological. Individual motivation is very important, and occupational problems may largely account for the high dropout rate. Relapse into illiteracy is usually attributed to resource-poor rural environments and to a lack of follow-up materials. Teaching methods and materials often imitate children's books, and adult learners may get bored by what they are reading.

However, literacy efforts might be battering against submerged cognitive and psychophysiological barriers somehow related to age. People may drop out of literacy programs partly due to their low performance and subsequent discouragement. The slow speed may be due to less efficient processing of newly learned patterns. The intense effort adult learners require may distract them from the meaning of the text and make reading laborious and boring. To design effective literacy interventions for illiterate populations of various ages, an educator ought to know a lot more about how the brain processes this information as people age.

4. Some Hypotheses about Age-Related Barriers

Three possible neurological barriers against the acquisition of reading skills as a result of age are discussed below. All three may exist, and their effects may be additive or multiplicative. Psychophysiology specialists could probably generate several more hypotheses.

4.1 The brain may be more developmentally prepared for reading acquisition at an earlier age

The brain is neurologically prepared to acquire language during childhood. Any language is made to fit neatly into the cognitive networks of a developing child. In previous years, a psycholinguistic mechanism called the “language acquisition device” was thought to mediate this process. This device was thought to die out before puberty. After that stage, a foreign language would be more easily acquired through higher-level processing, such as formal instruction, rather than through the effortless process children use.

Although in recent years psycholinguists have questioned the concept of a language acquisition device, it still remains useful. The childhood facility for language acquisition may influence reading acquisition; the same mechanism that helps children acquire grammatical patterns

auditorily, might, somehow, be involved in the visual acquisition of word patterns. Silent, effortless reading and the instant recognition of complex patterns might, for some reason, obey the not yet fully understood rules of speech acquisition.

The existence of a developmentally controlled mechanism implies the existence of critical periods; that is, optimal times when certain skills can be learned. Instruction too early or too late may not prevent learning, but may require much greater effort. Deaf children face considerable difficulties, if they do not learn some form of language by about age eight. The same phenomenon may take place with reading acquisition, possibly as early as the mid-teen years. I once read of an anecdotal, unsubstantiated upper limit of twenty-five years for reading acquisition.

4.2 The changing mechanisms of information storage may affect consolidation of letter patterns

The hippocampus is one of the brain structures that plays an important, though not yet well understood, role in memory storage. It continues to change throughout the childhood years and is somehow involved in short-term memory consolidation. It may facilitate the processing of information into the semantic memory; that is, the memory related to rules and procedures. Children seem more efficient than adults at gauging rules and procedures from sparse information. This mechanism may influence the learning and consolidation of word patterns. Age-related changes in the hippocampus may diminish the capacity to store letter patterns with relatively little practice and then to consolidate them.

4.3 Diminishing attentional resources may affect reading comprehension

People can pay attention to only a few stimuli at a time. A person has a finite amount of attentional resources to assign to simultaneous activities. Well-learned activities use up a small portion of the resources, so a person is able to drive and listen to the radio at the same time. Insufficient attentional resources result in errors on simultaneously executed activities, particularly when these are not well learned.

The amount of attentional resources available diminishes with age, making people less able to carry out many tasks at the same time. Diminished attentional resources could affect literacy acquisition in several ways: readers may be unable to process all the cues of a script simultaneously, and thereby incur the high error rate that I have observed. Insufficient attention may result in less efficient processing and storage of new word patterns. More important, reading comprehension may be affected. If decoding of written material is slow and tedious, few attentional resources are left for processing the meaning of the material.

5. Implications and Questions

Reading research in the United States has concentrated on reading disabilities and, ironically, on the lowest age limits of acquiring literacy—the latter to satisfy ambitious parents of toddlers. The illiterates of the developing world are usually inaccessible to developed country researchers, who typically get funding to tackle problems closer to home. The various organizations that carry out literacy programs usually lack the sophisticated research capacity necessary to study literacy acquisition. They may even lack the expertise necessary to pinpoint issues to the degree of specificity necessary for cognitive or psycholinguistic research. So, the literacy research that exists overlooks basic information processing, and focuses instead on instructional methods.

This research gap has left a host of questions unanswered, such as:

- Reading acquisition capacity has not been sufficiently charted as a function of age. How steeply does it decline, if at all?
- Is the hypothesized decline linear or are there periods of recovery that conform with hypothesized periods of increased susceptibility to learning?
- At what age does the decline become instructionally significant?
- How does age interact with gender, if at all?
- Does the nutritional status of an individual, which strongly influences cognitive development, also influence the rate or onset age of this decline?
- Do the hypothesized barriers mentioned above become more salient at different ages? How much practice is necessary for consolidation at different ages?
- How much practice is necessary for recovery of the reading skills learned in adulthood after a period of inactivity?
- How much of the observed variance would be systematic? Might individual differences on the above issues predominate to the extent that generalization is not possible?
- For how long would post-literacy materials have to be provided to new literates of various ages to consolidate pattern acquisition?
- What is the relative importance of socioeconomic, methodological, and psychophysiological factors as causes of dropout and relapse into illiteracy?

Basic neuropsychological research is needed to test the three hypotheses mentioned above. As technology progresses, this goal is becoming feasible, but most questions generated through these hypotheses can be answered through lower-tech cognitive and psycholinguistic research. The speed, error rate, and reaction time of pattern recognition, amount of forgetting, and eye movement patterns could be measured as a function of age, gender, nutritional status, and prior schooling. With robust experimental designs, one could find out why adults tend to lose the degree of pattern recognition they acquire with practice and how that loss could be minimized.

Once basic measurements on reading acquisition are obtained, they can be used to get around some of the age-related barriers. A fertile area of research, for example, might be improvement in pattern recognition. Some letter combinations in a given language seem to require consistently longer or shorter reaction times to recognize as patterns. Instructional methods based on this information could be developed and tested. The most easily recognized combinations could be emphasized early on to keep people motivated to read and to increase their speed. Conceivably, presentation of patterns through a tachistoscope (currently available only in a laboratory), combined with reinforcement techniques, would stabilize and minimize the reaction time needed to recognize difficult patterns.

In addition to developmental and neurological issues, there is much researchers do not know about the cognitive processes of illiterate adults learning how to read. Yet, what is not known could alter instructional delivery. Some areas that need research are described below:

5.1 Visual perception

How do illiterate adults visually perceive little black marks on paper? How does perceptual constancy for letters change with age? Is it possible to improve it by instructing adults on the constant features of each letter? Ophthalmological problems aside, do adults learn to focus on the page as effectively as children? How do the eyes of literates versus illiterates scan the letters and words on a page? Is it possible that illiterates use more or fewer systematic eye movements to focus on the stimuli?

5.2 Information processing

The scant research that exists on the subject indicates that schooling imposes a classification and reasoning system on people's minds. Illiterate adults:

- (a) categorize objects and concepts very differently; for example, a bird may be categorized under "food" rather than under "animal"; and
- (b) rely on consensus validation rather than on inductive reasoning to test hypotheses; for example, people may consider the opinions of elders more valid than their logical conclusions.

These findings imply that unschooled people in a training situation would process information quite differently from schooled people. The concepts they would find most memorable are probably different, as are the conclusions they may draw. This would also be the case with literacy instruction, but we have no systematic understanding of these processes.

5.3 The power of emotionally associated material

The limbic system that controls emotions in the brain mediates in learning, though it is still unclear how. For example, material presented with humor tends to be more memorable. Paulo Freire hit a gold mine when he discovered that Brazilian villagers were more likely to remember literacy information that was somehow related to their "predicaments." In general, however, emotions have rarely been used systematically as an instructional tool.

6. How Could more Knowledge Change Instructional Methodology?

Given the failed literacy campaigns of the past and the few resources available, providers of literacy instruction now tend to target specific groups, usually younger people and women. Increased knowledge would enable researchers to form optimal age groups, and then to optimize methodology and materials for those groups. For example, a nonformal education project might choose to provide separate classes for eleven to fourteen-year-olds and fifteen to thirty-five-year-olds to accommodate general developmental and occupational needs. Should the same instructional methodology be used for these two groups? If fifteen to nineteen-year-olds can learn or consolidate faster than young adults, should they be taught separately? I do not have an answer because I do not know at what age neurological barriers reach instructionally significant proportions. Nor do I have an arsenal of cognitively appropriate instructional methods to overcome the barriers.

If age-related factors indeed play an important role in literacy acquisition, prospects for large-scale literacy instruction may not be bright, given the instructional methodologies that can be realistically implemented in most developing countries. Researchers may find ways to minimize some effects of age, but they may depend on high-tech approaches; for example, tachistoscopes that would not be amenable to large-scale use. Use of suitable instructional strategies may also depend on highly trained teachers, who usually do not teach literacy. I still hope that researchers can find something simple, such as the colored filters that help many dyslexics to read. Unless some research and progress is made in this field, educators may be wasting precious resources on teaching adults. Nonformal education funds might be better spent on developmentally ready populations, namely children and adolescents, even though adults, with years of productive life ahead of them, may remain illiterate.

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