Learning Alphabetic System Difficulties

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Received: November 3, 2022 Accepted: December 10, 2022 Online Published: December 11, 2022

doi:10.5430/elr.v11n2p50 URL: https://doi.org/10.5430/elr.v11n2p50

Abstract

My aim is to discuss the ontogenesis of structured patterns of pertinent phonemic differences of a given sociolinguistic variety and the difficulties children face when trying to learn how to read. I first explain how the child innately guided loses her/his sensitivity to some phonetic features, realigns categories and sharpens or broadens categories in such a way that the cortex cells tune with categories that are pertinent to the sociolinguistic variety being acquired. Then, I focus on learning an alphabetic system like the Latin script, as a cognitive process, based on neurosciences findings about the reading process. I explain the initial difficulties children face, when trying to learn how to read. Before knowing the principles of the alphabetic system, the child does not perceive the contrasts among the syllable constituent units. The difficulty of delimiting words, namely unstressed words, and the fact that vision neurons of primates are genetically programmed for disregarding the minimal differences among basic features and the differences of direction such as right as opposed to left, and of vertical position, the bottom, as opposed to the top deserves an adequate early literacy education. Psycholinguistic research today can help overcome those difficulties by applying its results on developing new methods and new teaching materials intended for beginners in the literacy process.

Keywords: early literacy, phonology ontogenesis, letter recognition, graphic features, neuron recycling, clitics

1. Introduction

I will direct the discussion towards research, which explains similarities and differences between the ontogenesis of structured phonemic patterns of a given sociolinguistic variety and the learning of alphabetic systems, guided by Liberman's (1988) vital paper entitled "Reading is hard just because listening is easy".

Neuroscience findings explain those difficulties and suggest venues to overcome them. Left occipital-temporal ventral neurons must recognize invariant graphic features, which differentiate one letter from the others, namely, the invariant features directions (Dehaene, 2009: 270). Phonemic awareness must be taught, since there is a difference between unconscious phonemic knowledge for using language by way of non-declarative memory (Squire & Zola-Morgan, 1988) and phonemic awareness: the first one every native speaker has it, while, the second must be learnt in a systematic way. Conscious recognition of clitics (unstressed words) is another defying problem, because children, before efficiently learning early literacy, process the speech chain as a continuum: they are not able to delimit the clitic beginning and end: closed external juncture turns its frontiers opaque. Consequently, teachers must help the child´s mental lexicon realignment.

More recently, I have found that, in addition to the perceptual difficulties arising from the fact that vision neurons have not been genetically programmed to recognize the distinctions of the invariant features of letters, between left and right direction, as, for example, between b/d, postulated by Dehaene, it is necessary to add one more, object of communication: the inference of the baseline in the printed system of writing, in the Latin alphabet, necessary to recognize the only difference that exists between pairs of letters in which only in one of them, the invariant trace crosses the inferred baseline millimetrically, as in p/b, q/d (in three cases, the crossing results in a tiny semicircle: j/i, y/v, ç/c); the non-inference of the baseline, during literacy for reading, determined that, in the production of the first texts in cursive (they were invitations or fictional narratives), children ignored the crossing of the baseline by some traits: in the case of p, for instance, it resulted in transforming it into the capital P, with the inconsistency of its use in that morphosyntactic context.

2. Loss of Some Phonetic Features Sensitivity

Data obtained from experiments demonstrate that the child innately guided (Gould & Marler, 1987) loses her/his sensitivity to some phonetic features, realigns categories and sharpens or broadens categories (Jusczyk, 1997: 73-74), due to the role exposure to the sociolinguistic variety plays on the development of the perceptual abilities for speech, confirming Aslin and Pisoni's (1980) assertions. In consequence, the cortex cells tune with such categories. Enhancement happens, when stimuli neighboring a perceptual category boundary become more discriminable. Attenuation follows the reverse situation, when the stimuli in the category boundary region become less discriminable, such as is the case for the [r]-[l] distinction for Japanese speakers (Jusczyk, 1997: 74). Consequently, the sensitivity to contrasts that do not exist in a particular sociolinguistic variety begins to decay and not only to those contrasts but, also to the phonotactic structures and the rhythmic and intonation patterns.

3. Learning an Alphabetic System Is a Cognitive Process

Neurosciences findings about the reading process help us to understand the initial difficulties children face when trying to learn how to read. Although any normal baby compulsorily guided acquires the sociolinguistic oral variety, which he/she is exposed to in order to survive, human neurons are not genetically programmed for learning writing systems. Since it is attested that modern man appeared in Africa 140.000 years ago, neuroscientists registered that the number of neurons and the cerebral organization, namely the pre-frontal cortex underwent an enormous expansion (Changeux, 2007: 14-15). Throwing stones with the right hand for hunting shows that the left hemisphere was dominant, consequently specialization was already settled, including language.

Human species, characterized by a bio-psychological apparatus, allows constructing material and spiritual culture and by neurons plasticity able for learning new features. Under the pressure of various socio-economic needs, men invented new tools and techniques, which did not cause genetic changes but epigenetic ones, hence the first imply a longer time if compared with the last, which were caused by new techniques.

This happened with writing systems: the *proto-cuneiform* (Michailowski, 1996: 33) and the Egyptian script tradition, which included the hieroglyphs (Ritner, 1996: 73) known as the oldest writing systems in the world, were invented at the end of the fourth millennium B.C.E. Even the writing systems evolution demonstrate that what took place was not a genetic change on the genes which process natural languages, but a growing adaptation of the neural circuits on the occipital-temporal ventral region of the brain for the recognition of written words (Dehaene, 2007: 147).

If we compare the period when natural languages emerged with that when the first writing systems are attested, there is an enormous chronological distance. It raises important conclusions for understanding the reading processes and the learning process involved. They are even more crucial in the case of the alphabetic systems, derived from the proto-Sinaitic script, whose earliest manifestation around 1,400 B.C.E., appears on a small sandstone sphinx dedicated to the goddess Hathor (recent research reveals the existence of older examples of a similar script, discovered in central Egypt and dating from around 1,800 B.C.E. (Scliar-Cabral, 2009: 147).

The most important conclusion is that the writing systems are not spontaneously and compulsorily acquired, but they occur in a systematic context of learning, namely at school. All evidences demonstrate, on the other hand, that such learning is not easy. I will stress those difficulties examining them on the alphabetic system.

Both oral and alphabetic systems share some common architectonic properties, namely, three articulations, the first, combining meaningful units, the second, combining meaningless units, respectively phonemes and graphemes, and the third, articulating phonetic features and letters features. In contrast, however, to the traits that make up the phoneme, the letters features do not have the function of distinguishing meanings but the function of contrasting letters to each other.

As the alphabetical systems are secondary to the oral ones, they use scripts composed of letters, shared by several writing languages, as is the case of the Latin alphabet.

Thus, while graphemes and their values are specific to each language, the letters and their recognition are independent of the language. While the recognition of each letter does not depend on its position in the word, the value of many graphemes will depend on the position they occupy in it. For example, in 'complicity', in English, the first and seventh letters are recognized as the same letters, but the graphemes they perform are not the same. The first grapheme represents the phoneme /k/ and the seventh represents the phoneme /s/. In the word 'cumplicidade' (Port.), the first and seventh letters are the same in English, however, while in English the second and third graphemes represent respectively the phonemes /o/, /m/, in Portuguese the grapheme is the digraph <um>, which represents the nasal posterior high vowel. Differently from English, nasal consonants cannot occupy syllable final position.

There are deep differences determined by the way the speech chain is perceived and the way the written word is processed, so, alphabetic systems learning takes place when the learner is already able to use metacognitive and metalinguistic strategies feeding his/her procedural memory, since this learning demands a conscious work. The child will have: a) to reorganize the way he/she perceives the speech chain; b) to realign his/her mental lexicon and c) to recycle the vision neurons to recognize one letter's feature from the others. All this work has the following purposes: recycling the vision neurons at the left occipital-temporal ventral area and discovering each written language principles of the alphabetic system.

4. Differences Between Processing the Speech Chain and Processing the Written Word

The conference on *The Relationship between Speech and Learning to Read* (RSLR), sponsored by the Growth and Development Branch of the Institute of Child Health and Human Development (NICHD), took place at Belmont, USA, on May 16, 1971 (Kavanagh & Mattingly, 1972). There was an agreement among the participants on what Jenkins and Liberman (1972: 1) stated as the starting point of the conference, namely, the shocking contrast between the difficulties in perceiving the speech chain and reading.

The first difficulty consists in the fact that, before knowing the principles of the alphabetic system, the child does not perceive the contrasts among the syllable constituent units. Therefore, he/she cannot dismember it. This is necessary for understanding the principles of the alphabetic systems, since each grapheme (performed by one or more letters) represents a phoneme and not a syllable.

When the child enters school, he/she has already internalized the phonological system of his/her sociolinguistic variety. The chains of speech he/she processes show neither pauses among words nor contrasts between segments: by virtue of co-articulation, a permeation occurs among acoustic cues of the adjacent segments. Since this processing is not conscious, it is inaccessible for the child's inspection. The last one becomes possible only if a kind of language is available for labeling the units and cutting them down, a process known as phonemic awareness. Consequently, a differentiation is essential between unconscious phonemic knowledge for using language by way of declarative memory and phonemic awareness. The first one every native speaker of any sociolinguistic variety has internalized spontaneously during language acquisition, while the second one only those who had learnt an alphabetic system can manage it, as it was already mentioned.

The ability for separating a consonant from a co-articulated vowel develops only when a person becomes proficient in associating a grapheme to a phoneme. Neither illiterates, nor semi-illiterates nor even those who had learnt syllabic or morphemic systems (Read, 1978) are able to dismember the syllable.

The second difficulty deals with delimiting words, namely unstressed words. Before learning how to read, the child processes the speech chain as a continuum: there are no blanks separating words. The worst is delimiting unstressed words, *i. e.* clitics, which carry additional problems, since they only represent grammatical meaning, besides always being affected by phonetic changes, as, for example, syllabic reanalysis, i. e. the phenomenon known as closed external juncture or external sandhi. Examples are /´ku.dn/, which relates to two words "could" and "not", in English, /u. zow.´vi.duS/ which relates also to two words "os" (the) and "ouvidos" (ears), in Portuguese and /u.´nuo.mo/ which relates also to two words "un" (a) "uomo" (man) in Italian. This phenomenon turns blurred the frontiers between words, which probably has a repercussion on the form of mental internalized lexical items.

The third difficulty derives from the fact that vision neurons of primates, programmed genetically, disregard the minimal differences among basic features, namely the differences of direction to right opposed to the left, and of direction to the bottom, opposed to the top. For recognizing one thing as being the same, vision neurons disregard those differences, symmetrizing them. It does not matter if a cup is shown with its handle to the right or the left, it will always be recognized as a cup. This is not the case with letters perception, since, for instance, the three horizontal lines of the capital letter **E** must be located only on the right side of the vertical line. It is more difficult recognizing the differences between **d** and **b** or between **q** and **p**, since they depend exclusively on the fact that the first letters of each pair have the semicircle on the left side of line and the second letters, inversely, have it on the right side of the line, those showing a mirroring horizontal effect. A mirroring vertical effect is shown in the following pairs: **M/W**, **e/a**, **u/n, b**/**p**, **d/q**, but the major difficulty in recognizing the only difference between the two letters belonging to the last two pairs is that in one of the letters, the invariant trace crosses the inferred baseline millimetrically.

This means that for recognizing the letters, neurons of the occipital-temporal ventral region of the brain must be recycled for perceiving the minimal feature differences among them and this learning will only succeed, if it is learnt in a systematic way, namely at school, applying, Montessori's ideas, which consist of instructions given to children, for instance, to follow letter traces with one finger.

In addition, this recycling is quite difficult, because it must coexist with the other vision neurons, which disregard those minimal differences. This is the reason why some children persist in their mirroring reading and writing for so long, or in

ignoring that an invariant trace crosses the inferred baseline millimetrically but it does not mean that they are dyslexic.

5. Printed Invariant Letters Features

There are eight most basic features that form the printed letters belonging to the Latin script: **| O ˥ c U ⊃ ~ .**

They are articulated into other differences which will be described below (note that serifs in printed letters are irrelevant):

- Position of the straight line: vertical, horizontal or inclined or the walking stick, which appears in addition to straight, inclined, only in the letter y. Examples: **I V A Á À; n y**;

- how many times the same feature appears in each letter, one, two, three, four, five or six, sometimes in a mirroring way. Examples: **I S L X Z F H B N E M W É Ê s x n m k z w**;

- size of the straight line: it can be noticed that the horizontal straight lines are always shorter than vertical ones (both preserving each size in the same font). Examples: **L Z F H k z**;

- Exceeding the letter on the imaginary line (lowercase only, with the exception of capital letter **Ç**). Examples: **ç g j p q y**;

- direction and how straight lines, semicircle, half ellipse or walking stick combine to the right of the axis. Examples: **B D E F K L P R b h k m n p**; semicircle or walking stick to the left of the axis. Examples: **a d q g u**; straight lines to the right and to the left of the axis, only in capital letters. Examples: **A H N**; a small horizontal line at the top of the axis, like in **T**, or two, one at the top and one below the axis, like in **Z z**; a small horizontal line closing the beginning of the semicircle of the lowercase letter from right to left, like in **e**; walking stick axis starting from left to right, with an opening at the top, facing downwards, to which a semicircle is attached to the left, in the middle, like in **a**; walking stick starting from left to right, with opening facing down, sticking to the right, halfway along the vertical axis, like in **h**;

- other topological combinations: small line, at the top right of the axis, leaning, or cutting a third of the stick, or the base of the circle, or making an angle, at the end of the semicircle. Examples (**r f t Q G**); dot superimposed on the vertical line in lowercase, as in **i**.

Now, we list minimal pairs of letters, starting with those which show direction towards right or left side, towards bottom or top (mirroring) differences. This last feature is the most difficult one, since the perception of this difference is against the natural neurons' disposition to find symmetry on the visual cues. This difference is the sole one between the following pairs: **b/d**, **p/q**, **M/W**, **n/u**, **f/t**, **b/p**, **d/q,** but the major difficulty in recognizing the only difference between the two letters belonging to the last two pairs is that in one of the letters, the invariant trace crosses the inferred baseline millimetrically, as we have already mentioned.

Other minimal pairs of letters: **B/P, B/R, P/R, C/G, E/F, I/D, I/L, O/Q, C/Ç, c/e, d/c, h/n, h/l, i/j, m/n,** and, approximately, between **A/V**, **S/Z**, **a/e**, **s/z** and **f/j**.

An example of relation between curves is the letter **S** (both capital and small ones), where the curve **c** is mirrored top down and right to left. **-**

In order to save features, the same feature is sometimes used to identify different letters, requiring information from the distributional context to remove ambiguity. An example is the vertical line **I**, which, in isolation, can be either a capital letter that appears in the name Ivy, or the lower case that appears in the word "love". It is necessary, therefore, the context, or the prior knowledge that it is a proper name, to clarify which letter it is. We infer, therefore, that, in these cases, it is not enough to recognize the features for identifying the letter.

6. Concluding Remarks

In this paper, my purpose was to discuss the ontogenesis of structured patterns of pertinent phonemic differences of a given sociolinguistic variety and the difficulties children face when trying to learn how to read. I first explained how the child innately guided loses her/his sensitivity to some phonetic features, realigns categories and sharpens or broadens categories in such a way that the cortex cells tune with categories that are pertinent to the sociolinguistic variety being acquired. Then, I focused on learning an alphabetic system as a cognitive process, and based on neurosciences findings about the reading process I explained the initial difficulties children face at, when trying to learn how to read. Before knowing the principles of the alphabetic system, the child does not perceive the contrasts among the syllable constituent units. The difficulty of delimiting words, namely unstressed words and the fact that vision neurons of primates are genetically programmed for disregarding the minimal differences among basic features and the differences of direction such as right as opposed to left, and of vertical position, the bottom, as opposed to the top deserve an adequate early literacy education. Consequently, teachers must help the child´s mental lexicon realignment.

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So, I deeply described the eight most basic features that form the printed letters belonging to the Latin scrpt: **| O ɿ c U ⊃ ~ .**

and how they are articulated into other differences, demonstrating the problems children face at when trying to learn how to read. Psycholinguistic research today can help overcoming those difficulties applying its results on developing new methods and new teaching materials intended for beginners in the literacy process.

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