

## **The worries of wearing literate glasses**

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## Résumé

### Le souci de porter des lunettes lettrées.

Dans cet article d'opinion, nous affirmons que de nombreux universitaires, tout comme d'autres personnes lettrées, portent des *lunettes lettrées* qui les conduisent à négliger ou à sous-estimer la contribution de la littératie à la cognition, ce qui les conduit à son tour à se focaliser sur des matériels et participants lettrés, offrant ainsi une vision biaisée du langage et de la cognition humaines. Après quelques considérations historiques, nous illustrons cette idée dans les domaines du langage oral et du raisonnement.

## Abstract

### The worries of wearing literate glasses

In this opinion paper, we argue that many scholars, as other literate people, wear *literate glasses* that lead them to disregard or underestimate the contribution of literacy to cognition, which on its turn leads them to narrowly focus on literate materials and participants, hence offering a biased view of human language and cognition. After some historical considerations, we illustrate this idea as regards oral language and reasoning.

### **Our literate glasses**

Several researchers had already warned their colleagues against what they called a *written language bias* (e.g., Linell, 1982, 2005) or *scripticism* (Harris, 2000, 2009): many scholars who believe themselves to be studying ordinary oral language are actually primarily studying the properties of written language. Here, we go a step further and argue that this bias is a consequence of wearing *literate glasses* that often lead them to disregard or underestimate the contribution of literacy to cognition.

We thus argue that the ways those people get information, think and communicate, even when not involving reading and writing directly, are under the influence of literacy. We use here the term “literacy” not in the restricted sense of the ability to read and write, but as including all the outcomes and manifestations of this ability. It is all that, in the individual or in the culture to which the individual belongs, results, has resulted, or will result directly or indirectly from the development and use of the writing technology. Indeed, one can find both a huge impact and subtler marks of this technology in many different forms of mental and social activity and communication, scientific and artistic creativity, rational and affective behavior.

Even people presently recognized as being fully illiterate, in the sense of being completely unable to read and write, are influenced to some extent by literacy as an unavoidable consequence of living in a society that is at least partially literate. Thus, nowadays, individuals without any literacy are very rare. Many others do read but are unable to write, or do both but their skills and the frequency and quality of reading and writing are distributed over a very large range, as displayed in studies such as *PISA* (the worldwide Programme for International Student Assessment by the Organisation for Economic Co-operation and Development – OECD–, measuring 15-year-old school pupils’ scholastic performance on reading in addition to mathematics and science) and *Skills Matter* (the OECD

survey of adult skills, from 25 to 65 year old). According to both programmes, literate people, in the sense of individuals practicing intentionally and persistently high-level reading and writing skills, would represent much less than half of the world population. In other words, it is because we live everyday among a large majority of literates that we consider, erroneously, our societies as literate. To say it in a nutshell, as wealth, literacy is almost in everyone and everywhere, but it is by no means fairly distributed, neither between countries nor between individuals.

Literacy, through its acquisition and consistent practice, became a pervasive component of the literates' mind. It is worth noting, however, that both terms, literacy and mind, as we, literates, conceive them, are abstract nouns, the reification of activities and corresponding processes, respectively "literate" and "mental". Both literacy and mind are useful *literate* concepts to allow fixing our thinking (which is reified as "thought") and give permanence to what is just permanent change.

Literacy acquisition and practice also led to a very important functional reorganization of the human brain. The development of neural networks that are largely specific for reading and writing and the consequent increase of functional connectivity with other brain areas, namely those supporting language activities, are under scientific, so literate (as science is scientific literacy) examination (see e.g., Dehaene, Cohen, Morais & Kolinsky, 2015). The impact of literacy on other brain networks such as those involved in memory processes, reasoning, control and creative cognitive processes, affective and social experiences, is still largely unknown and will remain so as long as the contribution of literacy to these processes will be disregarded or underestimated.

It is important to emphasize that literacy has already a relatively long and extremely diversified history, that it never ceased to change and that it is changing again, now in two distinct directions (sophisticated digital literacy and the return of oral simplification in both

spoken and written communication). It would be foolish to believe or even to desire that one can stop literacy changes, as these result from the interaction of literacy-relevant technologies with socio-political transformations. No one would be able to command the latter, as they result from collective or, more realistically, group actions.

Not only are science, philosophy, law, and obviously literature, literate activities, so are also the actions of sociopolitical actors and the reactions of sociopolitical spectators. We believe that, for all of them, all of us, it would be opportune to gain awareness that in front of our eyes we wear literate glasses. One of this paper's authors uses optical glasses only in some occasions, and happens to look around for them, unsuspecting that they are just on his nose. In contrast, the literate glasses are all the time with us, and as we cannot take them out, it is certainly fortunate not to care about them, in particular when we read and write. Indeed, it would be extremely disturbing if we were permanently aware of our literate glasses. Yet, when we are engaged in meta-thinking about language, cognition, literacy itself, and related matters, namely when we are concerned by understanding what are our language and reasoning and how they did develop, it is almost certain that we need to acknowledge the presence of our literates glasses, to look at them attentively, turn them over and over, upside down, inside out, then look at our capacities and confront them with the ones of illiterate people, who by definition never wore such glasses. In these conditions, in the same way as optical glasses help us to see the external world as it is, literate glasses may help us to discover how literacy changed our internal world.

#### **The history of a failed theoretical revolution**

As already pointed out by Morais (2018), the impact of literacy on brain and cognition is disregarded by most, if not all, of the recent major theoreticians. Certainly, all of us, cognitive scientists, do wear literate glasses, but why are those theoreticians particularly blinded to literacy? The most important reason is likely to be the double marriage of cognitive

science since the last third of the 20<sup>th</sup> century with, on the one hand, evolutionary biology and neuroscience, and, on the other hand, informatics and computational science.

This marriage has been and keeps going fruitful, and it enchants the younger researchers. The lenses of their literate glasses only allow focusing on bio-informational accounts of the human mind, scorning a chief contribution of cultural factors. Cultural learning has been ejected from a more comprehensive view taking it as inherent to the human nature. The acceleration of technological development in scientific research, together with the ascending grips of financial capitalism on the economy and the political governance of human societies, is also contributing to lower the appeal of sociocultural perspectives.

It is important to know that, as regards the cognitive role of literacy, sociocultural proposals have been discredited by an intended but failed theoretical revolution in the 1960s. It was triggered by a small group of scholars in humanities, namely the anthropologist Jack Goody and the classicist Eric Havelock. In 1963 were published Goody and Watt's famous article *The consequences of literacy* and Havelock's book *Preface to Plato*.

Havelock (1977) commented on what was supposed to be the earliest Greek writing discovered, a poetic line on a vase: "Here in this casual act by an unknown hand there is announced a revolution which was destined to change the nature of human culture (...)" Havelock opposed oral and literate societies and claimed that scientific categories necessary for natural sciences, history and philosophy depend on writing (see also Havelock, 1971).

The major "failed theoretical revolutionaries" were Goody and Watt (1963), as they specified three main consequences of literacy: replacing myth by history, opinion by truth, and acceptance by skepticism. According to their view, oral language favored our binding in groups, but promoted obedience to authority and alignment with common sense. The technology of written language would have deeply changed our relationship with language and thinking capacities. In particular, Goody and Watt considered the invention of the

alphabetic script as a precursor of logic (“the kinds of analysis involved in the syllogism (...) are clearly dependent on writing” (p. 344), as well as of the democratic institutions of a society with rules and laws.

Roy Harris (2009, pp. 141-142), to whom we will return, paid tribute to Goody (1977, *The domestication of the savage mind*) saying that he “was the first modern theorist to stress the importance of the fact that only writing makes it possible to list words as individual items, to rearrange them in ordered sequences, to compare them with another, and in short to give them the status of physical objects on a par with drawings, tokens and other collectable things. The compilation of word lists is a practice that goes back the scribes of ancient Babylon: in oral communities no corresponding practice exists. (...) in preliterate communities there is no process by which a spoken word may arbitrarily be lifted out of its oral sequence and treated as an independent unit.”

Why did this theoretical revolution fail? Besides the trends mentioned above in scientific thinking, both Havelock and Goody made fatal errors. One was to attribute to only *alphabetic* writing either the whole (Havelock) or at least the crucial (Goody) role in cognitive changes. This was certainly not consistent with the larger concept of “literacy”. Another error was to take, or accept, the orality/literacy opposition as corresponding roughly to sociocultural oppositions such as “savage”/civilized” and “primitive”/sophisticated” mind. The idea of a fundamental difference between oral and literate societies was not accepted by many other anthropologists and ethnologists and led Ruth Finnegan (1973) to coin Goody and Watt’s ideas as a “Great Literacy Divide” theory.

The “Great Literacy Divide” has also been criticized from other perspectives, aiming educational and political targets. One of the motives was, and still is in some countries, to valorize popular cultures that include many illiterate individuals as well as many poor “literate”. In this perspective, there would not be a single literacy, the one of the elites, to be

reached after a long attendance of the institutionalized school and having survived exclusion, but also many other literacies depending on people's culture. Some scholars, as the historian H. J. Graff (1979, 2010), even argue that there is a "Literacy Myth", the belief that it "is a necessary precursor to and invariable results in (...) cognitive enhancement, and upward social mobility" (p. 635) whereas in reality it "has been used to foster political repression and maintain social conditions" (p. 640); moreover, although it is considered a basic human right, "possession of literacy (...) guaranteed neither success nor a rise from poverty" (p. 641). Although their socio-political perspective is worth attention, their position clearly depreciates the impact of literacy on cognition.

The Goody's proposal thus dove into a marsh of claims shooting in all directions. The impact of literacy was absorbed by literate glasses unable to put it into evidence, and the apparent fatal blow was given by the Scribner and Cole's (1981) study run in Liberia with the purpose of distinguishing literacy and schooling. After its publication, several scholars began arguing that the massive difference in capacity to manipulate speech at the level of phonemes that has been observed between illiterate and literate adults (cf. e.g., Morais, Cary, Alegria, & Bertelson, 1979; Morais, Bertelson, Cary, & Alegria, 1986) should not be attributed to literacy per se, as it could actually be due to schooling (e.g., Koopmans, 1987). Yet, it could not, as the literates examined in those studies were in fact *ex-illiterates*, namely just had attended literacy classes as adults, without benefiting from the usual school curriculum (see further discussion in Bertelson, Morais, Cary, & Alegria, 1987). Together with the objection made after the first presentation of our paper in the USA that the illiterates might be less intelligent than the *ex-illiterates*<sup>1</sup>, we developed the feeling that anyhow literacy as a psychological

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<sup>1</sup> Note that Cary (1988) as well as Verhaeghe and Kolinsky (2006) found no difference between the quite low scores displayed by *ex-illiterate* and illiterate unschooled adults in the



variable was troubling the spirits. As stated in a review of the Scribner and Cole's book (Frake, 1983), many scholars consider that “ ‘literacy’ is a cultural, not a psychological phenomenon”.

Anyway, it is important to examine why the evidence collected by Scribner and Cole (1981) sparked such a debate. In fact, the study reported by Scribner and Cole was the first to try to disentangle general effects of schooling from specific effects of reading acquisition. To this aim, Scribner and Cole studied the Vai, a Mande-speaking people of northwestern Liberia who use a writing system of their own invention (a syllabary) for commercial and personal affairs. The Vai script is interesting for this purpose, as it not taught at school, but instead at home, through a traditional individual tuition process. In addition, there were many religious schools for study of the Qur'an, where the Arabic script was used. Mission-based schools were also widespread in Liberia; they were conducted on the model of European education and had English as medium of instruction. Illiterate unschooled people were also quite numerous. Scribner and Cole had thus the opportunity to study the effect of literacy with and without schooling. As those who had attended school generally outperformed all other groups, with specific effects of either Vai or Arabic literacy quite scarce and restricted to linguistic tasks (for Vai literacy, analyzing oral speech and giving clearer instructions, see also Scribner & Cole, 1978, plus rebus reading and writing), Scribner and Cole concluded that it is the way literacy is deployed in the cultural practices associated with schooling that engenders cognitive consequences, not literacy per se.

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first three series of Raven's Progressive Matrices (PM 38, Raven, 1938) and in the easiest Colored Progressive Matrices (PM 47, Raven, 1969), respectively, with scores corresponding to the percentile 50 of 7 ½ year old children in the latter test.

According to the logician Marian Counihan (2008), “Not surprisingly, this study was popularly seen as the ‘death blow’ to Great Divide theories (Stanovich’s 1993 phrasing, p. 138). She also quotes Greenfield (1983) who expresses “the general view” (according to Olson, 1994, p. 20) in saying that Scribner and Cole should rid us once and for all of the ethnocentric and arrogant view that a single technology suffices to create in its users a distinct, let alone superior, set of cognitive processes”. Quite interestingly, Counihan’s work on the role of language, literacy and logic in reasoning remained almost unknown, having received only six citations. To Counihan, “the Vai script might fail to provide a means to test literacy because it was used for highly circumscribed purposes: primarily for letter writing and, to a lesser extent, record-keeping.” (p. 142). Letters have a prescribed format and are written for making requests, announce births, deaths or reasons for not having sent money. It is worth noting that there is no literature and almost nothing to read in Vai. As clearly expressed by Counihan, “there are several ways in which Vai literacy do not meet the criteria for the literacy intended by theorists: for Goody and Watt (1963), it would be the lack of access to accumulated knowledge, for Olson (1994), no essayist tradition” (p. 142). The ex-illiterates having learned to write in Vai were thus not equivalent to the schooled group. As Vai literacy was a very rudimentary form of literacy, at least at that time and in Scribner and Cole’s (1981) study, with no correspondence with the much more elaborated biliteracy acquired at school by the comparison group, we resolutely follow Counihan’s (2008) suggestion to understand Scribner and Cole’s study as a comparison of the effects of what she refers to as “primary” and “secondary” literacy, the latter meaning longer term and extended participation in the literate world, i.e., engagement with varieties of texts and writing activities. In addition, attendance at the religious schools was often an after-school activity, and hence the English and Arabic literacy were frequently associated. Thus, part of the better

performance observed in the English schooled group might be attributed to bilingualism<sup>2</sup>, which is known to have positive effects on cognitive functioning (e.g., Adesope, Lavin, Thompson, & Ungerleider, 2010).

In any case, we believe that calling the huge differences between illiterates' vs. literates' language and cognition a "Divide", either great or small, is inappropriate, if only for one reason. We created the literate and illiterate categories, and they might be useful, but we must be aware that the reality is continuous. On the one hand, as we already noted, in our partly literate society, the illiterate individuals are influenced indirectly by literacy. On the other hand, as we also already commented on, those who are not illiterates are not all literates, far from it. And among the literates, there are huge differences in terms of literacy, language and cognition. As, in literates, literacy interacts almost certainly with both language and cognition, in different ways and differently between the individuals, we would better forget divides of any kind and rather recognize that we need to explore again the multidimensional role that literacy plays in our mental functioning, from oral language to reasoning.

#### **Thinking, language, literacy and reasoning**

Hominids may have been capable of thinking; at the spring of our species language emerged; late at the summer, literacy; and at the early autumn, reasoning. We began by both thinking and communicating through oral language and, having invented a number of scripts, we developed literacy and literacy made thinking refine into reasoning. The distinction between reasoning and thinking, which we find extremely important as addressed below, is overlooked in most of the cognitive psychology literature, many authors using invariably one or the other without defining them.

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<sup>2</sup> Bilingualism did not characterize the Qu'ranic schooled group, as most of those students just had to rote learn the text without understanding what it meant.

Thinking is the activity that uses the capacity people call “thought”. Like language – like mind, which we will consider much later –, thought is an abstract noun. Thinking presumably preceded the emergence of speech and surely of written signs. Speaking and/or being able to process speech are not necessary to think. Preliterate children and illiterate adults do think. Arguing against the idea that “without signs of some kind, *there is no thinking at all*” (italics in the original), Harris (2009, p. 27) recalls what he calls “the most controversial claim of all in Peirce’s philosophy of mind: that ‘man can think only by means of words or other external symbols’ (Peirce, 1868).” To us, thinking may focus on many different objects, for example interpreting actions and face expressions, evaluating and comparing noises or the taste of food pieces, calculating the effort to throw a stone, its trajectory, whether it will fail or succeed, and whether one is ready to run away. Neither of these thoughts needs to involve signs or symbols, just images, memories from experience, comparison processes and decision. No language is strictly necessary, but the emergence of language must have helped a lot. And probably vice-versa. Indeed, hominin reliance on “technology”, namely on Oldowan stone tools (which appeared from 2.5 million years ago and are believed to have been socially transmitted) is hypothesized to have led to the evolution of teaching and language, and recent experimental evidence (Morgan et al., 2015) supports this idea of co-evolution of tool-making teaching and language.

Concerning the impact of language on preexistent thinking, it is worth reminding that the theory called cognitive linguistics and its precursors attack Chomsky “on the view that language is primarily a means for the expression of thought” and that he largely underestimates its role in communication, taken as useful but more or less accidental (cf. Linell, 1982; 2005). Indeed, Chomsky (1975) wrote that communication “is only one function of language, and by no means an essential one”. Per Linell, a pre-cognitive linguist, sees in this claim a consequence of literate thought, “since writing is monological rather than

dialogical”. We agree with Chomsky that language, even before the emergence of literacy (Chomsky usually referred to a general concept of language of which literacy was merely absent), must have strongly contributed to knowledge. But we also believe that language would not have emerged and developed if it were not to allow communication. Knowledge itself could not develop without communication between the individuals, and, more decisively, without social communication the human species would not have survived. On the other hand, however, we do not share Linell and others’ proposal that writing is monological but not dialogical. Writing persisted and developed also for communication with the others, although not always in a dialogical form. Writing is heterological.

### **Oral language and literacy**

In the present section, we will first discuss the differences or similarities between oral and written language, and then how oral and written language interact in processing. More precisely, we will contrast the characteristics of the literate and illiterate oral language, and then evoke the strong impact that literacy exerts on literates’ oral language.

One apparent characteristic distinguishing oral and written language would be that the former is temporally organized and the latter spatially, the former vanishes once produced and the latter is fixed and stays unless one destroys it. Beyond the fact that now speech can be recorded, thus no less fixed than writing, such a permanence vs. transience distinction takes into account the output of the activity, but does not contemplate at all some important characteristics of the processes involved in producing both speech and text. Concerning speech, it is also spatial in at least two aspects: first, it results from spatial (even if dynamic) configurations of the articulators; second, it was shown (Bertelson, 1972) that listening to a spoken sentence (in the absence of any visual stimulus) induces, usually without awareness, a spatial representation oriented from left to right or the reverse, depending on the directionality of writing/reading in the corresponding script (of course provided the listener knows well the

used language). After this demonstration, Jose Morais ran an experiment (never submitted for publication as it was not in the context of his PhD) showing that, in a strictly auditory situation, French-speaking people listening through headphones detected a target faster when the carrying sentence seemed to move from left to right than when it seemed to move from right to left (the perception of spatial movement being obtained by progressive change in the inter-aural difference). And speech is temporal, but is also spatial, because most of the time (and in fact it was always, before the sound recording technology) it is produced by a speaker posted in the near space of the receiver, which leads to a frontal position advantage in listening to speech in sighted (e.g., Morais, Cary, Vanhaelen, & Bertelson, 1980) but not blind (Bertelson, Morais, Mousty, & Hublet, 1987) people. Concerning reading and writing, both are obviously activities occurring in time. To resume, for both speech and text, what matters is the processing activity, not the acoustic or visual product.

To describe precisely preliterate oral language would require today a sort of paleolinguistics, because neither illiterate adults nor preliterate children can offer fully unequivocal evidence. Indeed, it is most plausible, although we do not know to what extent, that they are influenced by the sophisticated and constrained grammar of literates, and by the richness and precision of the literate vocabulary. Moreover, this influence may vary depending on the domains of oral language that concern, or not, situations usually involving words, sentences or knowledge required by the literate society. The same argument applies to modes of thinking. We cannot draw an even approximate picture of them in preliterate societies. As Harris (2009, p. 201) warns, “once literacy becomes established, it begins to invent its own myths about preliteracy”. Although recovering preliterate language and thinking might thus be quite difficult, if not impossible, what is important is not to believe that they arouse from a fantastica genetic mutation, like a Greek god emerging already armed from the thigh of Zeus. This sometimes vivid but false impression is caused by the fact that

language as examined by linguistics, in particular by structural linguistics, is actually a highly literate language.

To the risk of increasing the complexity of this issue, it is necessary to reaffirm that literacy means are also instrument of political power, as amusingly depicted by an historical anecdote reported by Di Pietro (1976) and retold by Linell (1982, 2005). In 1492, two weeks after Christopher Columbus sailed to the New World, the Spanish Renaissance scholar Elio Antonio de Nebrija presented the queen Isabella of Spain the first grammar of the Spanish language. As commented on by Di Pietro, her question to him was potentially disarming: What good is your grammar? What do you do with it?, but Nebrija had just the right answer: You need it, he explained, “to assure all peoples subjected to the Spanish crown will have one voice with which to talk to the Queen”. And he added that “language has always been the companion of empire”. Literacy is not independent of homogeneous power, which uses it to impose order, one language, one mode of thinking.

It is time to travel through the metalinguistic structure of the presumed spoken language that in reality is literate. This literate structure is made of embedded units, which do not really exist in speech. Speech is the acoustic effect of articulatory gestures with no marked physical separation. Utterances are chains of such effects. The literate structure is the decomposition of these utterances into phonemes, syllables, words, phrases, sentences, and, above, discourse. Hierarchical, like human societies in the last 12000 years or more.

The notion of phoneme is quite recent, it is only about 130 years old. Pike’s *Phonemics*, from 1947, was subtitled “A technique for reducing languages to writing”. More precisely, alphabetic writing invented the phoneme, but for a long time and still now teachers call it “little sound”. In the 1960, the scientists of the Haskins Laboratories, led by Alvin Liberman, showed that there is no acoustic invariance to the phoneme: in a consonant-vowel syllable, the beginning of the acoustic image results from a combined effect of the articulatory

gestures required for producing both the C and the V (Liberman, Cooper, Shankweiler, & Studdert-Kennedy, 1967). In 1978 a manuscript was sent to Science showing that ex-illiterates, who learned to read as adults, can delete the first phoneme (a consonant) of an isolated short word while half of the illiterates cannot at all do so, and the others make many errors. One of the reviewers (now this can be written), Isabelle Liberman, from Haskins, proposed its publication, the other refused based on the argument that it was impossible, because even 3-month old American babies can discriminate /ba/ from /da/, for instance. This reviewer was a very good scientist but was literate and unaware of wearing literate glasses. One year later the paper was published in *Cognition* (Morais, Cary, Alegria & Bertelson, 1979) but not immediately accepted by our community. At that time JM had the opportunity, during a symposium, to talk shortly with Chomsky who, very gently, did not approve or disapprove.

Still today, the educational world is highly refractory to the idea that phoneme is not just a sophisticated name for “shortest speech sound unit”, and many psycholinguists do not make a difference between “phonemic” and “phonological awareness” and do not believe that “phonemic awareness” is induced by learning to read in the alphabetic system. Phonemic awareness is confounded with phonetic sensitivity to speech sound resemblance, and, to be precise, it is true that “awareness” is not appropriate, it is literate “knowledge”, the real knowledge being the following. Through the influence of alphabetic writing we have learned to “hear” (it is a hallucination) a “component sound” from the correct interpretation, by our speech perception system, of the output of our articulatory gestures patterns. The result is that, similarly to literates, illiterate people do perceive /ba/ and /da/ as different, but only literates get the impression of hearing /ba/ as “b” plus “a” (they say “b” with a short and faint vowel, but believe it is “b”). We do not only wear literate glasses, we also wear *literate hearing aids!*



Going further, now to words, do words units exist for all of us? Certainly, when they are pronounced in isolation. In utterances they can be heard correctly (most of the time) by illiterate people, but these are unable to spontaneously break an utterance into “words”. They divide the utterance into different ways but always making sense: units made of article and noun, verb and its auxiliary, a whole constituent, etc. (for example, “The autobus is stopped near the house” was divided into “The autobus” - “is stopped” - “near the house”). When asked to try to divide it again into smaller units, words, the most common answer was a syllable by syllable decomposition (Cary, 1988). Alternatively, asking illiterates to say a long word and a short word, about 30% of the illiterates created a sentence for a long word: “I’d like to be able to read” and a short “I’d like” for a short word. About 25% said the name of a large object for a long word and of a small object for a short word; 15% said the same word but in a slow/loud or rapid/faint way, and only 19% gave correct responses (Kolinsky, Cary, & Morais, 1987). For illiterate adults, isolated words are unusual events. In an unpublished study we tested illiterates and ex-illiterate adults with a free word association task. The illiterates, much more than the ex-illiterates, tended to produce a complete sentence or a phrase rather than another word. Many responses (40%) involved a personal reference: for example, to the verb “know”, one response was “I know how to clean the house”.

Taking now utterances that we, literates, call sentences, illiterates also show great difficulties and make strange constructions or comprehension errors. For example, they do not say “The car of Mary stopped” – in Portuguese, “O carro da Maria parou”. They say “Maria, o carro (dela), parou” “Mary, her car stopped”. They seem to need to put the agent and the action as close as possible. This proximity strategy also occurs in comprehension. Scholes and Willis (1987a; b) presented illiterate adults with sentences like “If the boys watching the girls play ball, who plays ball?”, and “If the boys watch the girls play ball, who plays ball?”. The illiterates answered “the girls” in both cases. Their strategy is based on the order and

contiguity of the relevant terms. This is demonstrative of poor syntactic analysis.

Illiterate people are not the only ones to have great difficulties with syntax. Many poorly literate people also struggle with syntax. This was illustrated by Dabrowska (1997) using 20 sentences from *Linguistic Inquiry* (presumably believed by their authors to be normal English). The least educated of the participants of that study were university cleaners and janitor, most with no more than 10 years schooling, and the control participants were university lecturers in English literature and foreign languages. The intermediate groups consisted of undergraduate students and graduates with six years or more at the university. For each sentence, for example “The mayor who Julie warned after learning the ex-prisoner wanted to interrogate managed to get away”, which was one of the easiest to understand, the participants had to answer a few questions (Who wanted to interrogate someone? Who was supposed to have been interrogated? Who managed to get away?). The effect of educational level and professional involvement with language matters was dramatic: counting sentences with entirely correct responses, performance was only around 20% for the least educated group, 40% for the undergraduates, 60% for the graduates, and 90% for the lecturers. This, obviously, is not real language. It is not even literate language. It is linguistic language. Some linguists developed, for demonstration of their theories, a language that is correct according to syntactic rules, but that is not our language. It is as noxious, but for other reasons, as Newspeak.

Spoken language is much more fragmented than written language. Sentences in written narratives are more elaborated, contain more subordinate propositions, i.e., without formal syntactic autonomy, than spoken sentences, 35% vs. 14% (according to Kroll, 1977, cited by Miller, 1993, p. 112), and, conversely, contain less coordinated propositions, 25% vs. 40% (ibid.). Although the languages of some preliterate societies seem not to have been totally deprived of subordinate propositions, it is worth noting that, for example, in Inuktitut

(one of the principal Inuit languages of Canada) relative clauses appeared only after this language began to be written (Kalmar, 1985). In present language, even in literate people, subordinate clauses, participial phrases and other sentence constituents are very rare in spoken language and are only found in advanced writers. Mota et al. (in revision), analyzing hundreds of transcripts of verbal reports and hundreds of representative literary texts spanning about 4500 years, observed, for the former as for the latter, that lexical diversity and long-range recurrence increase over time, while short-range recurrence shows the opposite dynamics. Moreover, at the ontogenetic level, these effects are more linked to education level than to age. They also showed that Bronze Age texts are structurally similar to children's and illiterate adults' discourses, whereas subsequent texts converge abruptly to the adult pattern around the onset of the Axial Age (800-200 BC), a period of pivotal cultural change in which flourished many of the fundamental texts of ancient literature, and in which multicultural development and integration was accelerated by the consolidation of alphabetic writing and the foundation of the first high-level educational institutions.

All these data show that, if literacy had not existed, our spoken language would appear as primitive to us, who are all literates, as the languages of tribes and small groups still found nowadays in the last unexplored terrains. Yet it is only relatively recently that (some) theoretical and experimental cognitive psychologists have experimentally demonstrated the huge integration, in literate people, of spoken and written language at the level of word processing.

Most past models of word recognition presented spoken and written word recognition as entirely separate modules, with interactions between levels within each module but, by definition, not between the modules. This was the case, for instance, in a *Trends in Cognitive Sciences* (1999) opinion paper by Max Coltheart on modularity and cognition. In particular, it was assumed that there are no interactions between the processing of spoken and written

words, at least in adults. Indeed, Coltheart recognized that in the course of development the systems interact, quoting Hulme and Snowling (1992): “interaction between systems is probably the norm in development, (...) it may only be after a very extensive period of development that the relative modularity or autonomy of different systems in the adult is achieved”.

Jose Morais recognizes that he adopted the idea of strong modularity (for the adult) until late in the 1980s. Only at the beginning of the 1990s we began to propose a mixed approach (e.g., Kolinsky, 1998). We distinguished between two main levels of spoken language processing: a level of speech perception that is relatively independent of literacy, and a post-perceptual one, with a lower stage of *attentional* processing and a higher stage of *intentional* processes, both influenced by literacy. We began to elaborate this idea when we compared literate and illiterate adults in a word dichotic listening situation (presenting two different words, each to a different ear, but at the same time) with attention oriented to a pre-specified ear (Morais, Castro, Scliar-Cabral, & Kolinsky 1987). We found that for participants matched on overall performance, the literates, compared to the illiterates, made more segmental errors (e.g., in Portuguese, the language used in testing: “**p**ano” for “cano”), but less errors involving the two segments of a syllable (“**d**ono”). This suggests that, when perception is difficult, literates tend to focus on phonemic segments. They can do it because they developed phonemic awareness, which is not the case of the illiterates.

About 10 years later, Ziegler and Ferrand (1998) showed that spoken word processing is influenced not only by phonemic awareness, but also by our knowledge of the words spelling. Indeed, they found a clear effect of orthographic knowledge on spoken word recognition in an auditory lexical decision task. The participants, undergraduate students, responded faster (by 62 ms, on the average) and made ~13% less errors to words with a consistent rime (only one spelling) than to words whose rime is inconsistent (e.g., /o/ in

French can be spelled in many different ways). However, the effect did not occur for nonwords. Thus, it would seem that the involvement of orthographic knowledge occurs at the perceptual stage, but not necessarily and not automatically. Consistently, no orthographic effect was found in shadowing (immediate repetition), even for words (e.g., Pattamadilok, Morais, Ventura, & Kolinsky, 2007; Ventura, Morais, Pattamadilok, & Kolinsky, 2004; Ziegler, Ferrand, & Montant, 2004), except when embedding them in noise (Pattamadilok, Morais, & Kolinsky, 2011). However, quite interestingly, the electrophysiological response to orthographic incongruence occurs in the absence of auditory attention (Pattamadilok, Morais, Colin, & Kolinsky, 2014). Indeed, in a situation where the participants had no task and were distracted from the auditory stimuli, the mismatch negativity, an event-related potential component that reflects the brain's "automatic" response to change in auditory stimulation, is enhanced for orthographically incongruent riming spoken words, such as /pri-tri/ (<prix>, <tri>) compared to orthographically congruent ones such as /cri-tri/ (<cri>, <tri>).

Our conclusion, therefore, is that the influence of literacy on spoken language processing goes deep into an integrated system of word processing. In a study in which we joined Stanislas Dehaene and other researchers (Dehaene et al., 2010), we could illustrate that integration with fMRI data: it was found that the literate (but not the illiterate) adults activated the visual word form area (VWFA, usually mainly activated by written words, Cohen et al., 2000) during an auditory lexical decision task. It is therefore reasonable to think that the corresponding written word representations feedback onto the spoken language system. In the same study, it was also found that the activation of the planum temporale was twice as strong in literate compared to illiterate adults, in both passive listening and auditory lexical decision. This suggests that in addition to allow on-line activation of orthographic representations in the VWFA, literacy has refined the phonological representations hosted in that brain region.

Finally, it is worth mentioning the fact that literacy does not only impact oral language

processing, but also verbal memory (for a review and discussion on possible mechanisms, see Demoulin & Kolinsky, 2016). As a matter of fact, illiterate adults present poorer auditory verbal memory than ex-illiterates (e.g., Kosmidis, Zafiri, & Politimou, 2011; Morais et al., 1986) and, in literate people, orthographic representations support precise memory of spoken words (Pattamadilok, Lafontaine, Morais, & Kolinsky, 2010).

### **Literacy and reasoning**

We already discussed the idea that without literacy there would be no metalinguistics and therefore no linguistic theories. After commenting on this (“the ‘literate revolution’ in Western thinking seems to have been first and foremost a revolution in the way people thought about their own linguistic experience”, Harris (2009, p. 270), added that hence it was also “about the mental operations (...) exemplifying rationality, given their assumption that rationality was somehow manifested in, or might even been equated with, certain operations with words”.

Literacy, more exactly Western literacy (we are not thinking about the script, but rather about the ideas vehiculated in our intellectual tradition), took insidiously possession of thought like a virus, restructured it and gave birth to rationality. Preliterate thinking may have involved estimation of the relations between sequences of acts and outputs, a pre-rationality tainted of some sort of sensorial and bodily consciousness guided by emotions and desires. In contrast, at least the Western literate rationality accepts all premises even if they are presented as universal and even though they are blatantly false. This form of rationality requires memory capacities (allowed by literacy, as we already commented on) to keep in mind claims that could a priori be valued by the subject as false, pick part of the contents of one of them to relate it (if one finds a relation) to specific, not all, information included in at least another claim, and derive from both a consequence that would decide of the acceptability, or not, of a

third claim. This is possible when one can read and hence think at least more than once about several or all of the claims.

The idea that literacy engenders rationality is not so much different from the idea that it deeply changes spoken language. Both are cases of cognitive plasticity. It is paradoxical to pretend that language and grammar were given already equipped to us through a genetic mutation and refuse that culture *lato sensu* can profoundly change together our cognition and our brain, which are obviously correlated – no cultural change in cognition can happen which would be inconsistent with the required change in the brain. To put the finger on the hot issue: Why would culture not be as determinant – and as natural – as biology? To consider rationality specifically: there is little chance, as Harris (2009, p. 12) formulates it, that “human rationality (whatever that may mount to) is somehow already built into the structures of the brain *ad initio*.” To be more provocative: it is too easy to invoke genes or the brain rather than try to find how culture, in this case, literacy, made the coup and might make it again at the new times of digital and robotic literacy.

The underestimation of the force of culture extends necessarily to social organization and interactions. Harris (2009, p. 202) wonders whether “there is only one universal kind of rationality”, which would imply “that those who do not share it and act according to its dictates are (...) irrational.” This is an important question in a multicultural world. Moreover, our own culture is in an accelerated process of transformation due to the technological breakthroughs. “What the computer can do ‘with words’ is a lot more than *you* can”, and Harris (p. 206) pursues: “Nowadays we cannot even ourselves judge whether the computer ‘got it right’. We should have to employ another computer to check that. And perhaps a third (...). A rationality regress looms.”

The question of whether the literate human *species* (rather than the literate human *being*, which we all endorse but is a shift toward an individualist perspective) may lose the

control of their rationality is certainly exceedingly important, but we have nothing “reasonable” to offer on it. Instead, we think it still important, even if it is an old idea, to insist, with Counihan (2008) on the fact that the “individual’s literacy is shaped by social and cultural factors”. Counihan also notes that, in human sciences and in particular in those related to literacy, theories invariably “make use of the individual as ‘middle man’ by which changes to society or culture come about”, “middle man” meaning currently the person with literacy-based education. The two claims together reflect quite well the dialectical reality: individuals’ thoughts and actions change the society’s culture, but this produces both the milieu where the individuals develop (interacting permanently with her/his culture) and the means through which they introduce innovations. The individual is not a-historic, for this reason it makes more sense to consider the individual from her/his context than the context from the individual.

Literate and illiterate people do not differ only by being able to read or not. They differ by their social milieu and their literate vs. illiterate culture. Besides, literacy goes from modest reading and writing skills to a wide range of systematic critical and creative uses. This explains that the cognitive changes allowed by literacy also vary largely in content and deepness. These huge differences should not be forgotten. Related to this, Counihan (2008) evokes the Dabrowska’s studies briefly described above on the enormous differences in sentence interpretation as a function of literacy level. She also evokes Pierre Bourdieu (1991)’s comment on the linguist’s “illusion of linguistic communism”, the belief that (in Counihan terms, p. 146) “all speakers have equal and untrammelled access to a shared language”. The use in linguistic theory of an idealized speaker-hearer and the distinction between competence and performance, “à la Chomsky”, does not rid us of this lingering “communist ideal”: they bolster the sense of a universally given system of norms for



linguistic practice and mask the social nature of these norms, identifying “official language” with “ideal language”.

Let us now come back to the human reasoners, distinguishing illiterates and (though largely varying) literates. It is both funny and instructive to learn from Glick (1975, pp. 635-636) that in the Cole, Gay, Glick and Sharp’s (1971) study, Kpelle unschooled subjects<sup>3</sup> were relatively unsuccessful on sorting objects according to (what we consider as) taxonomic categories (e.g., food, clothing, cooking utensils, etc.), relying rather on functional relations (e.g., a knife might have been placed with an orange), but when the experimenters asked them to sort them the way “how would a fool do it”, they did it easily. Illiterate people but also many poorly literates are more prone to group objects in terms of functional or thematic relations. This happens because from illiterates/unschooled to highly literates one can find a progressive shift in what they rely on: from concrete and personal experience, sensorial as well as social, to abstract (usually scholar) knowledge. Interestingly, alias, in literates, the preference for grouping objects thematically, which has been reported as decreasing in school-aged children (e.g., Markman, 1981, 1989), is again observed in the elderly, probably because older people are removed in time from the influence of formal schooling (e.g., Smiley & Brown, 1979; see also Pennequin, Fontaine, Bonthoux, Scheuner, & Blaye, 2006).

We had the opportunity to study a very unusual case, TH, that combined an almost complete lack of controlled mobility with the acquisition and use of literacy abilities (see Morais, Macedo & Kolinsky, 2004). TH is anarthric (completely unable to speak) and tetraplegic since his birth, being able to control only ocular movements. His perception of speech is normal, which permitted him to acquire good abilities of reading and writing (choosing the appropriate letters through his gaze) which, in turn, allowed him to become

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<sup>3</sup> The Kpelle people are another (and in fact the largest) ethnic group in Liberia.

university professor. Macedo (2006) tested him when he was almost 16 years old, on the card selection task, a test of deductive (conditional) reasoning (Wason, 1966), which requires verifying the accuracy of a conditional relation. To adapt it to adolescents, we used images familiar to them (e.g., national – in this case, Brazilian– football players and the shirts of their respective teams) rather than the more abstract original version. TH's performance was about two times better than the one of the control participants, namely 15 (one year younger) classmates (30% vs. 16% average correct). Consistent with his literacy level, he seems to have developed rational thinking. One might object that, in a test of spontaneous choice between taxonomic vs. functional classification, he preferred the functional option in 70% of the cases. However, this was within the range of the controls (62%, on the average) and may reflect his visual experience and knowledge.

In contrast, TH performed poorly in a digit probe-span test (after auditory presentation of five digits, the tester said one of them and the subject had to indicate the next one in the sequence). His span was 4.43, clearly inferior to the controls' average score (5.37), and only one control had also so low a score. The reason of this inferiority is here not illiteracy (as already discussed, illiterate adults present poor auditory verbal memory), but probably his lack of own involvement in hand or machine writing and the inevitable slower pace of gaze-commanded writing, which may not have allowed normal development of the visual or orthographic component of short-term memory for symbols.

TH was also poor, compared to the controls, in a part-probe task which had been used in former studies on undergraduate students (Palmer, 1977) and unschooled adults (Kolinsky, Brito Mendes & Morais, 1990; Kolinsky, Morais, Content, & Cary, 1987). This task requires three different levels of visual analysis of a figure made of six segments, depending on the degree of embeddedness of the to-be-detected three-segment part. This characteristic modulates reaction times in undergraduates (Palmer, 1977) and correct performance in

children and unschooled adults (Kolinsky et al., 1990; 1987). TH was quite good at rejecting foils (part-probes that were absent in the figure: 90% correct) and when the analytic demand was low because the part was salient (80% correct). However, for higher levels of analytic demand, TH was very poor (20% correct). The controls were not available at the time of this test, but one may infer, both from Palmer and the fact that, in Kolinsky et al., second-graders were accurate through the three levels of analysis, that TH's performance pattern indicates a strong impairment in visual analysis. Indeed, his performance pattern was typical of the kindergartners and of the illiterate and ex-illiterate adults tested by Kolinsky et al. The development of visual analysis ability may critically depend on drawing or on manipulation of visual objects, both experiences that TH never had.

Analytic visual ability may also be involved in some reasoning tests, namely in the PM38, which requires consideration of a sequence of visual patterns in order to infer, from among several alternative figures, the one that would fit that sequence the best. We have already mentioned<sup>1</sup> that both illiterate and ex-illiterate adults are very poor in this kind of test, and this was also the case of TH in the PM38, in spite of his good literacy level. He correctly answered only 26.7% of the questions, significantly below all the controls, who reached 56.2% on average. It thus seems that analysis involved in some perceptual tasks and in inductive reasoning on visual patterns does not depend on literacy and does not preclude literacy acquisition. Given that TH performed above average on a verbal reasoning test (the Wason's card selection task), it is at least clear that "reasoning" is a too large concept and that distinct kinds of reasoning depend on different cognitive capacities.

The same version of the Wason's card selection task as the one used with TH was used with illiterate, semi-literate and literate adults, the latter with a university curriculum<sup>4</sup>.

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<sup>4</sup> Up to now we only made brief references to these results in a few papers (e.g., Morais & Kolinsky, 2002) but never had the opportunity to write them with Elias José Mengarda, to

The main difference is that we offered corrective feedback to half of the participants of each of these groups. Not surprisingly, performance of the control participants (to whom no feedback was offered) remained stable across the eight problems they had to solve, contrary to what was observed in those who received continuous feedback. Yet the way performance increased varied across groups, leading the significant interaction between educational group and experimental groups (with/without feedback) to be further modulated by test question (from the first to the latter). In the feedback condition, a large majority of the literates correctly answered to 7 out of 8 questions, just failing on the first one. Only 25% of the semi-literates presented such a good performance, another 25% noticing the solution from the third item. Illiterate participants also began understanding how to answer correctly, but much later, usually at the penultimate item. Does this mean that literacy is required to solve this kind of logical test? Certainly not. First, no group difference was observed on the first item (before feedback was offered to the experimental groups). Second, among the subjects of the feedback group that obtained the best average performance, there were not only the mentioned semi-literates and literates, but also one fully illiterate participant. This was in fact the only participant of all groups to present a perfect score, although he was unable to explain how he solved the problem, which in fact was the case of most literates as well. Nevertheless, the average results on the feedback condition illustrate that literacy and/or schooling might facilitate rapid adaptation to the task and/or rapid learning how to check a given rule. We can thus conclude that literacy, even high literacy, does not necessarily guarantees success in solving conditional reasoning problems, but it helps.

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whom we wish to render an affective and intellectual homage, given his tragic death in the 1<sup>st</sup> of February 2015.

Being able to solve this kind of logical problem is of utmost importance in our world. Coughlin (2008) makes us remind that several scholars blamed the Chernobyl disaster on the failure to draw the *modus tollens* inference required in that kind of task. As Byrne, Espino and Santamaria (1999) explained, given the premises of the general rule according to which ‘if the test is to continue, the turbine must be rotating fast enough to generate emergency power’ and given the fact that the computer monitoring system informs that ‘the turbine is not rotating fast enough’, conditional logic should have led the nuclear power plant workers to draw the *modus tollens* inference ‘the test cannot continue’.” They might have avoided the catastrophe. Yet the logical error of not drawing the inference impeded effective response, probably together with other factors such as the tendency of Ukrainian authorities to channel information and responsibility for action up the organizational chain of command rather than acting directly (cf. Potter & Kerner, 1988).

Still following Byrne et al., those workers may not have drawn the *modus tollens* inference because they considered additional requirements from their background knowledge, such as whether safety procedures had to be followed to the letter in such a case. According to Coughlin (2008), if additional requirements are considered, then the *modus tollens* inference is no longer deployable. Human error is thus actually to be located in the judgement of whether or not the turbine’s rotation speed provides sufficient reason to stop the test or not, and thus whether the *modus ponens* inference is appropriate or not; it has nothing to do with a fault in drawing the inference itself. Coughlin (p. 19) affirms to align with Stenning and van Lambalgen (2008) “in claiming the ‘logic’ of the task is *always* relative to an interpretation of the premises”, since this establishes (note that here we inserted the numbers ourselves) (1) “what it means to assume the premises are true”, (2) “the inferences which can be made on the basis of them”, and (3) “the kind of validity these have”. “Logic is thus essentially indexed to semantics.”, and “Reasoning is not a ‘mechanism that operates in a contextual

vacuum.” (p. 22). Counihan cites Bruner (1990, p. 4): “Very early on [in the cognitive revolution], (...) emphasis began shifting from ‘meaning’ to ‘information’, from the *construction* of meaning to the *processing* of information. (...) Information is indifferent with respect to meaning.”

This is indeed the problem. The quantity of information does not take into account the ecological relevance (if we estimate probabilities either about the carbon effects for the climate or about raining during Real Madrid – PSG for the players and the public) nor the fear of a parent learning that her/his whole close family was in a plane that fell in the ocean of which some escaped (not sure this fear will be modulated by the relation between the number of relatives and the number of people in the plane). Should human reasoning become someday computer reasoning, to avoid Chernobyl-like disasters?

#### **Final comment**

We are not inviting literate people to throw out their literate glasses. Anyway, this would be impossible to do. We are just inviting scholars to take the right measure of how much we as species have changed, first, under the influence of oral language, then, under the joint influence of literacy, literate spoken language, and literate reasoning. We invite them to take also care of the present huge differences between us in language, literacy and reasoning. Some of these differences might be associated with life conditions and formal education, others might be directly related to the acquisition of a script.

We are not saying it is bad to wear literate glasses. Yet it is bad to ignore we wear them. We should reason knowing that rationality is largely a product of literacy and that it is not easy to detect its influence on the ways we reason, especially because we tend to believe that there is only one “true” or “objective” rationality. We accepted relativity and indetermination in physics, we never thought it might also be the case for mental life. We work with data about mental facts, but a fact is never just a fact, totally independent of our

judgment of it, because if we ratify it as a fact it is on the basis of our judgment on what we believed to be a fact. Does this mean that it is impossible to identify facts, the relations between them and what produces facts constellations? Not necessarily. It is at this point that interactions between us, members of the scientific community, is of invaluable help.

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#### **References**

- Adesope, O. O., Lavin, T., Thompson, T., & Ungerleider, C. (2010). A Systematic Review and Meta-Analysis of the Cognitive Correlates of Bilingualism. *Review of Educational Research*, 80, 207-245.
- Bertelson, P. (1972). Listening from left to right versus right to left. *Perception*, 1(2), 161-165.
- Bertelson, P., Morais, J., Cary, L. & Alegria, J. (1987). Interpreting data from illiterates: Reply to Koopmans. *Cognition*, 27, 113-115.
- Bertelson, P., Morais, J., Mousty, P. & Hublet, C. (1987). Spatial constraints on attention to speech in the blind. *Brain and Language*, 32(1), 68-75.
- Bourdieu, P. (translated by J. B. Thompson, 1991). *Language and symbolic power*. Cambridge, Mass: Polity Press
- Bruner, J. (1990). *Acts of Meaning*. Cambridge, MA: Harvard University Press.
- Byrne, R., O. Espino, and C. Santamaria (1999). Counterexamples and the suppression of inferences. *Journal of Memory and Language*, 40, 347-373.

Cary, L. (1988) *A análise explícita das unidades da fala nos adultos não alfabetizados*. [The explicit analysis of speech units in illiterate adults]. Unpublished Ph.D. dissertation, University of Lisbon.

Cohen, L., Dehaene, S., Naccache, L., Lehericy, S., Dehaene-Lambertz, G., Hénaff, M. A., & Michel, F. (2000). The visual word form area: Spatial and temporal characterization of an initial stage of reading in normal subjects and posterior split-brain patients. *Brain*, 123 (2), 291-307.

Chomsky, N. (1975). *Reflections on language*. Glasgow: Fontana/Collins.

Cole, M., J. Gay, J. A. Glick, and D. W. Sharp (1971). *The cultural context of learning and thinking: An exploration in experimental anthropology*. New York: Basic Books.

Coltheart (1999). Modularity and cognition. *Trends in Cognitive Sciences*, 3(3), 115-120.

Counihan, M. (2008). *Looking for logic in all the wrong places: an investigation of language, literacy and logic in reasoning*. Amsterdam: ILLC Dissertation Series DS-2008-10.

Dabrowska, E. (1997). The LAD goes to school. A cautionary tale for linguists. *Linguistics*, 35, 735-766.

Dehaene, S., Cohen, L., Morais, J., & Kolinsky, R. (2015). Illiterate to literate: Behavioural and cerebral changes induced by reading acquisition. *Nature Reviews Neuroscience*, 16(4), 234-244.

Dehaene, S., Pegado, F., Braga, L. W., Ventura, P., Nunes, G. Jobert, A., Dehaene-Lambertz, G., Kolinsky, R., Morais, J., & Cohen, L. (2010). How learning to read changes the cortical networks for vision and language. *Science*, 330 (6009), 1359-1364.

Demoulin, C., & Kolinsky, R. (2016). Does learning to read shape verbal working memory? *Psychonomic Bulletin & Review*, 23(3), 703-722.



- Di Pietro, R. (1976). The Strategies of Language Use. In P. A. Reich (Ed.). *The Second LACUS Forum, 1975*. Colombia, S.C.: Hornbeam Press.
- Finnegan, R. (1973). Literacy versus non-literacy: the great divide? In R. Horton & R. Finnegan (Eds.), *Modes of Thought, Essays on Thinking in Western and Non-Western Societies*. London: Faber and Faber.
- Frake, C. O. (1983). Did literacy cause the great cognitive divide? *American Ethnologist*, 10(2), 368-371.
- Glick, J. (1975). Cognitive development in cross-cultural perspective. In J. Horowitz (Ed.), *Review of child development research*. Chicago University Press.
- Goody, J. (1977). *The domestication of the savage mind*. New York: Cambridge University Press.
- Goody, J., & Watt, I. (1963). The consequences of literacy. *Comparative Studies in Society and History*, 5, 304-345.
- Graff, H. J. (1979). *The Literacy Myth: Literacy and Social Structure in the Nineteenth Century City*. New York: Academic Press.
- Graff, H. J. (2010). The literacy myth at thirty. *Journal of Social History*, 43(3), 635-661.
- Harris, R. (2000). *Rethinking Writing*. London: Athlone
- Harris, R. (2009). *Rationality and the literate mind*. London: Routledge
- Havelock, E. A. (1963). *Preface to Plato*. Cambridge, MA: Harvard University Press.
- Havelock, E. A. (1971). *Prologue to Greek Literacy*. Cincinnati: University of Cincinnati Press.
- Havelock, E. A. (1977). The Preliteracy of the Greeks. *New Literary History*, 8(3), 369-391.
- Hulme, C., & Snowling, M. (1992) Deficits in output phonology: an

explanation of reading failure? *Cognitive Neuropsychology*, 9, 47-72.

Kalmar, I. (1985). Are there really no primitive languages? In D. R. Olson, N. Torrance, & A. Hildyard (Eds.), *Literacy, Language and Learning* (pp. 148-166). Cambridge: Cambridge University Press.

Kolinsky, R. (1998). Spoken word recognition: A stage-processing approach to language differences. *The European Journal of Cognitive Psychology*, 10, 1-40.

Kolinsky, R., Morais, J., & Brito Mendes, C. (1990). Embeddedness effects on part verification in children and unschooled adults. *Psychologica Belgica*, 30, 49-64.

Kolinsky, R., Cary, L., & Morais, J. (1987). Awareness of words as phonological entities: the role of literacy. *Applied Psycholinguistics*, 8, 223-232.

Kolinsky, R., Morais, J., Content, A., & Cary, L. (1987). Finding parts within figures: a developmental study. *Perception*, 16, 399-407.

Koopmans, M. (1987). Formal schooling and task familiarity: a reply to Morais et al. *Cognition*, 27, 109-111.

Kosmidis, M. H., Zafiri, M., & Politimou, N. (2011). Literacy versus formal schooling: Influence on working memory. *Archives of Clinical Neuropsychology*, 26(7), 575-582.

Kroll, B. (1977). Combining ideas in written and spoken English: Discourse across time and space. In E. O. Keenan & T. L. Bennett (Eds.), *Discourse across time and space* (pp. 69-108). Los Angeles, CA: University of Southern California.

Liberman, A. M., Cooper, F. S., Shankweiler, D. P., & Studdert-Kennedy, M. (1967). Perception of the speech code. *Psychological Review*, 74(6), 431-461.

Linell, P. (1982). *The written language bias in linguistics*. University of Linköping; 2005 edition: London: Routledge.

Formatted: English (US)

Macedo, C. (2006). Habilidades cognitivas de um adolescente com anartria e tetraplesia. [Cognitive abilities of an adolescent with anarthria and tetraplegia]. *Cadernos de Estudos Lingüísticos*, 48(2), 233-262.

Markman, E. M. (1981). Two different principles of conceptual organization. In M. Lamb & A. Brown (Eds.), *Advances in Developmental Psychology* (pp. 200- 235). Hillsdale, NJ: Erlbaum.

Markman, E. M. (1989). *Categorization and naming in children: Problems of induction*. Cambridge, MA: MIT Press.

Miller, J. (1993). Spoken and written language: Language acquisition and literacy. In R. J. Scholes (Ed.), *Literacy and Language Analysis* (pp. 99-141). London: Routledge.

Morgan, T. J. H., Uomini, N.T. Rendell, L. E. Chouinard-Thuly, L. Street, S. E. Lewis, H. M. (...) Laland, K.N. (2015). Experimental evidence for the co-evolution of hominin tool-making teaching and language. *Nature Communications*, 6: 6029.

Mota, N. B., Pinheiro, S., Sigman, M., Fernández Slezak, D. Cecchi, G. Copelli, M., & Ribeiro, S. (in revision). The ontogeny of discourse structure mimics the development of literature. <https://arxiv.org/abs/1612.09268>.

Morais, J. (2018 a). Literacy and Democracy. *Language, Cognition and Neuroscience*, 33, 351-372.

Morais, J., Bertelson, P., Cary, L., & Alegria, J. (1986). Literacy training and speech segmentation. *Cognition*, 24, 45-64.

Morais, J., Cary, L., Alegria, J., & Bertelson, P. (1979). Does awareness of speech as a sequence of phones arise spontaneously? *Cognition*, 7, 323-331.

Morais, J., Cary, L., Vanhaelen, H. & Bertelson, P. (1980). Postural determinants of frontal-position advantage in listening to speech. *Perception and Psychophysics*, 27, 141-148.

Morais, J., Castro, S. - L., Scliar-Cabral, L., Kolinsky, R., & Content, A. (1987). The effects of literacy on the recognition of dichotic words. *Quarterly Journal of Experimental Psychology*, 39 A, 451-465.

Morais, J. & Kolinsky, R. (2002). Literacy effects on language and cognition. In L. Bäckman & C. von Hofsten (Eds.) *Psychology at the turn of the millenium, Vol. 1: Cognitive, biological, and health perspectives* (pp. 507-530). Hove, UK: Psychology Press.

Morais, J., Macedo, C., & Kolinsky, R. (2004). Contrainte et expérience dans l'apprentissage de la lecture. In Ferrand, L., & Grainger, L., *Psycholinguistique Cognitive*. Bruxelles: de Boeck.

Olson, D. R. (1994). *The World on Paper: The Conceptual and Cognitive Implications of Writing and Reading*. Cambridge: Cambridge University Press.

Palmer, S. E. (1977). Hierarchical Structure in Perceptual Representation. *Cognitive Psychology*, 9, 441-474.

Pattamadilok, C., Lafontaine, H., Morais, J., & Kolinsky, R. (2010). Auditory word serial recall benefits from orthographic dissimilarity. *Language and Speech*, 53(3), 321-341.

Pattamadilok, C., Morais, J., Colin, C., & Kolinsky, R. (2014). Unattentive speech processing is influenced by orthographic knowledge: Evidence from mismatch negativity. *Brain and Language*, 137, 103-111.

Pattamadilok, C., Morais, J., & Kolinsky, R. (2011). Naming in noise: the contribution of orthographic knowledge to speech repetition. *Frontiers in Psychology*, 2, 361.

Pattamadilok, C., Morais, J., Ventura, P., & Kolinsky, R. (2007). The locus of the orthographic consistency effect in auditory word recognition: further evidence from French. *Language and Cognitive Processes*, 22, 700-726.

Pennequin, V., Fontaine, R., Bonthoux, F., Scheuner, N., & Blaye, A. (2006). Categorization deficit in old age: Reality or artefact? *Journal of Adult Development*, 13, 1-9.

Pike, K. L. (1947). *Phonemics: A Technique for Reducing Languages to Writing*. Ann Arbor: The University of Michigan Press.

Potter, W. C., & Kerner, L. (1988). Soviet decision-making for Chernobyl: an assessment of Ukrainian leadership performance. *Studies in Comparative Communism*, 21(2), 203-220.

Raven, J. C. (1938). *The Standard Progressive Matrices*. London, UK: Lewis.

Raven, J. C. (1969) *Coloured Progressive Matrices*. London: Lewis.

Scholes, R. J., & Willis, B. J. (1987 a). Language and literacy. *Journal of Literary Semantics*, 16, 3-11.

Scholes, R. J., & Willis, B. J. (1987 b). Age and education in oral language skills. *Developmental Neuropsychology*, 3, 239-248.

Scribner S. et Cole M. (1978). Literacy without Schooling: Testing for Intellectual Effects. *Harvard Educational Review*, vol. 48(4), 448-461.

Scribner, S., & Cole, M. (1981). *The Psychology of Literacy*. Cambridge, MA: Harvard University Press.

Smiley, S. S., & Brown, A. L. (1979). Conceptual preference for thematic or taxonomic relations: A nonmonotonic age trend from preschool to old age. *Journal of Experimental Child Psychology*, 28, 249-257.

Stanovich, K. (1993). Does reading make you smarter? literacy and the development of verbal intelligence. *Advances in Child Development and Behavior*, 24, 133-180.

Stenning, K., & van Lambalgen, M. (2008). *Human reasoning and cognitive science*. Cambridge, MA: MIT Press.

Ventura, P., Morais, J., Pattamadilok, C., & Kolinsky, R. (2004). The locus of the orthographic consistency effect in auditory word recognition. *Language and Cognitive Processes*, 19, 57-95.

Verhaeghe, A., & Kolinsky, R. (2006). O que os iletrados nos ensinam sobre os testes de inteligência. [What illiterates teach us about intelligence tests]. Lisbon: Fundação Calouste Gulbenkian- Fundação para a Ciência e a Tecnologia.

Wason, P. (1966). Reasoning. In B. M. Foss (Ed.). *New horizons in psychology*. Harmondsworth: Penguin.

Ziegler, J. C., & Ferrand, L. (1998). Orthography shapes the perception of speech: The consistency effect in auditory recognition. *Psychonomic Bulletin & Review*, 5, 683-689.

Ziegler, J. C., Ferrand, L., & Montant, M. (2004). Visual phonology: the effects of orthographic consistency on different auditory word recognition tasks. *Memory and Cognition*, 32, 732-741.