

Applied Psycholinguistics: A Science at the crossroads of cognition and language

Psicolinguística Aplicada: Uma Ciência na Encruzilhada da Cognição e da Linguagem

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Abstract: Applied Psycholinguistics is a science that engages many others: experimental psychology, cognitive and neurocognitive sciences, linguistics, psychology of language and literacy, and educational and remediation sciences. The present paper's objective is to show Science is itself a changing combination of ever-changing sciences without close boundaries, which implies the necessity of crossing domains in both research and learning. After a reminder of several topics of relevance to applied psycholinguistics, which concern mental processing, how cognition relates to the brain and to language, and how cognition and language engendered literacy, I argue that research in the corresponding sciences needs to be opened to other dimensions, such as society, culture, and politics. Finally, I evoke the history of the ideas regarding the isolationism of individualized sciences vs. their unification, taking, as examples of the latter, the early Marxism, and the International Movement for the Unity of Science from the fourth decade of the 20th century.

Keywords: Applied Psycholinguistics; literacy as product of cognition and language; concept of Science; history of scientific ideas; permeability of science to culture and politics.

Resumo: A Psicolinguística Aplicada é uma ciência que envolve muitas outras: psicologia experimental, ciências cognitivas e neurocognitivas, linguística, psicologia da linguagem e da literacia, e ciências da educação e da remediação. O objetivo do presente artigo é mostrar que a Ciência é, mais exatamente, uma combinação em constante mudança de ciências sem fronteiras fechadas, o que implica a necessidade de cruzar domínios tanto na pesquisa quanto na aprendizagem. Depois de lembrar vários tópicos de relevância para a psicolinguística aplicada, que dizem respeito ao processamento mental, a como a cognição se relaciona com o cérebro e a linguagem e a como a cognição e a linguagem engendram a literacia, defendo que a pesquisa nas ciências correspondentes precisa ser aberta a outras dimensões tais como a sociedade, a cultura e a política. Por fim, evoco a história das ideias no que respeita ao isolacionismo das ciências individualizadas versus a sua unificação, tomando como exemplos desta última o marxismo inicial e o Movimento Internacional pela Unidade da Ciência na quarta década do século XX.

Palavras-chave: Psicolinguística Aplicada; literacia como produto da cognição e da linguagem; conceito de Ciência; história das ideias científicas; permeabilidade da ciência à cultura e à política .

Introduction

The present paper is based on a speech delivered in 2021 at the 12th International Society for Applied Psycholinguistics (ISAPL) International Congress. The ISAPL, created in 1982, has been one of the major societies if not *the* major society addressing a large scope of issues specifically related to applied psycholinguistics. Like the Phoenix, the ISAPL has endured difficulties, particularly in the present pandemic situation, but its resilience and rebirth, due mainly to the tenacity and wisdom of Prof. Leonor Scliar and of the new Board chaired by Prof. Marcus Maia, was manifest in the recent Congress.

The two main sources of Applied Psycholinguistics are *Linguistics*, the science of language, and *Psycholinguistics*, the science of human language processing. Language is our biocultural system of communication, through gesture, speech, or writing. The Applied vocation of ISAPL concerns mainly human language education and reeducation, but its scientific grounds and interests are vast and were expressed in the recent Congress through the addressed topics, among others, *cognitive issues* (“Language and Cognition”), *socio-cultural* (“Culture and society effects on language”), *social communication* (“Psycholinguistic perspective of Mass Media”), *analysis of literary texts* (“Psycholinguistic methodology for the analysis of literary texts”), *artificial language* (“Effects of navigating on Internet”), and *political questions* (“Psycholinguistics and manipulation: Language and power. Political discourse”).

Here, I address language and cognition in a double but related perspective, theoretical and historical. Cognition is knowledge, for a large part obtained through language and expressed in language. Experimental cognitive psychology is the science, which seeks to understand mental capacities such as perception, attention, memory, reasoning, decision, etc. Its roots are relatively old, in the middle of the 19th century, but it was in the

post-war, after the behaviorism period and with the interest in information processing and the involved mental capacities, that cognitive psychology was recognized. It happened, first, when I was student in Psychology in the passage of the 1960s to the 1970s (with the publication in 1967 of *Cognitive Psychology* by Ulric Neisser, and the creation in 1972 of the journal *Cognition* by Jacques Mehler (for some information on the creation and the former issues of *Cognition*, see Morais, 2021). The following turn was the conversion of Cognitive Psychology into Cognitive Science, which occurred by the end of the 1970s (with the journal *Cognitive Science* founded in 1977, and the Cognitive Science Society in 1979).

It is worth noting that the study of language and of psychological processes through the impact of brain lesions is much older, as it emerged and developed during the 19th century. When the journal *Brain* was created in 1878, it was identified in its title as *A Journal of Neurology*. The journals *Neuropsychologia* and *Cognitive Neuropsychology* only appeared, respectively, in 1963 and 1984, the delay between them reflecting the youthfulness of the concept of cognition. On the “brain” side, the disqualification of psychology was quite rapid: it is marked by the creation of the journal *Cognitive Neuroscience* still in 1989, but it began earlier given that the journal *Cortex*, devoted to the study of “the relationship between the nervous system and mental processes”, had been created in 1964.

We have thus lived two important conceptual changes: first, the emergence and constitution of *cognition* – and the respective science – from a huge variety of mental processes, including will, affects, emotions, which cannot be easily translated into informational data; and the attribution to the *brain* of explanatory powers concerning the *mind* and the cognitive events that would occur in it. Such explanatory powers have been candidly accepted as the new technology allowing to “see” into the brain was prodigious, highly persuasive, and consistent with the “seeing is

believing” presumption. Until recently we had assumed that we have a mind to guide ourselves but having just “learned” that our brain is guiding our mind, since now we are told that we will find in the images of our brain both the best explanations of what is happening in us and outside, and fortunately the best predictions for future acting.

1. Encapsulation versus distributed processing

A theoretical war opposed, in the 1980s and 1990s, those who believed that all low-level processes are modular and encapsulated to those who think that such processing is distributed and in principle interactive, that is, consisting of lateral, bottom-up and top-down influences. Here we only refer the main characteristics of the two theories.

Jerry Fodor, author of *Modularity of Mind* (1983), and his colleague, Zenon Pylyshyn, persuaded many people – including myself for some time – that the unconscious processes leading to conscious recognition of oral or written language are *modular and informationally encapsulated*, in other words that they occur *separately* and strictly *from bottom to up*, from the sensory representation to conscious recognition. So, for example, auditory recognition, or even retention in memory, of a spoken word would not be influenced by its visual characteristics; and visual recognition of a written word would not be influenced by its auditory or phonetic characteristics. Now we know neither of these claims is true.

On the other side, Jay McClelland and David Rumelhart, co-authors of *Parallel distributed processing* (1986), proposed the opposite, at least concerning the direction of the processing. To them, processing is not strictly bottom-up and during it there is retro-propagation of the information: more abstract information could influence less abstract information, for example semantic properties could influence the recognition of formal features. This theory was verified both on computers and on human subjects, most of them being university students.

However, at that time, neither of those theories admitted the potential inter-modality activation, for

example the role of the written properties of a spoken word during its phonetic and phonological processing. This inter-modality interaction has been demonstrated for, at least, perception or recognition, and short-term memory. In a lexical decision task, consisting of deciding, on each presentation, whether a heard speech stimulus is a word or a non-word, Ziegler and Ferrand (1998) found that “words with phonological rimes that could be spelled in multiple ways produced longer auditory lexical decision latencies and more errors than did words with rimes that could be spelled only one way.” “This finding – the authors said – adds strong support to the claim that orthography affects the perception of spoken words.”

This effect was observed on university students, thus literate people, for words, not for non-words, which is easy to understand. Literate people are familiar with the written representations of known words, not with the spoken or the written representations of non-words. In literates a “lexical” effect – it occurs only if the speech stimulus is a word – is plausible and indicates that literacy (knowing and being familiar with its corresponding written representation) helps spoken language recognition by reducing the processing time and the risk of error. The auditory representation of a known word activates automatically its corresponding written representation, which does not happen for a non-word. Moreover, for consistent words (in which the word rime could be spelled only one way) the lexicality (word vs. non-word) effect was much greater (a reduction of about 100 ms) than for inconsistent words (in which the word rime could be spelled in multiple ways), which elicited longer responses and showed a smaller lexicality effect (of about 50 ms). To complete the pattern of results, spelling consistency also influenced accuracy: for words the errors were more than the double when their spelling was inconsistent (21%) than when it was consistent (8%), whereas for non-words there was almost no difference (11% and 13%, respectively).

The role of literacy in these effects has been confirmed in different ways. First, with other languages (Ventura, Morais, Pattamadilok & Kolinsky, 2004, in Portuguese; Pattamadilok, Morais, Ventura & Kolinsky,

2007). Obviously, the orthographic consistency effect in auditory lexical decision has been shown to develop with literacy instruction, for example in Portuguese (Ventura, Morais & Kolinsky, 2007) and in French (Pattamadilok, Morais, de Vyllder, Ventura, & Kolinsky, 2009). It is also possible to obtain evidence of orthographic knowledge in a non-performative task. As a matter of fact, Pattamadilok, Morais, Colin and Kolinsky (2014) studied the influence of orthographic knowledge on unattended speech perception – there was no explicit task, and the participant was distracted by an irrelevant video presentation – and found that MMN (magnetic mismatch negativity) amplitude increased over the fronto-central regions when two rhyming spoken words had different spelling. Therefore, the orthographic dimension of spoken words may still influence a physiological marker of unintentional speech processing. There is more in our brain than what we can notice.

It is precisely because there is so much in our brain that we must visit it and take care of it to understand ourselves. There is no part of us we need more than the brain. We need it as our closest companion. By using our brain in the best ways, we change it and change us. More precisely: together, we, social and cultural humans, change our brains by using them in the interactions we have among us and with the physical and biological world. Not necessarily for the best.

2. It is not our brain that changes us. We do change it

Both the encapsulation and the distributed processing theories have lost quite rapidly their influence during the nineties when a major technological improvement, the Magnetic Resonance Imaging, developed and became *fMRI*, *f* for functional. This technology became more and more sophisticated and enabled the researchers to “see” the areas that are differentially activated in the brain of the participants for specific tasks. It was a triple revolution: technological and scientific, but also epistemological.

The neuroscientific revolution led to a reversal in the roles of the concepts. The upgrade of the brain

to the role of an active and determinant entity, as a subject, almost on equality with the “mind”, did not awake old monism vs. dualism polemics, perhaps because the new master was mainly recognized by the popular literature on science and by some researchers naïve regarding epistemological issues.

Thus, in some if not most concerned literature, the brain ceased to be a biological tool to become the subject of the human actions: the “brain processes” or the “brain learns” are now current expressions, even in scientific papers. We have now “learned”, if not our brain itself, that the brain learns to read and write. And more: “the brain thinks”, “the brain speaks”, “the brain sings”; soon “the brain learns to dance rock and roll”. We, as protagonists, disappeared behind our brain. The operating individual became a brain, and “it” – your brain – is guiding you. This is pathetically false: the “brain-mania” is not accountable only by the extraordinary discoveries that the neurocognitive scientists have already accomplished – and which hopefully will be pursued – concerning the changes in brain activation occurring correlatively to cognitive processing. It developed in a favorable context resulting from two quite distinct factors, which I will address in the following order: first, still in this section, the epistemological debate regarding the “locus” or “subject” of cognitive processes – the “mind” issue; and later, the socioeconomic impact of the imaging technology.

Morais and Kolinsky (2021) argued that “the ‘mind’ is an abstract concept that would not have been generated and settled if literacy had not been developed as it did.” I will not come back to this here and will ask instead why we need to have a Mind as an “organ” or a “place” for our cognitive processes if we have a brain whose activity corresponds to such processes. Our lives and experiences are peculiar to each of us, even if they may resemble, so that our cognitive activities, and more generally our mental lives, can be distinct, singular, without requiring a specific organ. After all we already have a brain, where our mental life occurs, triggered by our desires, fears, capacities, and limitations, and dependent on the

potentialities of the brain. So, why should we need a further locus?

The fact that the mind is not a physical locus, nor a material organ, does not imply that it is the brain that decides what we think. Each of us, human beings, decides using our brain. The brain does not think, does not approve nor disapprove, it is in perfect correspondence with what we think. The fact that we think implies that in our brain there is neural activity, chemical and physiological processes corresponding to our thinking. Our thinking and the corresponding brain activity are a single event but in different codes. Only each of us who lives in the world does interact both with the others and with the inner sensations and the outer physical reality. And it is each of us who is able of perceiving, minding, thinking, feeling, writing, dreaming, choosing how to behave and being aware of existing. It is our multiple activities with the others and within the world that change our brain. It is because one learns to read and write and practice these skills that the brain systems supporting reading and writing do develop.

This has been systematically demonstrated by scientific research showing the impact of literacy acquisition on the brain. Among other relevant papers, Dehaene et al. (2010) could compare the brain activation of literate, ex-illiterate, and illiterate adults in reading tasks. Their huge differences in reading were clearly due to the opportunities they had or not to acquire and develop reading skills. A more recent paper (Lopez-Barroso et al., 2020), which analysed functional connectivity data from the Dehaene et al.'s samples, showed that literacy acquisition in adults created a bridge between language and vision and increased the functional coupling between the VWFA (visual world form area) and the left-frontal network (covering the Broca's area and the Wernicke's area, the former involved in grammar and production, the latter in semantics), while decreasing the coupling of the VWFA with the auditory network and the other high-level visual areas. Brains do not choose to be literate or illiterate. We, more exactly the *inequalities* that are a constant characteristic of the societies in which the humans live since the invention of writing, are the

crucial factor determining the individual's history of literacy and the corresponding history of neural changes in the relevant brain regions. The great majority of the individuals, alone, cannot do much to determine their literacy abilities; these are mainly determined, since birth, by the degree of socioeconomic and educational poverty or richness of their families. As exemplified below, the socioeconomic inequalities influence the development of scientific literacy. Science in general tends to develop in the directions that are the most convenient for those who wield the economic and political powers. Neuroscience is one illustration of this rule.

3. The socioeconomic and political factors of the neuroscientific revolution

Neuroscience is a big science, based on an industry that requires important and profitable investments of capital. Shallice (2009) expressed the idea, which most scientists would not employ to not pollute science, that the great industry behind neuroscience makes itself prosper much faster than cognitive science can advance. In other words, the science of the brain now progresses much faster than the science of the "mind", whereas in the last two decades of the 20th century the cognitive neuropsychologists had formulated more theoretical models than the neuroscientists (p. 75) and the functional imagining had mainly served to support the concepts proposed by the experimental psychology and the cognitive neuropsychology (p. 76). These are, economically and politically, much less relevant than neuroscience, and most scientists persist thinking that science is politically neutral and so should themselves remain. According to Shallice (p. 81), the first decade of the century "predisposed the atomised individual scientist, part of the highly competitive system in which modern science is organized, to a completely reductionist approach".

I share the above Shallice's viewpoints and will only make two comments on the last claim. First, I interpret "reductionist" as involving making abstraction of the social and cultural dimensions without which cognitive issues cannot be fully understood. Second,

such a reductionist stance does not characterize only most of the individual scientists but also most of the cognitive laboratories' directors. Abstracting cognition from the most relevant aspects of the contexts in which it operates can only give a distorted or at least partial picture of cognition. This distortion results from the tentative to describe and explain a single, common human cognition and psychology valid for the whole society. They cannot be unique, given the socio-economic and political characteristics of our society, which, far from being homogeneous, is dramatically unequal and conflictual. The current "scientific" description of human cognition and psychology is just the portrait of a combination of three elites: the economic, the political, and the academic. Unfortunately, most of the members of the academia, including young researchers, are unaware of the role they are playing. Language also reflects the insidious class dominance. Human capital (proposed by two North American economists: Theodore Schultz, Nobel prize 1979, cf. Schultz, 1961¹ and 1971; and Gary Becker, Nobel prize in 1992 (Becker, 1964), psychological capital, cognitive capital, highly frequent terms in Google scholar, do not designate faithfully what characterizes humans' mental life and cognition. These concepts, typical of the capitalist society, are ideologically biased and have penetrated not only the popular magazines but also the scientific literature.

4. The human brain: the product of a long history, inherited by genetics, and modelled by Praxis

Each individual brain is born from a long biological and cultural history. Having found skulls, not brains, we can hardly imagine how different our brain is, at birth and as young adult, from the one of an *Australopithecus africanus* (from more than 3 to 2 My ago) or of a *Homo erectus* (from 2 My to more than 100 kya²), and even of a modern *Homo Sapiens* of around 100 kya. The effects of their praxis from birth to death have impacted through the generations on our brain, and each of us acts on her or his own. The organ does

not change *per se*, it is changed by the development and accomplishment of its potential function. If we, *Sapiens*, change the world is remotely due to the practical and mental activity of our ancestors. Studies in the macaque's F5 area, the homolog to our Broca's area, show that it has functions ranging from fine sensorimotor control to higher order control such as the choice among many possible responses (Petrides, 2005). In the *homines*, both the sensitivity and the motricity of the hand and the mouth, respectively crucial for stone manufacture and speech articulation, were presumably well represented in the now called Broca's area (Ruck, 2014).

Theoretical neuroscience has also linked language and action. Rizzolatti and Arbib (1998) were among the first to propose that the human language evolved from a mechanism that was concerned with the capacity to recognize and coordinate actions. The human body coordinated movements, including the hand gestures, certainly predated oral language and, *fortiori*, the more recent emergence of syntax. In the history of language, of which we still do not know much, recursiveness, given its complexity and cognitive demand, must be quite recent and nevertheless it shares with manual praxis the concatenation and ordination of bits of action. This, in what concerns stone tool manufacture, improved for more than one million years. It is not astonishing that nowadays syntax and high manual skill share common or very close brain areas, e.g. (Kemmerer, 2012).

5. Do not explain cognition by the Brain, show how the brain does support cognition

Our actions, either productive or communicative, result from our will, our voluntary decisions, not from our brain. The brain is the site where our will and decisions are registered, but their signatures are ours. We are the pilot, even if we are not always rational and aware of our desires, limitations, and real motivations. Imagine I am giving a talk and you

¹ It is worth noting that Schultz himself recognizes that such know-how and knowledge are a form of capital and that this

capital is, for a substantial part, the product of a deliberate investment.

² thousand years

are in the audience. It is not my brain that decides the precise moment and how I pronounce a given sentence. I can stop for a few seconds if I need to find a word and go ahead, and my brain just “obeys” my decisions. If I could have in front of me, in a screen on the table, the image of my brain’s activity, my attention could be perturbed, and my speech would show signs of it, but I could also not look and think at my brain’s image. You too might take the decision of attending *only* to what I say or *only* to what is shown on the slides. This is the situation cognitive psychologists call “selective attention”, and it is not your brain that decides which message to give preference and processing priority, it is you.

It is, indeed, particularly difficult to process at the same time two different messages, one written, the other spoken. Cohen et al. (2021) attempted to answer the question “How does inattention affect written and spoken language?” The main question they formulated is cognitive: “Can we still integrate multiple words into a syntactically and semantically coherent structure, without attending to those words?” The authors presented either sentences or word lists in one sensory modality, auditory or visual, but in one condition attention to the target was affected by asking the subjects to perceive at the same time concurrent stimuli presented in another sensory modality, and this is a really difficult task. There were two conditions: Spoken language + Visual distractors; or Written language + Auditory distractors. In each of the language modalities the stimuli were either sentences or lists of words; the visual distractors were colored patterns, and the auditory ones were melodic patterns.

The first question was: Can sentence-level processing occur for unattended stimuli? The answer was largely negative for both modalities. The second question was: Would inattention cancel the top-down effects in the ventral occipitotemporal cortex? The differential response to known vs. unknown alphabets did not vanish under inattention, but it was reduced. Quite importantly, the strong posterior and mid-lateral response to the known alphabet *remained* in the unattended condition, which implies that there was automatic processing of the letter strings at the site

called “Visual Word Form Area”. This is a case of unconscious processing by our perceptual system (the visual permeated by the audio-phonological): whilst our brain does process the word letters, we, the intentional human subject, do not process them. We are not our brain, and our brain is not us. This admitted, it is also necessary to admit that neither exists without the other.

It is worth noting that Dehaene et al. (2010) had found, but only in highly literate subjects, a significant activation of the VWFA during an *auditory* task of lexical decision. This effect is unequivocally both *top-down* and *cross-modal* although in the experiment there were *no written stimuli*. It thus implies that the VWFA can be activated from auditory information, more likely phonological, compatible with a known orthography. The general comment I want to offer is the following: These brain studies (Dehaene et al., 2010 and Cohen et al., 2021) are less valuable for the information they provide on the neurological activation patterns than for their contribution to a theory of our perceptual-cognitive processes and of how these processes influence the neural activity.

6. Cognition and language: a productive couple. They engendered literacy

We tend to consider cognition and language as distinct domains. This is unfortunate as they are inter-related. We will not have a good idea of language by studying only language, and we will not have a good idea of cognition by studying only cognition. They appear to us as separate domains because we introduced frontiers between them. Language is *also* cognition, because what we say or write is presupposed to convey meaning and reflect knowledge. Cognition is *also* language, because without language we cannot communicate knowledge or meaning. And we cannot escape this by saying that we are only interested in the “applied” issues.

Language includes, beyond spoken language, two other forms: gestural language – for many deaf people – and literate language. In contrast to *language* and *cognition*, there is no broad consensus of the meaning of “literacy”. The word *literacy* only appeared near the end of the 19th century.

Literate language is not universal but should be taught to all children and developed and practiced by all adolescents and adults. Literate language includes literacy of natural language and computational literacy. I am convinced (almost everybody is) that the learning and use of computational literacy will be largely extended and will become crucial. It will take time, but the human society already faces two dangers: on the one hand, the development of a restricted contingent of professional experts, a reminding of the scribes, coexisting with many computational illiterates; and, on the other hand, the persistence of a large contingent of fully illiterates.

In Kolinsky and Morais (2018) we have estimated that literacy cannot be reduced to the skills of reading and writing and that it has a strong impact on both language and cognition. We have suggested that “many scholars (...) wear literate glasses that lead them to disregard or underestimate the contribution of literacy to cognition”; and those who believe “to be studying ordinary oral language are actually primarily studying the properties of written language.” (p. 321). We have also mentioned, among the many instances of the influence of literacy on language and cognition, the following ones: 1. illiteracy does not allow the distinction of enantiomorphic, symmetrical figures, like b and d (Kolinsky et al. 2011), and more generally, the illiterates’ visual analysis of figures is poor (Pegado et al., 2014); 2. Illiterates are much poorer than literates in auditory verbal memory, especially for memory of serial order (Kolinsky et al., 2020) and of pseudo-words (Castro-Caldas et al., 1988; Reis et al., 2003; Kosmidis, Zafiri & Politimou, 2011); 3. The same happens for lexical and semantic knowledge (Kolinsky & Fernandes, 2014); 4. Contrary to literates, illiterates are unable to decompose spoken sentences into words (Cary, 1988; Ramachandra & Karanth, 2007); 4. Illiterates rarely produce spoken sentences with relative clauses and recursion (Ong, 1982; Chafe, 1982), and tend to misunderstand them when the relevant terms are not contiguous (Scholes & Willis, 1987); 5. Poor literates have great difficulty in understanding sentences with embedded propositions (about 20% correct, compared to 60% for graduates),

and in anticipating visual objects during listening to sentences that include a reference to them is poorer in low literates than in high ones (Mishra et al., 2012); 6. Both illiterates and unschooled ex-illiterates display very poor scores, not above the percentile 50 of 7-years children, in tests of inductive reasoning from visual tests (Cary, 1988; Verhaeghe & Kolinsky, 2006). Having deleterious effects on memory and reasoning, illiteracy and poor literacy compromises the understanding and use of complex knowledge. Science is one of the babies engendered by literacy. If the humans had not invented writing, we would not have science and most of our present technologies. Astonishingly, even scientists may not be aware of the roles played by literacy, although they spend around 50% of their time reading or writing. Literacy has been and remains essential to communicating and storing knowledge.

Two other dimensions of our life that are deeply influenced, directly or indirectly, by literacy. One is *culture*. By culture I mean the aspects of our life that are determined, conditioned or chosen by the fact that we live in nature and in social contexts that we contribute to transform. The other is *politics* and *economy*, more concretely the political and economic activities in which our society and each of us are involved. What we call culture, politics, economics, and the modalities of either violence (on nature, strangers, enemies) or, instead, empathy towards the others and the close ones, all that is not immune to *literacy*, given that our literacy activities or lack of them may contribute to determine our needs and our character. Sharing among them most of their literate activities, the literates tend to find these activities natural and do not notice their effects. This may explain why even many philosophers and cognitive scientists do not recognize the impact of literacy on science, cognition, culture, and politics. It is therefore quite easy to install in a large majority of people the idea that the mere right to vote in “democracy” guarantees the conditions for political rights equality. As if illiteracy and poor literacy were not undermining cognition, language and, through all these effects, the citizenship rights.

Among the great scientists and philosophers of our time, few are those who point out clearly the role of illiteracy and poor literacy on rendering vain and hypocrite the assumption of the human rights equality and the consequent apology of individual merit. Cognitively and linguistically “blind” people cannot compete with “sighted” ones in finding an odorless object: not only scientists and philosophers, even the illiterates would understand the atrocious inequality of that situation. The reason why most scientists and philosophers do not notice the atrocity of the differential impact of the socioeconomic inequalities on cognition and language, in a large part via the literacy inequalities, is quite simple: they have become “blind” and “deaf” to the literacy inequalities and the consequent effects. Such blindness and deafness may be due, in most cases, to an unnoticed effect of high-level literacy: the abstractness power of literate thought, which tends to eliminate from our sight the real people in favor of an abstract human, for whatever dimension: social, political, cognitive, linguistic...

This phenomenon can be widely observed in cognitive and neurocognitive scientists and philosophers. For instance, Bechtel (2008), in his major and voluminous book on the mental mechanisms, analyzed the polemic opposing the partisans of encapsulation to those of distribution without using at all the words “literacy” or “literate”. He only used “literally”, which shares the same root but, having been deprived of its origin (“written with all letters”), has now a quite different meaning. For the tenants of encapsulation, language was innate and for the connectionists it was only the capacity to learn language that was innate. Both groups disregarded the fact that the languages they employed were literate. Neither considered that illiterates are people whose language and thinking deserves to be examined. Even non-human animals do think and consequently dispose of a language of thought, although this is not verbal but made of images and movements. We, humans, share this basic capacity with non-humans. By imaging movements, we may get improvements that are close to those obtained by actual practice.

Literacy provided us with an extraordinary tool to develop science and conceptualize the world, and at the same time we must be permanently cautious because it induces us to see everything with literate glasses. Our knowledge of what we call human mind, of its relations with the brain, of its biological and social origins, of how it is influenced by cultural and political factors across history, all of it is the product of a host of scientific literacies. Before the emergence and development of literacy, the humans felt in love and believed in hidden powers, but I doubt they would have formulated and discussed abstract concepts such as those of love and religion, their attributes, and their relations with other concepts.

7. Against the isolationism of cognitive and neurocognitive sciences

Our disregard of illiteracy is not the only black spot, or neglect-inducing lesion, of which the contemporaneous cognitive and neurocognitive sciences are suffering. It is symptomatic the disdain that those sciences have been showing towards other human sciences, old and respectable, like anthropology. Such disdain is just a case of the more general repudiation of the so-called “human sciences”. Cognitive and neurocognitive sciences, in particular their theoreticians, have at some crucial moments adopted the souverain posture of the noble families who do not want to be mistaken for the poor and barbarians: such disciplines might not even deserve to be called science. This stance has contributed to accomplish “the double marriage of cognitive science since the last third of the 20th century with, on the one hand, evolutionary biology and neuroscience, and, on the other hand, informatics and computational science.” (See Kolinsky & Morais, 2018, from p. 324 on). That focusing led to scorn the 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.” (ibid.). In that paper we illustrated the cognitivism’s cavalier scorn for cultural factors by the way its leaders rejected or remained indifferent to the discoveries and proposals of anthropologists and classicists like Goody and Watt (1963; cf. also Goody, 1977) and Havelock (1963, 1971). We recognized in the mentioned paper that many of the Goody and Watt’s claims were excessive, leading their position to be called the “Great Divided Theory” (ibid., p. 325) and facilitating the cognitivists’ enterprise of eradicating *Culture* from the comprehension of the context, factors and dimensions of cognition and language. Ironically, the cognitive and neurocognitive sciences covering the end of the 20th century and the early beginnings of the present century installed in cognitive science another great divide (cognition as an a-cultural object), of which we are now progressively emancipating.

We need to look at other human and social sciences, among which Anthropology. Lebnner (2020), an anthropologist, warned us that the most recent anthropology over-cultivated the “concept” in contrast with previous anthropologists of the 20th century. Lebnner says that “in the British anthropological tradition beginning with Malinowski (...) there is no such thing as a concept”. The individual mind – it is grudgingly that I use “mind” – is a product of philosophy legitimated by the modern cognitive science, but it would be nothing out of the social, economic, political, cultural, ideological, and psychological relations. Another anthropologist, Marilyn Strathern (1996) recalled Thatcher’s assumption “There is no such thing as society. There are individual men and women and there are families”, and she commented that “the heightened concern with individuals (...) can inhibit our understanding of the work of relations.”

The mind alone, cut of all relations, is a phantasm. The mind does not exist, it exists only as a concept. We use in our thinking the literate concept of mind. Scientific literacy adopted the concept of mind, as in our preliterate times the humans have created a pre-concept, the soul. The isolation and fixation of concepts through literacy, when drawn from the context that explains them, produce such hallucinations. The belief that we possess a mind, an internal organ or

power, is linked to the necessity of assuming that some instance in ourselves commands our desires, affects, thoughts, memories, decisions, and acts. *Esprit* and *espírito* have an older origin, a religious one, but now it has been influenced by literacy. The Old English words for *mind* and *remind* did not appear before the 14th century and the expressions *never mind* and *don’t mind* only in the 18th and 19th centuries. It seems that the educated high-social class may have been determinant of such meanings and expressions.

We wrote in Morais and Kolinsky (2021) that literacy “allowed fixing mental processes as ‘mind’”, which is “nothing more than a conceptual abstraction”; that “cognitive scientists forgot that (...) “billions of people are nonliterate (and) that most of these could, but do not, share the same kind of mind as ours”; and we invited cognitive scientists to “read our science with new eyes” as “there is no mind, neither quantities of minds, there are people each with a history of mental processes.” We argued that we do not need a Mind as an organ or a place because we have our brain for our mental processes. Why should we need a further locus? Using the face for comparison, the mind would better evoke the succession of living expressions allowed by a configuration of traits that depends on the head bones, the skin, the life events; it is different from the other’s facial expressions, although it may also resemble them to some extent. Like facial expressions, mental events change from birth to death but across life they reveal a personality.

Interestingly, the philosopher Gilbert Ryle, who wrote “The concept of Mind” in 1949, never used the concepts literacy or literate in the book, but he used, only once, the word “obliterate”. Indeed, he unconsciously obliterated something important. In contrast, Diderot, two hundred years earlier, wrote “le cerveau est un livre qui se lit lui-même” (“The brain is a book that reads itself”). The metaphor “The brain is a book” is the recognition that the brain needs the nutrient brought by the book, the prototype of literacy. For the brain he used the metaphor “cire sensible et vivante” (“sensitive and lively wax”), in other words the brain is malleable, open to reorganization, and indeed

learning literacy deeply changes the brain functions and its connectivity.

8. For a cognitive Revolution

In the last few centuries, under the influence of the technological revolution, there has been an important increase of knowledge, leading to a large diversification of sciences, most of which ending by claiming their maturity and independence. This did not prevent the sciences that directly concern the humans to be considered as linked on a strict unidirectional relationship and in a bottom-up way. As expressed by Colagè and d'Errico (2018), “biological/genetic evolution sets neural substrates, (...) neural substrates fix cognitive abilities, and (...) cognitive abilities determine the spectrum of cultural practices exhibited by a biological species”. More succinctly, “genes → brain → cognition → culture”. The genes are the little gods that we inherit, presented as immune to the actions and reactions involving the human environment and human activity, the brain is the genes’ son in charge of making us intelligent or stupid, good readers or dyslexic, and our individual actions contribute to engender culture. This caricature is only a too simple one-way from a set of much richer and more complex interactions that operate both ways: culture influences cognition, which impacts both the brain and, through it, behavior, the latter takes place in its environment, and touching the starting point, both epigenetic and genetic selection can occur in the organism.

This two-way interplay between genes, brain, cognition, culture is highly schematic and excludes a fifth dimension, without which we would be condemned to talk only a long succession of Adams and Eves. The human beings are social animals, and the human societies are, first, always culturally different even quite different between them, and second, quite heterogeneous within them. These differences concern the individuals’ social positions within their society, and these social positions which are widely distributed can be categorized into *classes* according to their roles in the society. The different social positions and roles impact their cognition (mostly through their different educational level), contribute to cultural differences

within the whole society, have been shown to affect the brain and may even affect the genome or at least lead to epigenetic changes. Obviously, the relevance of the concept of class is dismissed by the dominant, in other words the richer and powerful classes, whose education is privileged and allows to reach higher levels of cognition so that these classes can control the whole society economically, politically, by law and, when necessary, by violence.

Early in this paper I mentioned the cognitive theory that argued for the encapsulation of the initial stages of cognitive processing. This theory has been challenged and refuted. Just above I have called for a dis-encapsulation, not of a theory but of cognition itself. This implies that cognitive education, which is crucially dependent on high level literacy, be accessible to the lower classes of each human society to the same extent as to the higher classes. We – me and all those able to read and understand what is written in this paper – are members of an educationally and cognitively (although probably not economically) privileged class. A further human mental dimension that has not been considered above is the moral and – when it is reasoned – the ethics. I want to assume that everybody – excepting most of those who belong to rich and powerful classes – are morally and ethically prone to call clearly, strongly, for a high level of education, and hence of literacy, and hence of cognition, for all. Cognition is socially encapsulated. We must render it socially universal. And to achieve this result, it is necessary to understand that the impediment is not in our genes nor in our brain.

Love, appropriate nutrition, appropriate education, are the three conditions for reaching socially universal high-level literacy and cognition. Which implies a deep political change. About three hundred years ago, the humanity launched the industrial, more exactly the capitalist revolution. It created new classes, new ways of experiencing richness and poverty. The political change we must impose now is just an educational revolution allowing all children to develop moral values, literacy, cognition, and rational thought. Is there any impediment to it? I am sure there is none.

9. The dreams of a unified science and the reality of its fragmentation

Almost all scientific issues engage more than one science, even if this is not apparent in most scientific papers. The present paper, dealing with cognition, language, and literacy (CLL), plunges into distinct but related sciences. The issues I have been dealing with are unrelated to “natural” sciences like astronomy, physics, chemistry, and even to biology and ecology. Among the human sciences, sociology, economics, politics, and psychoanalytic theories would be considered irrelevant to CLL. The fragmentation of science into natural and human sciences have led to the invisibility of their links and involving philosophy would seem pretentious.

The mastery of spoken language, as well as the mastery of literate language and literate knowledge are and have always been the privilege of a minority across the history. The property of high-level language and literacy is largely confounded with wealth and with membership in academic or intellectual elites. Which does not prevent the rich from welcoming populist presidents of low-level literate culture, which they did with Trump and are doing now with Bolsonaro, who demagogically incense the people but act against it, and contribute to the sharpening of the economic and social inequalities.

Those who benefit from the material and cultural inequalities have a vested interest in presenting the material and cultural goods as unrelated. It is a shame that human sciences like cognitive, neurocognitive, and psychological sciences tend to use the graduate or undergraduate student as a prototype. They give a distorted image of what humans really are, as if we should only show well-dressed models in sailing shops. The cognition, language, literacy, and brain of the poorly educated people are much less developed than the exhibited portrait, and yet they are the majority in the world population.

The distortion of knowledge by the *fragmentation of science* and the fact that the access to science and its management are restricted to a privileged group seem to play similar roles, respectively, to the social injustice due to the

fragmentation of humanity into classes and the fact that wealth is concentrated in the pockets of a few. Split science is both the mirror and source of split society.

I come back for a while to the notion of “mind”, the presumed locus of feeling, perceiving, attending, imaging, memorizing, thinking, reasoning, desiring, deciding, moving, acting, speaking, writing, dreaming, etc. In the cognitive science literature, the mind is individual, each person her or his own mind, and what is pictured is the cognitively superior mind of the literate person. Comparatively, only a few researchers give the scene to the “collective mind”. It was the case of Wilson (2005, in the Abstract), concerning memory: “While memory is conceptualized predominantly as an individual capacity in the cognitive and biological sciences, the social sciences have most commonly construed memory as a collective phenomenon”. And of Shteynberg et al. (2020, also in the Abstract) concerning learning: “collective learning, or learning with others, has been underappreciated in terms of its importance to human cognition, cohesion, and culture. We offer a theory of collective learning, wherein the cognitive capacity of collective attention indicates and represents common knowledge across group members, yielding mutually known representations, emotions, evaluations, and beliefs.”

Before those authors, the historian of philosophy Thomas Teo (2001) attributed the dominance of the individual mind and the base of knowledge to the Descartes (1596-1650)’s cogito and observed that the “*cogitamus* (we think) never entered his foundational reflections (...) not seeing the dependence of the cogito on the *cogitamus*” (pp. 195-6). Teo noted that Hegel in 1830/1992 discriminated among the subjective mind (individual, and encompassing sensation, habit, consciousness, perception, reason, desire, memory, imagination, and so on), the objective mind (the mind of a social community or era and expressed in law, morality, and ethics) and the absolute mind (an infinite entity, expressed in art, religion and philosophy); and, before, Hegel (1817/1986) had linked the subjective and the objective saying that for the individual “the mind of the time is also his mind”. Teo attributed the

conceptualization of the mind in the 19th-century German philosophical psychology to the Hegel's subjective, empirical mind.

Marx and his friend Engels changed completely the concept of mind by giving clear predominance to its sociocultural component. To them, the individual mind is a personal expression of the society and of its culture. It is the division of the society into classes and the huge variation of the experiences and roles within it that gives each individual since her/his life beginning a huge material to build her/his character, values, and mental life. "It is not the mind of humans that determines their being, but on the contrary it is the societal being of humans that determines their mind." (Marx & Engels, 1848).

The flow of mental representations that corresponds to a presumed but undemonstrated entity, the so-called mind, may be the locus of the fusion of quite different stimulations and experiences, which, for sake of simplicity, I group into physical-natural and socio-cultural. The understanding of this "mental fusion" (the mind) necessarily calls for a fusion of the respective sciences, the natural and the human, into a unique science. It is what Marx (1844/1993) predicted: "The natural science will later subsume the human science as the human science will subsume the natural science: There will be one science." (cf. also Teo, 2001, p. 209). To Marx, "Even when I'm active as a scientist (...) I am societal because I am active as a human being. Not only the material of my activity is given to me as a societal product, as is the language in which the intellectual is active, but also my existence is societal activity." (Marx, 1844/1993, cf. Teo, 2001, p. 199).

To Marx, nature (where we live) and society belong to the same dynamic process. There is no reason to be anthropocentric rather than eco-centric, or the reverse, as both humanity and nature are inseparable. Capitalism, against which Marx fought, has been across the last three centuries an insatiable predator for both. "What is science today?" – asked Thomas Mann in *Reflections of a nonpolitical man*, written in 1918 just before the end of the First World War. He answered: "Narrow and hard specialization for profit, exploitation, and control. What is culture?

Humanity perhaps? Breath and goodness? No, nothing more than a means for earning money and for dominance. What is philosophy? Perhaps still not a way of earning man, but also very narrow specialization in the style and spirit of our times." (Mann 1918, p. 313). We ask: and more than one century since then? The answer: humanity is more divided than ever, between the richer and the poorer; nature more endangered than ever; science runs in all directions, desperately; and philosophy does not follow.

In the 1930s, Mann's worries about science and philosophy might have been partially lifted, due to remarkable advances in physics and the collective involvement of scientists in philosophical issues and in connecting with the society. They did it via the Vienna Circle, the Ernst Mach Society and the Otto Neurath's Unity of Science movement, and their public lectures extended in Europe and North America. The objective was "to cultivate epistemological and scientific sophistication among even ordinary citizens so that they might better evaluate obscurantist rhetoric from reactionary and antiscientific quarters and better contribute to planning a future unified science that would assist society's collective goals" (Reisch, 2005, p. 3). Those circles, together, formed an open movement under the notion of logical empiricism, which differed in many ways but shared the concern for scientific methodology and for an impact on society. Interestingly, one of the groups was the Berlin Society for Empirical Philosophy, denoting the will to get philosophy and science closer. The Unity of Science movement organized, after an initial conference in Prague in 1934, a series of International Congresses for the Unity of Science: Paris, 1935; Copenhagen, 1936; Paris, 1937, Cambridge, England, 1938; and Cambridge, Massachusetts, 1939. The latter was known as the Harvard congress. It focused on how to unify the sciences and included topics in social science under the label "socio-humanistic sciences". Two students of Carnap (also a major figure of the Movement), wrote about it a paper entitled "Unifying science in a disunified world". Given the World War, the last congress occurred in Chicago, 1941. For this congress, the pragmatist philosopher Charles Morris

wrote in the promotional flyer that “the present world conditions enhance rather than restrict the need for the vigorous continuation of the unity of science movement”. Among the topics, one addressed “Science and democracy”.

The Austrian Otto Neurath, a polymath, scientist and philosopher, whose dearest goal was philosophy *with* science, who also worked in museums and in public education, and who had taken part in the Bavarian socialist revolution of 1919, was the most influent and active in the movement. He died of a stroke in 1945, a fact that weakened the movement considerably. Neurath had been at the head of the Unity of Science movement and the editor-in-chief of the International Encyclopedia of Unified Science. He disliked metaphysics and praised the Marxist naturalistic methodology in which “everything lies in the same earthly plan” (Neurath, 1928, cited by Reisch, p. 7, footnote 3). In the early fifties the political repression led by the FBI and the senator McCarthy played a major role in the collapse of the movement as it did of progressist culture in general³. According to Reisch (2005, p. 20), there were three grievances against the movement: the unified science was a popular goal; the goal of preserving a place for philosophy of science was incompatible with the Cold War academic culture; and “collectivism” was rejected by intellectuals that celebrated “individualism”. Moreover, says Reisch, “As a whole, the academy and higher education engaged in something like an orgy of patriotic conformism (...)”. Schrecker (1986, 340-41), cited by Reisch, commented that “Patriotism, not expedience, sustained the academic community’s willingness to collaborate with McCarthyism.... When, by the late fifties, the hearings, and the dismissals (at colleges and universities) tapered off, it was not because they encountered resistance but because they were no longer necessary. All was quiet in the academic front.” The Unified Science Movement had been killed by the Cold War.

Since then, there has been remarkable progress in the sciences, but these remain fragmented, with only superficial bridges between them. Cognitive and neurocognitive sciences form a duo, but, proud of their sophisticated apparatus and methodologies, do not look enough beyond their frontiers. Cognition, language, and literacy are still relatively insulated topics. Revolutionary advances in the knowledge of cognition, language and literacy will not take place if these are not crossed, via interdisciplinary studies, with the human sciences, of history, culture, society, with natural sciences, in particular biology and ecology, and if science in general remains fearfully distant from quite relevant political issues.

Applied Psycholinguistics is an interdisciplinary science, rooted on parts of linguistics and of cognitive experimental psychology. It should also benefit from cognitive science, cognitive neuroscience, and educational and re-educational sciences. In turn, each of these sciences does, or should interact with others. Moreover, sciences, among them, share to some extent methodologies, common language, concepts, and knowledge. Applied psycholinguistics, which evaluates the conditions and the causes of disturbances as well as the effects of the actions it proposes on humans considering their milieu, natural or cultural, should also benefit from many other sciences, and this is true for all other applied sciences. In the sciences’ family, both theoretical and applied sciences deserve the same rank.

³ “State and federal policies and laws affected nearly all major research universities and made it practically impossible, without genuine risk to one’s professional

and social standing, to be sympathetic to Marxism or socialism inside or outside the classroom.” (Reisch, 2005, p. 19).

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