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Neurophilosophy of Second Language Learning: Conscious and Unconscious Aspects

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Background and objectives

Dealing with the ancient Greek philosophical debate around the relation between heart and brain, Aristotle opted for assigning to the former the central role of “seat of the heat” and therefore principle of perception and movement, whereas the brain was relegated to the role of a refrigerant organ that stabilizes the temperature¹.

The Aristotelian concept of the heart as the center of human biological functioning was accepted as an undeniable truth for many centuries. As a consequence, the brain maintained its subordinate role and was not reputed worthy of much inquiry.

It was only in the XVIII century that the development of a modern discipline, electrophysiology, slowly settled a new conceptual framework made of a capillary electrical impulses/information bearing signals network, whose center was finally recognized in the brain². The new conceptual framework put into question the previous beliefs on well-established “truths” like consciousness, emotions, behavior and even free-will, shading on them a new enigmatic light.

A class of neurons called von Economo (VENs), for instance, present only in a few brain regions as anterior insula and anterior cingulate, are supposed to play a pivotal role in interoception and communication (Kemmerer, 2015), thus undermining the more common metaphysical view on these human skills, or at least proposing a neurobiological alternative approach.

As Patricia Churchland (2002) puts it: “neuroscience is morphing our conception of what we are³” and suggesting that many feelings we took for granted as non-physical

¹ Michal Oleksowicz, “Aristotle on the Heart and Brain”, *European Journal of Science and Theology* 14 (2018): 77-94.

² H. Kettenmann and N. Wade, “A Short History of European Neuroscience from the late 18th to the mid 20th century”, Oxford Neuroscience website, *Federation of European Neuroscience Societies* document, accessed February 2020, <https://www.neuroscience.ox.ac.uk/files/about/short-history-of-european-neuroscience.pdf>.

³ Patricia Smith Churchland, *Brain-Wise. Studies in Neurophilosophy* (the MIT Press, 2002), p. 1.

events could eventually have a neurophysiological ground, thus there could be “no soul to fall in love⁴”. Whether we decide to accept such a reductionist view or not, it is up to us, but what we cannot avoid is to face the new perspective and to take it into account when building our own conception of human nature.

The main shift seems to be methodological in such a deep way that all the truths collected so far have to be put into doubt. Again Churchland (2008) notes that in the twentieth century conceptual analysis, which is based on introspection and reflection, has been the principal methodology applied in the field of philosophy of mind. Neuroscientific data challenge the a priori truth collected by philosophers and, especially, contrast with the Cartesian mind-body vision on the subject matter of cognition.

Given these issues, not surprisingly, both neuroscientists and philosophers have become aware that their paths are interwoven in many ways. The former, turning away from the objective scientific examination of nature, were stepping into the unpredictable field of cognition, where the philosophical definitions of consciousness, self and will were dominant insofar. The latter have been forced to cope with the power of evidence based data and, in a quite genuine philosophical spirit, have not rejected the challenge.

The result is a vibrant and charming scenario made up of scholar mutual help and cooperation but also defiances and reciprocal provocations, where a fruitful and powerful dialectics is taking place.

The cooperations between neuroscientists and philosophers has given way to an impressive amount of significant scientific literature.⁵

Notwithstanding the examples of enthusiasm, it has to be acknowledged that some philosophy has also shown some resistance to the new cooperation. According to Barry

⁴ *Ibid.*

⁵ From the cooperation between the philosopher J.Hacker and the neuroscientist M. Bennet (2003, 2008) to the theoretical considerations made by P. Churchland based on A. Damasio’s works; from Damasio [1994]’s scientific *accusations* to Descartes to entire collections of essays written by teams of philosophers and neuroscientists like the following: Felipe De Brigard and Walter Sinnott-Armstrong (eds.), *Neuroscience and Philosophy* (MIT Press, 2022).

C. Smith (2018) this has happened because some philosophers feel that the new science is essentially eroding a domain of inquiry that they believe to be exclusive to philosophy. Nevertheless, I agree with Smith's conclusion: not only the fact of being a new science that begins from a starting place makes it a tremendous opportunity for reconsideration of old schemes, but philosophy could play a pivotal role in neuroscientific research. The recent increment of contributions both in the field of philosophy of neuroscience and neurophilosophy⁶ is a hint of the fact that this idea of mutual necessity is abundantly spread among scholars.

Ultimately, considering neuroscience as a consistent source of insights, involves rethinking our own beliefs and sometimes to reshape the philosophical frameworks used till now to inquire human cognition.

In this dissertation I have faced the issue of second language learning/acquisition with a neurophilosophical approach, namely, using neuroscientific data as hints to solve a philosophical problem.

The initial clue for starting my research was that I noticed a general lack of interest, among philosophers, on the theme of second language acquisition if compared to the parallel theme of first language acquisition. Goodman (1967) faces the problem, hypothesizing a "rudimentary prelinguistic symbolic systems" that supports both first and second language but does not demonstrate his claim. In the same decade Chomsky triggered a revolution with his inquiry on knowledge of language, but seemed to have neglected the specific status of second language learning, incidentally maintaining that second and first language acquisition are identical processes⁷. The relativist linguistic perspective concerns more the possibility of mutual comprehension (especially

⁶ For an exhaustive history of the relation between philosophy and neuroscience see John Bickle, Peter Mandik and Anthony Landreth, "The Philosophy of Neuroscience," *The Stanford Encyclopedia of Philosophy* (Fall 2019 Edition), Edward N. Zalta (ed.) <https://plato.stanford.edu/archives/fall2019/entries/neuroscience/>

⁷ For instance here: "one does not learn the grammatical structure of a second language through explanation and instruction,[...] the second- language learner, like the first-language learner, has somehow established the facts for himself, without explanation or instruction." Noam Chomsky, *Language and Mind* (Cambridge University Press, 2006), p.155.

translation) than acquisition, though an orthodox interpretation of the ideas of Sapir and Whorf could probably lead to the view that no second language acquisition could be considered authentic.

One of the aims of the present research is to fill in what was looking to me as a gap. The way I decided to do it is by maintaining an interdisciplinary approach with major reference to neuroscientific findings. Here, again, I found a remarkable silence among philosophers, as the issue seemed to concern only linguists and neuroscientists. Conversely, in the specific domain of Second Language Acquisition (SLA) studies, there's a growing attention towards neuroscience. Nevertheless, I noticed that many studies lack a background strong enough for systematizing the results. I do believe that philosophy could provide this missing background, because second language acquisition is not only a matter of teaching methodologies or brain processes, it is a complex phenomenon that implies questions about intersubjectivity, human interrelation, collective memory and even collective consciousness, which I treat in the last chapter.

Given the relevance of the subject matter I came to the conviction that not only it concerns philosophy, but that philosophy is the most suitable framework for giving a theoretical shape to such a manifold material. As Patricia Churchland states, "Philosophy is, traditionally and currently, quintessentially the place for synthesizing results and integrating theories across disciplinary domains⁸."

The structure that I gave to this inquiry is a journey that kicks off from philosophy and, passing through neuroscience, synthesizes many contributions given from psychology, linguistics, sociology, cognitive linguistics, to pose the basis for a theory of second language learning that takes into account also ontological aspects.

I have extensively borrowed hints from the works of philosophers like Hacker, Searle, Dennett, Hornsby, Churchland, Tsai, Dummett, Russell, Lakoff, Goldman, as well as from linguists like Chomsky, Andrews, Jakobson, Whorf, Boroditsky, Grosjean, Kroll,

⁸ P. Churchland, *Brain-Wise* (MIT Press, 2002) p.3.

Lieberman, Wierzbicka, and psychologists and cognitive psychologists like Barsalou, Guiora, Asher, Craik, Bialystok, Brysbaert and Duyck, DeLuca; from psychiatrists like Lozanov and neuroscientists like Bennett, Damasio, Kemmerer, Catani, Price, Cerri, Hickok, Costa, Fabbro, Rizzolatti, Gallese, Abutalebi and Green, Alladi et al., Guenther, Levelt, Pulvermüller, Sacks; from researchers in SLA studies like Krashen, Singleton and Leśniewska, Reiterer, Schwartz, and even from neuroanthropologists like Donald and “neurosociologists” like Rose and Rose as well as from many lesser-known researchers⁹. Each of these perspectives has been a precious step forward for the present research project.

In the pages that follow, I will summarize the main contents presented and outcomes achieved throughout my work.

Summary

I think that is mandatory for a *philosophy worker* like me that is about to dive into the uncomfortable field of the scientist, to spend a few words while still being in a “safe place” both for me and for the reader. For this reason I decided to start my work with an introductory chapter (chapter 1- *Mind, brain, language*) entirely focused on issues well grounded in the most traditional philosophical domain. Besides the above mentioned need of *psychological comfort*, there was a methodological urge that justifies it. This dissertation is a philosophical work, not a scientific *tractatus* on language acquisition. It means that it addresses old philosophical questions picking up new material around wherever it is available. In chapter 1 I clarify that the problem of second language acquisition is essentially an epistemological issue and that it is strictly related to the problem of the definition of the nature of mind. Additionally, following a hint given by Chomsky in his research about the nature of language¹⁰, I advocate the need for an interdisciplinary approach to face both the problem of language acquisition and mind.

⁹ For an extensive and more precise list of references, see the extended biography attached to the complete version of the dissertation.

¹⁰ See, in particular, Noam Chomsky, *Language and Mind* (Cambridge University Press, 2006), where several times Chomsky claims that linguistics, philosophy and psychology share similar or even identical concerns in the regard of knowledge of language.

I will justify this stance as follows. Being a phenomenon that concerns at the same time subjectivity and intersubjectivity, language and its acquisition pose some dilemmas while being inquired. Introspection is a tool that gives only partial answers. Observation, a methodology mutated by natural sciences, reduces intersubjectivity to external behavior for detached measurement and analysis. Tough, language is not only heard, it is also spoken. What if, for instance, hearing is also speaking in a kind of simulation mechanism where the traditional categories of sender and receiver melt in an intersubjective space? If so, as I try to demonstrate in chapter 3, no pure methodology could bring us far in this domain of inquiry. We need, conversely, a scenario that takes into account psychological, social, linguistic, and neurobiological aspects. This is what cognitive sciences have done for a few decades: Using an interdisciplinary and even multidisciplinary approach to shed some light on cognitive processes.

This approach cannot disregard the contributions given by a relatively new domain like neuroscience, that since Paul Broca demonstrated the causal relation between brain damage and aphasia¹¹, has stepped in the field of language inquiry.

Though my conclusions divert from Chomsky's claims of a separate mental module, innate in its nature, devoted to language, I have borrowed from Chomsky the initial standing point, namely that the problem of language acquisition is essentially epistemological¹²: What kind of knowledge is knowledge of language and how is it acquired?

I claim that the problem of second language acquisition is not a problem separated from first language acquisition. In this respect, I maintain that the different circumstances in which native and not native languages are acquired have given way to a common misunderstanding, spread among scholars even nowadays, according to which second and first language acquisition are two different processes. This latter idea has several

¹¹ Paul Broca, "Perte de la parole: ramollissement chronique et destruction partielle du lobe antérieur gauche du cerveau," *Bulletins de la Société d'Anthropologie*, 1re série, vol. 2 (1861): 235-258.

¹² See, in particular, the first 10 pages of Noam Chomsky, *Knowledge of Language*, (Praeger, 1986).

advocates¹³, in philosophy, linguistics, neuroscience and even second language acquisition (SLA) studies. I confute some of the arguments that support this view in chapter 2 and 3, as we will see in the following pages.

I dedicated a few pages to the description of the neurophilosophical approach proposed by Patricia Churchland. Problems like cognition and identity, as a point of fact, have become even more puzzling in the light of neuropathological phenomena like the split brain¹⁴ and somatoparaphrenia,¹⁵ yielding the necessity of reconsidering the methods of inquiry. I claim that not only philosophy cannot ignore neuroscientific findings, but also that neuroscience urges philosophy to give conceptual clarity to the impressive amount of data that is currently collected.

Bennet and Hacker (2008) propose an interesting reflection on the necessity of a philosophical guide for neuroscience. Expressions like “the brain thinks”, that show a clear reductionist approach, are the result of a conceptually wrong assumption according to which the part could replace the whole for the attribution of psychological states (“mereological fallacy”). A variation of the classical Cartesian dualism is at stake here, where the duo mind-body is replaced by the pair brain-body, giving way to a materialist perspective that is not justified by empirical evidence but by a theoretical distortion.

I dedicate the last two paragraphs of chapter 1 to the setting of the problem of language acquisition as an epistemological issue (1.5) and to the relativist perspective (1.6).

The problem of the nature of representation is crucial when talking about language and mind, since the term has been used for the both with the opposite tendencies of considering language based on thought versus thought based on language (Recanati,

¹³ For a discussion see Bonnie D. Schwartz, “The epistemological status of second language acquisition,” *Second Language Research* 2, No. 2 (December 1986), pp. 120-159.
<http://www.jstor.org/stable/43103275>.

¹⁴ An example of split brain behavior filmed by Micheal Gazzaniga: “Split brain behavioral experiments,” youtube video, channel *Neuroslicer*, accessed June 2022.
<https://www.youtube.com/watch?v=ZMLzP1VCANo>

¹⁵ An example has been reported from O. Sacks, *A Leg to Stand On*, 1984, later conveyed in *The Man who Mistook His Wife for a Hat*, 1985.

2008). Yet, the nature of the “representations” has not been unequivocally clarified so far, neither in neurobiological nor in philosophical terms. What makes things even more difficult is that the definition of “knowledge of a language”, largely debated by scholars like Dummett, Hornsby and Chomsky, is a controversial issue that, seen in the light of knowledge of a second language, becomes even more controversial.

I considered it useful, before exploring the neuroscientific findings about language acquisition, to keep in mind the relativist warning that I would synthesize like this: a linguistic experience is essentially an anthropological experience that happens in a shared state of being. Thus, to say that language acquisition is a process that takes place in an isolated mind/brain is just a theoretical simplification. Conversely it could be viewed as a distributed cognitive activity that is shaped by experience, as I try to demonstrate in chapter 3, based on the findings on neuroplasticity.

In chapter 2 (*Neuroscience and language acquisition: What do we know?*), I start introducing the issue of the models used to study the brain and the consequences this choice brings to the collection and interpretation of the results in coherent theories. I critically sketch the main perspectives adopted in the last decades and their reverberations in the scientific frameworks used for defining the field of research.

I examine the standpoint of theories grouped under the label of *classical computational theory of mind* (CCTM), which have in common the idea that human mind is a computing/computational system, therefore the description of cognitive processes can benefit from abstract computational models like the one provided by Alan Turing (1936). Among this group, the most famous is Fodor (1983)’s theory of independent modules (like perception and language) that are domain specific. Amodal approaches like Fodor’s imply that knowledge, albeit initially acquired by the senses, consists in amodal representations stored in the mind/brain which are context independent (Krishna and Schwarz, 2013). This perspective is deeply grounded on a computer processing framework, where every information is just a piece of code stored and processed by the machine-like mind/brain. This idea of a language module is well alive nowadays in many domains and one of its most prominent advocates is Chomsky (1986).

A parallel approach, rival though not always in opposition to the CCTM and representational theories, has been seen in connectionism, which focuses on neural networks made of interconnected nodes to which is usually assigned a value of activation and by which researchers have attempted to map several cognitive actions. In the same framework has been developed the branch of computational neuroscience (Rescorla, 2020).

Most of the views examined have in common the habit to address the brain functions as context independent and to classify them in a hierarchy where perception and the senses occupy a bottom position whereas the transduction of the knowledge acquired through them into inputs or representations gives way to what we usually call *higher* cognitive functions.

In opposition to this stance, the Embodied or Grounded Cognition approach (EC and GC) has started to massively spread in recent years . The perspective adopted is that “cognitive activity is grounded in sensory–motor processes and situated in specific contexts and situations” (Borghini and Pecher, 2011). According to this approach, cognition works on the same grounds as perception and action.

The psychologist Lawrence Barsalou is a promoter of this approach. According to his account (Barsalou 2008, Barsalou et al. 2008, Barsalou 2010), during the cognitive processes, simulations take place (consciously or unconsciously) as an enactment of moto-perceptual and introspective states, implying a reactivation of multimodal representations derived from experience. Simulations of all kinds are supported by a unique multimodal representation system closely integrated with the linguistic system (Barsalou, 1999). *Body states* are thus pivotal for cognition to work, as well as *situated actions*, because *we think for doing*. Finally, cognition is multimodal and it is grounded in contextual experience.

The implication for language from this approach is that, while it is often treated based on archival memory models, we may instead consider every linguistic act as a task

oriented process occurring in an interactive context (i.e. a *situated act*), as Barsalou (2009) proposes.

Applied in cognitive linguistics by Lakoff and Johnson (1980), these ideas gave way to the vision that the human conceptual system and language are fundamentally metaphorical in character, where metaphors (ex. *up* for positive, *down* for negative) are built in experience.

Though some aspect of Grounded Cognition models are still vague, this view has started to be supported by evidence in several domains, including neuroscience, where the activation of specific parts of the brain devoted to motion or color perception has been registered in word meaning retrieval (for example, brain activation in a specific spot in the motor strip during the interpretation of the verb *walking* shown by Pulvermüller et al., 2001).

Despite the lack of formal and computational accounts, the amount of evidence is sufficient to resist to the temptation to think that concepts are stored in the brain in neurally discrete cells, like in a “mentalised” dictionary.

The neuroscientist David Kemmerer (2015) clearly shows that this latter view is not at all applicable, for the evidence is consistent enough to suppose that at least object concepts and action verbs depend (partly or entirely) on the same neural systems that underpin action and high-level perception. To comprehend a word, in this view, is to activate related modality specific records in long term memory in an automatic and mostly unconscious manner, as exemplified in figure 1. Therefore, meaning retrieval engages a network of multimodal cortical areas.

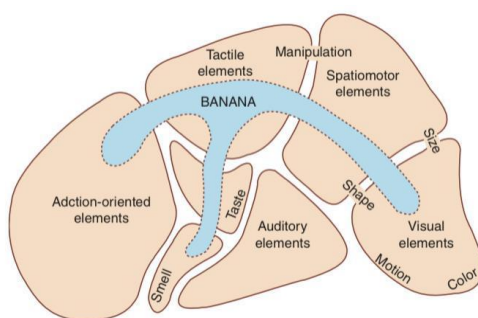


Figure 1.

Example of how the word “banana” is supposed to be processed by modality specific states related to color, shape, smell, taste and even manipulation and possible actions. From Kemmerer (2015).

According to this framework the “meaning” of a word, for example “banana”, does not reside in a specific spot of the brain but across multiple cortical areas.

The way these simultaneous cortical activations take place is not totally clear, Damasio (1989) hypothesized ensembles of neurons that activate in specific patterns and that he calls “convergence zones”.

This latter view poses justified doubts on some attitudes mostly spread in early neuroscience labeled as localization (i.e. there are discrete, computational cognitive functions; each of these functions takes place in a specific part of the brain) in favor of a holistic view in which “complex behavior is mapped at the level of multifocal neural systems rather than specific anatomical sites, giving rise to brain-behavior relationships that are both localized and distributed¹⁶.”

In 2.2 I sketch in the simplest way possible the current knowledge of neurolinguistics about the way language is perceived and produced. The most part of the evidence collected on the matter is based on a localization optic, though a more complex scenario unfolds recently.

The first brain spots related to language that have been discovered are Broca’s area, Wernicke’s area and Geschwind’s territory. Later on, a much more extended map has been developed with the involvement of a large part of the cerebral cortex and the underneath white matter, usually, but not necessarily, with a left-hemisphere predominance.

Given that the Geschwind-Wernicke’s model (i.e. Wernicke’s area has the role of decodifying sounds whereas Broca’s area is in charge of speech production), has been completely abandoned, there are several models of speech production and comprehension, with the evident limitation to never consider language competence as a whole but to sectionate it in subcompetences. As Hickok and Poeppel (2004) note, this is a coarse conceptualization that has been maintained to simplify a complex task.

¹⁶ M. Marsel Mesulam, “Fifty years of disconnection syndromes and the Geschwind legacy.” *Brain* 138, no. 9 (September 2015): 2791–2799, p. 2791.

I follow the scheme and the theories proposed by Kemmerer in his comprehensive volume *Cognitive Neuroscience of Language* (2015) to briefly illustrate what neuroscience is supposed to know about language.

The very beginning of speech perception is the analysis of sounds in terms of frequency and rate. This computation takes place in the primary auditory cortex -Heschl's gyrus and other portions of superior temporal areas- bilaterally. The detection of phonemes is an interactive process that gives way to different patterns of firing rates.

The most prominent theory on what happens after this first stem is the *dual-stream model* by Hickok and Poeppel (2007), which is modeled on the visual system brain architecture, and suppose that the stream of information moves through two distinct pathways to two divergent brain areas (usually located in the left hemisphere) for different purposes and uses. A first stream channel links the phonological representations to the semantic system and a second stream heads to the motor articulatory system.

I suggest to the reader see the extended version of my dissertation for all the details. What has to be noted in this summary is that the weaker and less supported part of the model is the ventral stream responsible for semantics in the proper sense. As a point of fact, the exact brain site (distributed or localized?) of the semantic structure of words is far from having been clarified yet. It is interesting to add that speech perception is visually supported, as demonstrated by Macdonald and McGurk (1978) with what came to be known as the McGurk effect¹⁷.

The most prominent neuroscientific framework of speech production is Levelt and colleagues's Lemma Model¹⁸. The model has been inspired by speech errors and later on

¹⁷ If a subject is exposed at the same time to a visual articulatory signal and a sound, the result is the perception of an integration of the two stimuli. For example, for the sound "ta" accompanied by a visual "ba", many individuals tested perceived "pa".

¹⁸ Willem J.M. Levelt, *Speaking: From intention to articulation*, the MIT Press, 1989.
Willem J.M. Levelt et al., "A theory of lexical access in speech production,"
Behavioral and Brain Sciences 22 (1999): 1–75.
<http://www.linguisticsnetwork.com/wp-content/uploads/A-theory-of-lexical-access-in-speech-production.pdf>

supported by studies on reaction times during speech production. It consists of two subsystems, one that could be considered the semantic stage, for it is essentially the process of lexical selection, and a second one that is aimed at the physical articulation of speech and so entails a series of morphological and phonological encoding stages. In this account the “lemma” is not still a word but a mental item deprived of any morphological feature (conjugation, genre, declination, number etc.) or phonological representation. After a process of lemma competition, the last stages make the lemma a recognizable word. All the process is supervised by a self-monitoring mechanism.

Again, the reader could look for the details in the extended version of this work, for now, what I would like to notice is that in the model the step of phonological retrieval is subserved by Wernicke’s area (left STG and STS), again opening a scenario of shared codes in speech comprehension and production.

The computational architecture that underpins speech production has recently started to be studied also through computer simulations with impressive results. Guenther¹⁹’s Directions Into Velocities of Articulation (Diva) project is the most prominent example. This framework is particularly interesting in this context because it focuses on speech learning and monitoring as well as on the control systems that enable speakers to deal with the complexity of language articulation. The project makes use of a speech synthesizer that simulates a vocal tract and emits acoustic signals. Basically, the system simulates the way speech learning should happen. The framework is based on refinement in repetition where the presence of two control subsystems play a pivotal role. The DIVA model not only has proved to be a cogent framework for speech production but, even most importantly, has started to find practical application for developing brain computer interface devices aimed to relieve the condition of subjects affected by illnesses like the lock-in syndrome.²⁰

¹⁹ Guenther Lab. “The DIVA Model of Speech Motor Control”. Guenther Lab official website. Accessed March 2020. <http://sites.bu.edu/guentherlab/research-projects/the-diva-model-of-speech-motor-control/>

²⁰ “Some electrodes have been implanted in the primary motor cortex of a patient affected by lock-in syndrome, with the result of permitting him to produce some sounds for communicating. More details in K. Smith, “Brain implant allows mute man to speak,” *Nature* (2008) <https://doi.org/10.1038/news.2008.1247> and in this interview of Frank Guenther:

A last subparagraph has been dedicated to the specificity of the skills of reading and writing, whose neural mechanisms only partly overlap those for speech production/reception. For the sake of brevity I will skip this section, spending just a few words on sign language.

Concerning sign language, as in spoken language, there's a left hemisphere dominance and, contrary to what one could expect, it is not subserved by the same neural resources as non linguistic visuospatial cognitive abilities or pantomime. Interestingly enough, the brain areas activated in spoken and sign language production mostly overlap, with a major activation of the supramarginal gyrus for sign language.

I dedicated 2.3 to the following issue: is the brain/mind by its nature multilingual?

First of all, we need to get rid of a common shared misconception: monolingualism is not the norm. It has been estimated that at least half of the world population is bilingual (Palmer et al., 2010). Nowadays over 7,000 language²¹ are classified as living idioms around the world and many of them are shared by the same communities, especially in the case of dialects.²² Given this multilingual reality, to shift the problem from "how language is subserved" to "how languages are subserved" is a quite reasonable proposal.

Bilingual and multilingual people are a useful source of information on language processes. According to Grosjean (2008) needs and purposes play a key role in language acquisition and maintenance. The same could be said of the sense of belonging to a particular sociocultural community, for a bilingual could be either bicultural or not. The mastery of a language is situation-dependent and highly subjected to external/contextual or interlingual influence.

<http://www.scienceforthepublic.org/life/how-the-brain-produces-language---and-what-can-go-wrong>
(minute 37:47 to 49:09)

²¹ Source: <https://www.ethnologue.com/>

²² As an example, in the sole Italy there are at least 15 Italo-Romance variations plus 12 non romance dialects coexisting with the official language, Italian. See Gaetano Berruto, "The languages and dialects of Italy", in *Manual of Romance Sociolinguistics*, edited by Wendy Ayres-Bennett and Janice Carruthers (Berlin, Boston: De Gruyter, 2018), pp. 494-525.

Neuroscience shows us that there is a strong interactivity between higher cognitive functions -language, memory, attention, emotion (Costa, 2020).

About bilinguals it shows us that there is significant overlap between the areas of the brain that sustain the processing of both languages, with relevant differences in relation to proficiency (Costa, 2020). The higher the proficiency, the larger the brain areas involved, the more consistent the overlapping.

Now, Edna Andrews (2014) is probably right when suggesting to focus on proficiency rather than age of acquisition as a reference for setting the experimentations. Proficiency, I would add, is strictly related to *language experience*. Andrews remarks that most neuroscience have failed the main framework of inquiry in two major ways: First, focusing massively on neuropathological subjects; secondly, considering languages as a monolithic individual phenomenon instead of recognizing that they are dynamic and embedded in a socio-cultural environment.

“[S]peakers, whether they consider themselves to be monolingual or multilingual, are always translating between different registers, dialects, speech communities, and communities of practice within or across recognized languages of the world.²³”

The conclusions that I drive in this paragraph are that, first, there is no reason to consider first and second language acquisition as different phenomena, secondly meaning is not embedded in single words but it is a dynamic and contextual process that takes place not in one brain but in a collective of communities of practice.

In 2.4 I examine two models of lexical retrieval in bilinguals: Kroll and Stewart (1994)'s, that supposes separated lexicon for the first (L1) and the second (L2) language, with a strong dependence of L2 from L1; and Dijkstra and van Heuven (2002)'s, which describe an integrated lexicon taking into account the context (linguistic or extralinguistic) and the task of the speaker. The discussion makes me conclude that an integrated lexicon has a stronger neuroscientific support and that proficiency, again, plays a pivotal role on how efficiently a language is accessed.

²³ E. Andrews, *Neuroscience and Multilingualism* (U.K.: Cambridge University Press, 2014), p.80.

In 2.5 I focus on neuroplasticity, namely, the ability of the brain of readaptation, reallocation and resettlement of areas and circuitries according to the subject's needs, a phenomenon that happens especially in the cortex. It has been hypothesized that neuroplasticity plays a key role in individual variation and presumably affects learning. As Voss et al. (2017) remark, neuroplasticity can be viewed in the wider sense of "brain's ability to modify, change, and adapt both structure and function throughout life and in response to experience²⁴."

In principle, neuroplasticity contradicts the mostly spread Critical Period Hypothesis, according to which certain cognitive functions and language have to be acquired in limited time-windows to be fully developed.

According to Singleton and Leśniewska (2021) many factors could be mistaken for age related for language acquisition, like psychological, social, and educational ones. As a point of fact, the changes that occur in brain organization throughout the lifespan could either be attributed to development or environmental experience or even a combination of the two.

According to DeLuca (2019a), factors like intensity of exposure and use might potentially modulate the mechanism by which neural adaptations towards efficiency or automation of language control take place. This goes beyond the difference between early and late bilinguals, since there is evidence of white matter increase in late bilinguals that are similar to those in child bilinguals (Singleton and Leśniewska, 2021).

The "active" way in which language operates and is acquired is not only in relation to the context in which the subject is immersed, language seems to have the same neural underpinnings of situated action.

In an experiment with word recognition, Pulvermüller et al. 2005 provides evidence for what he calls *Semantic Somatotopy Hypothesis*, showing that the cortical systems for language and action are linked to each other in a category-specific manner.

²⁴ Voss et al. "Dynamic Brains and the Changing Rules of Neuroplasticity: Implications for Learning and Recovery." *Frontiers in Psychology* 8 (2017) <https://doi.org/10.3389/fpsyg.2017.01657>, Introduction.

Several fMRI studies have confirmed that action verbs and sentences engage the same brain areas that process movement execution with specific parts of the body (Kemmerer, 2015).

Glenberg and Kaschak (2002) report a phenomenon that they named *action-sentence compatibility effect* (ACE). In their experiment, they demonstrated that the actions implied by a sentence can interfere with real action. When the subjects were asked to make a movement that had a direction opposed to that one implied in the sentence meaning, they experienced difficulty. For example the sentence “open the drawer”, that implies a movement towards the body interferes with an action response that requires to move the hand away from the body to press a button, thus the time of response (supposed to be the comprehension time) is longer in comparison to the opposite sentence “close the drawer”. Glenberg and Kaschak drive the conclusion that the amodal conceptions of meaning are not reliable and that language comprehension is mostly grounded in bodily action. They stress that understanding a sentence most probably calls upon the same cognitive mechanisms as those used in planning and taking action.

These results strongly support a Grounded Cognition model for language. Hypothesizing that a first language is partly or totally grounded in sensory experience, should a second language be considered differently? Is it reasonable to think of a different nature for L1, L2, L3 ecc.? Intuitively and following the considerations previously made, I would say that it is not.

I suggest the hypothesis that the difference between the L1 and the L2s is essentially in the amount of experience related to them (with obvious consequences in performance). Though not yet verified, this idea is nonetheless compelling for further inquiry.

In 2.6 I deal with the distinction between learning and acquisition, attributed to Stephen Krashen. In his theories (1982) he implies that, if children have a sole way of developing language competence, adults have two distinct and independent ways of doing it: learning, namely the conscious mastery of grammar rules and their equally

conscious application, and acquisition, that is to say the same way of children. No matter if it is a first or a second language, acquisition is a subconscious process that develops slowly. “Language acquirers are not usually aware of the fact that they are acquiring language, but are only aware of the fact that they are using the language for communication²⁵.”

How does acquisition take place, exactly? Krashen developed what is better known as “natural approach”: a language is acquired by communicating in significant contexts and useful practices. Krashen’s view is quite dynamic, it describes the process as a tension between the *status quo* and the possible evolution that could be reached by just using the language and encountering what he defines as “input”.

Krashen seems to view this process as an internal one, I would put the emphasis on the experience that makes this dynamics possible. Intersubjective contextualized experience makes acquisition possible.

I will spend a few more words on neuronal adaptation. Deluca et al. (2019) provides evidence of the phenomenon of neuronal adaptation to bilingual use, mostly in the brain regions and pathways implicated in language processing and control. Studies that show differences in cortical and subcortical gray matter volume, subcortical shape differences, differences in diffusivity patterns, support the idea that, to put it simply, bilingualism does shape the brain. Most intriguing, “bilingualism itself reflects a multidimensional state of experiences, which might result in different adaptations to individuals with different language backgrounds²⁶.”

The crucial point is that, as Deluca et al. put it: “Experience-based factors should be accounted for in all future studies investigating the effects of bilingualism on the brain and cognition²⁷.”

²⁵ Stephen Krashen, *Principles and Practice in Second Language Acquisition*. Pergamon Press Inc., 1982 (Internet Edition July 2009). http://www.sdkrashen.com/content/books/principles_and_practice.pdf, p. 10.

²⁶ Deluca et al. “Redefining bilingualism as a spectrum of experiences that differentially affects brain structure and function, *Proceedings of the National Academy of Sciences* 116, no.15 (Apr 2019): 7565-7574. <https://www.pnas.org/content/116/15/7565>.

²⁷ *Ibid.*

It is easily noticeable that the traditional framework used in neuroscience (and not only in neuroscience!) to shape the relationship between language and the brain is here totally subverted: Not *how the brain shapes language* but *how languages shape the brain*. An opposition that has permeated the history of Philosophy for a long time, empiricism versus rationalism, echoes in this controversial statement, reminding us that the inquiry of neuroscience is a philosophical matter.

I conclude the paragraph with some considerations on the effects of language on ageing and the many cognitive advantages of bilingualism that I will not report here for necessity of brevity.

I close chapter 2 with some considerations on the *Innateness Hypothesis* (I.H.) attributed to Hilary Putnam (1967) and the *Critical Period Hypothesis*. I refute the both in the light of some considerations made in the previous paragraphs.

Finally, the two approaches have in common a not well specified sense of determination, of obliged process and of undiversified destiny. The terms by which both topics are usually accompanied are “universal” (as the innate universal grammar theorized by Chomsky), precision (as the set of an exact age as deadline for acquisition) and unavoidability. Both of them have never been strongly demonstrated by empirical evidence, but only supported by reasoning and maybe somehow accepted to solve problems that are probably unsolvable differently with the same clarity. But *sake of clarity* not always means *sake of Truth*.

In chapter 3 I adopt the *Embodied Cognition* approach to face some issues related to language acquisition. I additionally address the problem of consciousness in relation to language.

I start with a few words on reductionism, the stance that is often addressed as the only possible in neuroscience (and neurophilosophy).

I agree with the neuroscientist Steven Rose (1992), who maintains that reductionism is just a method, it is not how things are. The laboratory setting is not a reproduction of reality but a way to approach a phenomenon indirectly, when direct access is denied.

According to me this has to be kept well in mind when addressing the subject matter of consciousness, that is strictly involved in the discussion about *languages acquisition*. Is this process a conscious or unconscious process or even a mixed one? To face the problem inevitably brings the necessity of defining what consciousness is. A task particularly hard both for neuroscientists and philosophers.

Damasio (1999) defines Consciousness as a contradictory tension where *firstperson* is closely tied to *thirdperson*.

Based on neuropsychological evidence, Damasio claims that consciousness and wakefulness can be separated, whilst consciousness and emotions are not. When consciousness is impaired so is emotion. Attention is necessary but not sufficient to what he defines as *Extended Consciousness* (autobiographical self as identity, i.e. with a past and a future). There are certain pathologies in which patients could stay attentive without being conscious of themselves.

Damasio claims that neuropsychological evidence shows that cognitive functions like language are built on extended consciousness.

Given this idea of consciousness mostly based on neuroscientific data, I try to extend it in a wider perspective.

According to Donald (2001), in Western societies, the role of the individual is overemphasized. Individual consciousness is considered, in a solipsistic view, a single item detached from the world. Social environments are thus just an aspect of reality, separated from the *true* self. Donald rejects this view and claims that there is a sociocultural basis for consciousness. In this framework, culture and consciousness coexist and coevolve. Social habits, as a point of fact, have most probably affected our biology till the point that we are not able to exist outside society. Donald labels this idea

with the term *bio-culture*. Humans have evolved collectively, and not as a sum of single individuals. This perspective on consciousness entails that humans are more than single brains, and I suggest that neuroplasticity is the means in which this experience based collective consciousness leaves an imprint in the brain itself.

In my view, consciousness is not a personal status but a relation, the most important relation between the human being and the world. In this light, since I would consider language as the manifestation of collective consciousness and maybe even collective consciousness itself, it is reasonable to consider second language learning as a progressive attempt to take part in a collective consciousness.

It is probably true that humans do not know but *cognize* (Chomsky 1965) language, but in my opinion it does not happen in a mentalistic sense, for, as seen previously, cognition is, largely or partly, grounded in action and sensation.

At the same rate language is not influenced by culture, it is grounded in culture, namely in a collective consciousness.

Second language acquisition is usually considered as characterized by awareness.²⁸ This point needs to be clarified. When referring to language, consciousness is interpreted as metalinguistic awareness, whereas I would better refer to the same awareness of riding a bicycle while we do ride a bicycle. We do not think of how to ride a bike but we are aware about it, partly because we feel it. It is a knowledge coded in sensory experience. In the same way I claim that when we hear a new linguistic structure we are aware of its being new, as well as we are aware of hearing a known sentence in a given language. Some language processes are automatised but that does not mean that we are totally unaware about them.

In the research on second language acquisition there has been an overestimation of the level of attention required for acquisition due to the non natural learning context in

²⁸ See, for instance, Russell Tomlin and Victor Villa, "Attention in Cognitive Science and Second Language Acquisition," *Studies in Second Language Acquisition* 16, no.2 (1994):183-203.
https://www.jstor.org/stable/44487723?read-now=1&refreqid=excelsior%3Aa7f755733b62ae0125291463b2022ed7&seq=1#page_scan_tab_contents

which acquisition usually takes place. Krashen (1982) would call it the *Monitor*. However, in his view the Monitor is not true acquisition but a compensatory strategy. Nevertheless, metalingual functions have a pivotal role in acquisition (Jakobson 1960, Andrews 2014), and so has the Monitor, but it is so both in first and second language acquisition.

As regarding the mostly debated topic of implicit and explicit memory in relation to language, I would propose to shift the topic to a model of collective memory proposed by Rose (1992) and supported by Andrews (2014). Collectivity is deeply implied in phenomena like language, as it is mostly with language that the shared story of communities are told. In a certain way, we could even suppose that language itself is the reification of the collective memory proposed by Rose.

I conclude 3.2, for the sake of completeness, with an examination of a major topic in second language acquisition, namely language control. Since I estimate that it has a minor impact on the main discussion, I leave it to the reader to eventually explore this issue in the extended version of this dissertation.

In 2.3 I address the massively debated topic of mind-body problem in the light of the *Grounded Cognition* approach.

Given the neuroscientific consistent evidence on (at least partly) shared neural underpinnings for sensory and motor states and higher cognitive functions like language comprehension, I wonder whether the Chomskian claim that “properties of the cognitive system are language-specific (i.e. there’s a language faculty)²⁹” is still convincing.

If “individual excitatory and inhibitory connections [...] are highly plastic, and this adjustability is one of the most powerful cellular mechanisms by which brains are able to continuously modify and update themselves on the basis of experience³⁰,” as Kemmerer (2015) claims, and this process operates both at the microlevel of single neuronal connection and macro-level of brain areas (i.e. neuroplasticity, neural

²⁹ N. Chomsky *Knowledge of Language* (New York: Praeger, 1986), p. 4.

³⁰ D. Kemmerer, *Cognitive Neuroscience of Language*, p.8.

adaptation), shouldn't we wonder if the search for Universals have individual experience related boundaries? If experience has been proven to shape the brain, in opposition to what is commonly believed, namely that mind modulates reality, what are the role and the consequences for linguistic processes (acquisition, maintenance, loss)?

Lieberman (2007) maintains that the evolutionary root for language and in general human creative behavior (music, dancing) is identified in the neuronal mechanisms of motor control.

Given these inputs, we could suppose, contrary to the most common mentalistic views which tend to consider language acquisition as an abstract intellectual act, that this latter one could take place as a motor training process. If we consider how children learn to speak by babbling to test and refine over time their articulatory skills, why should we consider this process only due to motor prematurity external to any linguistic fact, and not as a stage required by any type of language learning at any age? Also late language learning implies such a kind of sensory-motor process of articulation and self-listening for monitoring, regardless of age factors.

Moreover, to learn a language is more than memorizing a code and its compositional rules. It means to take part in a ritual of communication, to interact with the world in a given way. Prosody plays a key role in communication, and Mimesis is essential in language acquisition.

To talk about *linguistic* and *extralinguistic* is basically an abstraction, since every speech act just happens in a context, and is made of the ensemble of the interlocutors, their gestures, their kinesthesia.

As for the relation between language and neuroscience, the legacy of the Cartesian model that has been transplanted from the mind to the brain, as claimed by Bennet and Hacker (2008), has produced misleading conceptions. Language is a physical act and has a contextual dimension, it happens in the world and not in the brain, it is a "doing" process that has a contextual application. Even the idea of the silent linguistic thought occurring in the brain could actually be interpreted as a simulation of action: We are

simulating our next conversation, we repeat something because it helps to recall what to do, we are preparing for an exam, we are talking to ourselves in order to understand things, since understanding is a negotiation that needs at least two participants, that's why we "double ourselves" in thought, enacting reality through simulation.

In 3.4 I examine some teaching methodologies, considering the fact that *neuroscientific trends* have massively influenced this field. I examine, in particular, *Suggestopedia* by Lozanov, *Natural Approach* by Terrell and Krashen and *Total Physical Response* by Asher. The conclusions that I derive are the following: First, to be successful, second language learning experiences should be as similar as possible to first language acquisition experiences and focused on social interaction, therefore the teaching settings should try to recreate real communicative situations; secondly, psychological barriers (i.e. ego boundaries) are the major obstacle to acquisition; thirdly, physical action enhances acquisition.

I dedicate paragraph 3.5 to the concept of *ego permeability* introduced by Guiora et al. (1972) which could be synthesized as follows: New language, new identity, less boundaries, more success. According to Guiora a key role in language acquisition is played by empathy, which he considers as a cognitive device that leads to knowledge (of the Other, of a language).

This view implies a subversion of the conception of learning a language that is spread in folk psychology: Learning is not (or not only) a "taking in", an internalization of concepts and practices, but a "giving up" of parts of the self in favor of the "external" world and, in particular for language, in a more traditional philosophical framework, in favor of the *Other*.

In 3.6 I make a few considerations on the role of simulations in mindreading, their supposed neural underpinning (mirror neurons), the relevance it has for language communication to take place in the form of linguistic acts, and the idea of language acquisition as an imitation process. I also consider the evolutionary hypothesis proposed by Rizzolatti and Arbib (1998), according to which linguistic ability has originated by means of action-recognition systems and then, over time, evolution has implemented

their functioning till the birth of speech. This theory presupposes a non specificity and action based nature of linguistic exchange, which supports my view on second language acquisition as a situated action based process.

I close the last chapter with some reflections on the several implications of emotions on language, both in terms of acquisition (*affective filter* etc) and in language use and judgment. This topic is particularly interesting if viewed in a neuroscientific perspective, for recognition of abstract words seems to partly imply the neural underpinnings of emotional reactions (Kemmerer, 2015). This latter point could be a fruitful starting point for future investigation.

Contributions of the dissertation

With this project I try to shed new light on some massively debated topics on second language acquisition, using a new perspective that is not only multidisciplinary but that considers neuroscientific data to support my theoretical considerations. My starting point is epistemological: what kind of knowledge is knowledge of a second language³¹?

On the issue of hypothesized different processes for first and second language acquisition I demonstrate that there is no reason to consider this difference as true, given the evidence provided by neuroscience on almost overlapping neural underpinnings for each language acquired. I bring the discussion further, proposing that instead of talking of language acquisition faculty, it would be more correct to talk of *languages acquisition*, given that humans are potentially multilingual and that monolingualism is more an exception than the normal condition.

I additionally take further the proposal advanced by Andrews (2014) to consider the level of proficiency as a target point for designing experiments on bilingualism. The role of proficiency, that I interpret as quantity and quality of language experience,

³¹ A preparatory work for this project that deals with epistemology of language: Venera Russo, “To Know or Just to Speak?. Epistemological Questions for Second Language Acquisition (SLA),” *In Statu Nascendi* 5, n.2 (2022) [in press]

brings me to think that Grounded Cognition Approach to second language acquisition is the most suitable for framing the problem of language acquisition.

I try to demonstrate that language faculty is multimodal and based on situated actions and sensory experience and that meaning is not a separated abstract storage of information. To understand a word is to see, to taste, to act. This could be partly true also for abstract words that are usually associated with emotions (Kemmerer, 2015), though, this class of words could be interesting for future investigation using theoretical models based on metaphor, as already attempted by Lakoff and Johnson (1980).

I also try to show that action is fundamental in language acquisition, advancing the hypothesis that simulations, as it happens in mindreading, play a key role in language acquisition, for language is an intersubjective entity. *We speak for doing and we speak by doing.*

This project tries to demonstrate that the vision of languages based on archival memory models are misleading, for every linguistic act is a task oriented process occurring in an interactive, intersubjective context

In addition, language acquisition processes have often been inquired in the light of consciousness/unconsciousness. In this dissertation, following a hint by Donald (2001), I propose to consider consciousness as collective rather than a single mind/brain phenomenon. In this perspective, acquiring a language is more than a grammar or I-grammar process, it is entering a collective consciousness and a collective memory, as somehow postulated by the relativists³² though in other terms.

Moreover, as the studies on bilingualism demonstrate, language experience shapes the brain. Thus, there is a mutual adaptation between the individual and the intersubjective reality that only in an oversimplified view could lead one to consider the individual outside his/her context.

³² I have treated the implications of relativity previously. See Venera Russo, "Cross-language Relation. The Implications of Relativity in Translation and vice versa," *In Statu Nascendi* 3, no. 1 (2020): 115-126.

On the grounds of Embodied Cognition evidence, I think that Chomsky's claim of a language function as an impenetrable mental module is not convincing anymore.

I suggest that language learning is a motor training process that engages simulations of articulatory and speech acts (like in the babbling of toddlers) that get more complex with age. The key role played by mimesis in language acquisition confirms this hypothesis.

I suggest considering language acquisition, at least largely if not totally, as a sensory-motor form of apprenticeship. Language is not the voice of thought but it is situated action and to learn a language is a situated sensory-motor experience.

Empathy, moreover, has proved to have a key role in language acquisition, redefining the mentalistic view in which acquisition is a solitary process, independently from the Other and the intersubjective context. I suggest that language makes the synergy of many brains possible.

Any linguistic act is never a solitary fact. Cognitive science has encountered difficulties in describing language acquisition not only because of a wrong epistemological model, but above all because of an ontological misconception of the human being as an isolated self endowed with cognitive abilities to shape the world.

I think that these considerations could lead to design more effective frameworks in the research on language faculty and language acquisition.

Previous contributions to the topic:

Russo, Venera. "To Know or Just to Speak?. Epistemological Questions for Second Language Acquisition (SLA)" *In Statu Nascendi* 5, n.2 (2022) [in press].

Russo, Venera. "Cross-language Relation. The Implications of Relativity in Translation and vice versa." *In Statu Nascendi* 3, no. 1 (2020): 115-126.

Other publications:

Russo, Venera. "The Phenomenology of Women. On Female Discourse in Julia Kristeva and Simone De Beauvoir's works". *In Statu Nascendi* 3, no. 1 (2020): 115-125

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