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Effects of treatment provided in both languages to a bilingual Sardinian-Italian speaker with aphasia: A case study

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A te, Alessio, che sei la mia dolce
ed eterna malinconia.
Tra le tante attese e speranze,
quella di rincontrarti sembra
essere la sola a non sbiadire
con il trascorrere del tempo.
Continuerò a cercarti,
in ogni soffio di vento
e non smetterò di seguirti,
oltre mille colline.

“Supplico il passato, il presente,
dormi più profondamente,
non singhiozzare nel sonno,
non mi seguire con la coda dell’occhio,
angelo, cerbiatto, falchetto.
Dalle pietre di Sumer,
dal deserto d’Arabia,
da quale girone della memoria
mi stringi forte con un nodo la gola?
Non so dove ora tu regni sovrano,
e non so come rivolgere la supplica,
per perdere ancora il diritto a possedere
il tuo respiro, e le mani, e l’abito.”

Arsenij Tarkovski

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"Si guarda indietro apprezzando gli insegnanti brillanti, ma la gratitudine va a coloro che hanno toccato la nostra sensibilità umana. Il programma di studi è materia prima così tanto necessaria, ma il calore è l'elemento vitale per la pianta che cresce." *Carl Gustav Jung*

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Introduction

Over the years, much has been discussed about first- and second-language acquisition. The studies focused on brain mechanisms which rule language acquisition and on the differences between the monolingual and bilingual brain, have been several. But, if in the past bilingualism was considered an exception, nowadays the globalization has changed the society and, as a consequence, the way people communicate with each other. Thus, the bilingual population has become bigger than it was in the past and, consequently, more cases of bilingual aphasics have occurred. Then, the necessity to better understand the issue has increased. Although this topic has interested neurosciences for a long time, only recently research has evolved from a descriptive perspective, to a neurofunctional approach. The focus of these recent studies has been to figure out which assessment is the best in order to determine residual language abilities, in either language spoken, and which treatment might obtain the best outcomes in bilingual aphasics. Specifically, which language should be treated and if treatment conducted in both languages may ease the recovery.

The present work aims to discuss the studies on the phenomenon of bilingualism, in both non-brain and brain-damaged population. Furthermore, it investigates language assessment, treatment and degree of recovery in a bilingual Sardinian-Italian speaker with aphasia.

Initially, it will be analysed first- and second-language acquisition, by depicting how infants acquire the capacity to perceive, comprehend and produce L1 and other additional languages in normal conditions. In this regard, a variety of studies in the field of neurosciences will be reviewed, in order to better understand the way first- and second-language acquisition is manifested in the brain and the cognitive benefits related to knowing more than one language.

The discussion will then move to acquired language and communication disorders, in both monolingual and bilingual adult individuals, with the purpose of summarizing the main characteristics in either case. In particular, the focus will be on the studies involving bilingual adults with aphasia, in order to obtain useful insights into their assessment, treatment and recovery.

At last, it will be presented the case of a bilingual Sardinian-Italian speaker, 63-year-old right-handed male, with severe non-fluent aphasia, assessed and treated in both languages spoken prior to the cerebrovascular accidents he had suffer, so as to understand whether all languages

spoken by a person prior to a brain damage have to be assessed and treated and if treatment conducted in both languages may increase the probability of recovery.

Both the assessment and the speech-language therapy in Sardinian and Italian were mediated by a bilingual co-worker, since no bilingual speech-language pathologists were available when the study took place.

While pre-treatment assessment showed an almost equal impairment in both languages known by the patient, the results of post-treatment evaluation revealed an improvement of oral expression in Sardinian. As a matter of fact, the patient improved significantly better in Sardinian than in Italian, showing a partial recovery in at least one of the languages known before the brain damage. A similar outcome wasn't reached when treatment was provided exclusively in one language (Italian). In that case, only the auditory comprehension significantly recovered in both Italian and Sardinian and to the same extent, while the spontaneous speech output didn't show any significant improvement in either language known.

I. Human Language

"When I use a word," Humpty Dumpty said in rather a scornful tone, "it means just what I choose it to mean - neither more nor less."

'The question is,' said Alice, 'whether you can make words mean so many different things.'

'The question is', said Humpty Dumpty, 'which is to be master - that's all."

Lewis Carroll, *Through the Looking Glass.*

1.1 Characteristics of Language

Human Language is a system of communication, which is peculiarly used by humans in order to convey specific contents and meanings. As Noam Chomsky (1960) says

> "It's perfectly obvious that there is some genetic factor that distinguishes humans from other animals and that it is language-specific. The theory of that genetic component, whatever it turns out to be, is what is called universal grammar."

When we use the word 'communication', we can mean both an intentional act, like the human verbal language; or a simple, non-deliberate passage of information between two speakers, that is what happens, for instance, during non-verbal communication.

The fundamental unity of human verbal communication is called 'sign', defined as "something which refers to something other than itself. Namely, something which stands for something else" (Danesi, Perron, 1999). We can talk about 'signs', every time the human mind recognizes meanings in an object, in an image, in a sequence of sounds and so on, and this meaning goes beyond the perception of their physical characteristics.

Speaking about these signs, we can identify different types:

-*Indexes*: non-intentional signs, based on a cause and effect relationship (e.g. dark clouds are an index of imminent rain);

-*Signals*: intentional signs (e.g. birds which sing in order to signal their presence);

-*Icon*: intentional signs, based on structure similarity, namely they resemble what they stand for (e.g. geographical map, or photographs);

-*Symbols*: intentional signs, culturally determined (e.g. standing/bowing to show respect in Europe and in Japan, respectively);

-*Signs in the strict sense*: arbitrary, conventional and intentional (e.g. busy signal sounds while calling someone on the phone; gestures and signs used for communication).

In order to distinguish the human language from any other form of language, in particular from the one used by animals, we can identify some characteristics which are specific to human communication. Some of these properties might be found in certain forms of communication other than human language. Nevertheless, they are considered typically belonging to human language, since they appear in their entirety only in the latter.

According to the linguist Charles Hockett (1960), whose contribution was one of the most influential in the field of language nature, there are unique traits which differentiate human language from all the other forms of interaction. These traits are known as 'design features.' In many later works, the number of Hockett's language properties has been revised and the ones, which can be nowadays considered the most significant, are the following: *spontaneous use*, *turn taking*, *redundancy*, *displacement*, *dual structure*, *discreteness*, *semanticity*, *arbitrariness*, *structure dependence*, *prevarication*, *reflexivity*, *productivity*.

For one thing, the expression 'spontaneous use' refers to the spontaneity of both acquiring and using the language. This means that infants develop naturally their language abilities and that both children and adults use language automatically.

According to Locke (1993), the feature of 'turn taking' is the skill on which all the other language skills depend and the first which appears in infants. An example of this are the interactions between mothers and their babies. Indeed, even when the baby hasn't begun yet to communicate verbally, the mother considers, as turns in conversation, all those behaviours (e.g. sneers, crying, gurgling), that children use to interact with who surrounds them. The same attitude to respect turns in conversation can be observed during the interactions between adults, when a speaker usually takes the floor only after the other interlocutor has finished talking.

As Shannon and Weaver (1949) state, 'redundancy' is "the fraction of the message which is unnecessary (and hence repetitive or redundant), in the sense that, if it was missing, the message would still be essentially complete, or at least could be completed". This definition perfectly describes what redundancy means, namely that speakers intentionally use elements which can be often considered superfluous to convey the content of their verbal messages.

Another important property of human language is called ‘displacement’, whose meaning refers to the possibility that speakers have to talk about things and events which are far away from the context where the communication takes place.

The term ‘dual structure’ refers, instead, to the presence of two different levels in human language. On the first level, the signifying of a linguistic sign is organized in modular units which are meaningful and, consequently, used to build other signs. These units are called ‘morphemes.’ For instance, the word ‘cats’ is the combination of the morphemes *cat-* and *s-*, each of which has its own, peculiar meaning: *cat-* is a ‘furry animal often kept as a pet’, while *s-* stands for ‘more than one/plural’. On the second level, the morphemes can be broken up into smaller units, each of which is meaningless itself. These units are called ‘phonemes’ (e.g. the word ‘cats’ is a succession of the four phonemes /k/ /æ/ /t/ /s/).

By the term ‘discreteness’ we mean that language uses discrete linguistic units, where the term ‘discrete’ implies that these linguistic units strongly differ from one to another without intermediate cases. This is particularly relevant with sounds, which are perceived distinctively by a speaker of a certain language, and with words as well, since they are composed of phonemes. This means that we can only have the presence, or the absence of a certain linguistic unit, with no ‘more or less’ cases.

A further design feature of language is ‘semanticity’. With this term we mean that words and sentences have meanings, through which language can express ideas, events, feelings and so on. The next property is somehow related to the former. Indeed, ‘arbitrariness’ refers to the fact that the meaning given to a linguistic unit is conventional, namely it is arbitrary, since the bond between the ‘signifiant’ and the ‘signifié’ exists only by convention and not for a logic. For instance, the word ‘cat’ means a ‘small, furry, carnivorous animal, often kept as a pet’, but this definition is given only by convention, since there isn’t any real relation between the sounds of the word ‘cat’ and the animal cat.

The next language feature is what is known as ‘structure dependence’, which means that the understanding of language depends on the capability of perceiving the meaning of the structural relationships between the sentence elements and not on the sequence of words which form sentences.

With the term ‘prevarication’ we mean that human language can be used to prevaricate, that is it can convey information that is not always true. This intentional use of language to transmit

false contents can be also observed in many animals, which use certain behaviors to explicitly deceive their competitors.

‘Reflexivity’, also known as ‘metalanguage’, refers to the capacity that speakers have to use language to talk about language itself.

Finally, the property of ‘productivity’ is the one that allows speakers to create an infinite number of verbal messages, including those that have not been heard or said yet. As Berruto (2006) states: “Through language is always possible to create new messages never created before, and to talk about new things and new experiences never made before, or even about nonexistent things”.

1.2 The neural and linguistic basis of language production and comprehension

Although the big amount of studies in the field of language production and comprehension, the description of the precise, underlying, neural mechanisms involved when we produce and understand language, is still a matter of debate.

Over the years, several models have been proposed in order to explain which components are involved and how they work at a neural level. According to the main researches in this field, it is now widely accepted that the areas most relevantly involved in language abilities are Wernicke’s area, located in the superior temporal gyrus (STG); Broca’s area, placed in the inferior frontal gyrus (IFG); and both the inferior parietal and angular gyrus in the parietal lobe. In addition to these main areas, other subregions either are involved in language production and comprehension. As a matter of fact, Wernicke’s area consists of BA 42 and BA 22, that covers most of the STG, namely the posterior two-thirds of its lateral convexity. This is the area primarily involved in language comprehension. With regard to Broca’s area, it consists of two different subregions: the pars opercularis (BA 44) and the pars triangularis (BA 45). In turn, area 45 itself can be divided into area 45a, adjacent to BA 47, which is the pars orbitalis placed anterior to Broca’s area; and 45b, bordering BA 44, which consists of a dorsal area (44d) and a ventral one (44v).

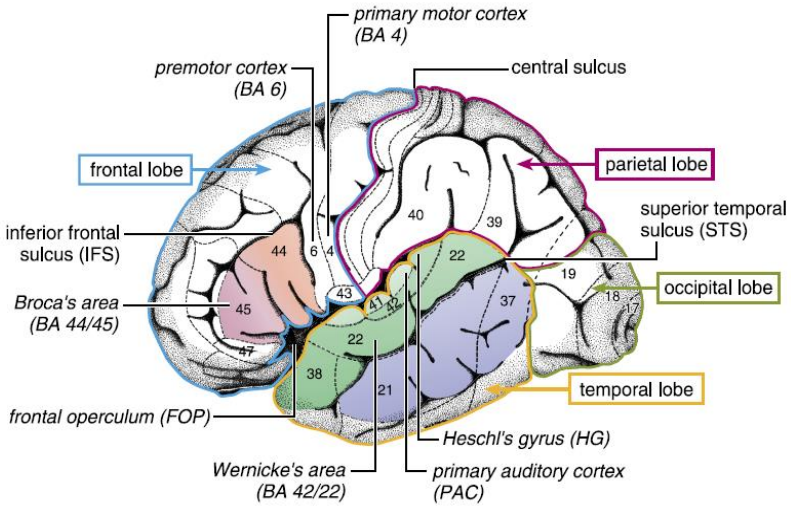

Fig. 1 Anatomical details of the left hemisphere.

Several findings have shown the existence of two dorsal and two ventral pathways that connect the pre-frontal cortex, involved in language production, and the temporal cortex, which is instead responsible for language comprehension. Precisely, one dorsal pathway connects the temporal lobe to the premotor cortex, while the other goes from the temporal lobe to BA 44. Concerning the two ventral pathways, they are responsible, respectively, for the connection of BA 45 and FOP (frontal operculum) to the temporal cortex.

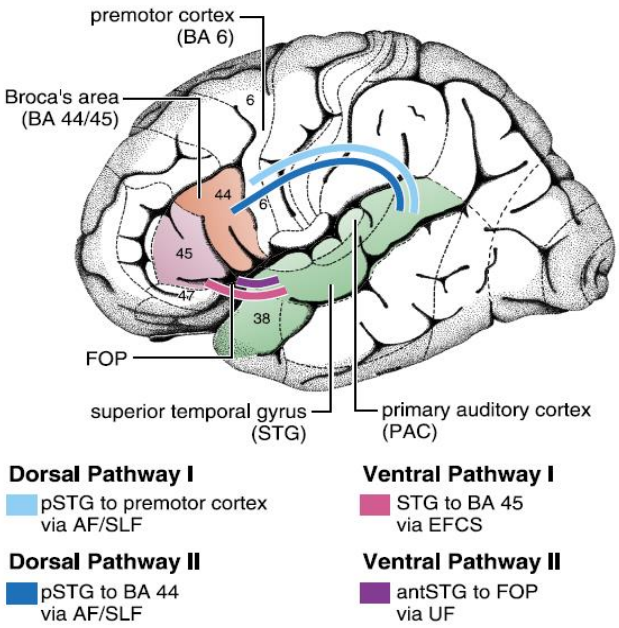

Fig. 2 View of the dorsal and ventral pathways.

The overall picture resulted from studies focused on which areas of the brain and which stages are involved in language processing, has shown that the hemisphere typically involved is the left one. Furthermore, although most of the studies in the field have treated language production and comprehension separately, the two processes have actually some traits in common. An example is given by the tendency to use gestures during verbal production. Indeed, if on one hand these gestures might help speakers to convey their messages, on the other hand they can also facilitate listeners to get a better understanding of what has been talked about.

Both spoken and written production and comprehension involve several distinct levels of planning. The understanding of these language abilities derives from observational approaches, as well as experimental techniques, including those where participants' brain activity is monitored during some language-related task. The great advantage of these methods is that they give a direct and precise measure of the underlying, neural processes of language production and comprehension, much more than the one provided by observational approaches.

As previously mentioned, the tasks of producing and understanding language are somehow related. Nevertheless, they require different processes and planning. Thus, each of them will be here discussed separately.

Expressing a specific content through words requires the generation of a verbal message, that means to convert an idea into an utterance, whose construction goes through a number of different stages. These stages involve, in turn, distinct levels of planning. The first step in the process of producing a linguistic message is, actually, a pre-linguistic stage, since at this point no concrete verbal messages are produced yet. As a matter of fact, during this process of 'conceptualisation' the speaker decides what he wants to express verbally, namely he plans theoretically the concepts of what will be the final verbal message. The process of planning involves the sub-process of 'macroplanning', whose goal is to organize the set of mental ideas in the most appropriate way to convey the speaker's intended message; and the sub-process of 'microplanning' that is, for instance, the decision of what aspects of the message will be emphasized and which, instead, won't be. The second step of language production is what is called 'formulation'. It is, indeed, at this stage that the speaker formulates his message by using his knowledge of grammar and phonology in order to construct the appropriate sentence

structure and sequence of sounds. At first, the semantic traits of words, called ‘lemmas’ are selected from the mental lexicon, which can be considered our own mental dictionary, and they are inserted into the sentence structure.
Let’s take as an example the sentence ‘The boy eats the apple’. The lemmas for the content words are inserted into the sentence frame as it follows:

(DETERMINER) {boy} [singular; definite] {eat} [past]
(DETERMINER) {apple} [singular; definite]

Secondly, the morphological aspects of words are selected from the mental lexicon. It is, indeed, only at this stage that the lemmas are given their forms, namely their sounds, and are finally inserted as actual words, or ‘lexemes’, into the frame created for the message that the speaker wants to express.

(DETERMINER) /bɔɪ/ [singular; definite] /iːt/
(DETERMINER) /ˈæpᵊl/ [singular; definite]

After the lemma and lexemes for the content words (nouns, adjectives, verbs, adverbs) have been inserted into the frame, the function words (determiners, prepositions, conjunctions, etc…) and grammatical endings (such as the plural marker -s in English), are inserted either.

/ˈðə bɔɪ iːts ˈðə ˈæpᵊl/

The last step of spoken production is the process of ‘articulation’, during which the chosen words for the intended message are finally articulated in the shape of speech sounds, or letters (in case of written production).
As it happens in the case of language production, spoken and written comprehension as well involve several stages, which in turn require specific skills to achieve the final goal, that is the recognition and interpretation of the spoken and written signal. Both the auditory and visual processing have some crucial similarities, as well as differences, and for this reason either modality will be here treated separately.

As briefly mentioned above, the process of recognising spoken words involves different stages, which are somehow related to one another. The first step is called ‘pre-lexical analysis’. At this initial stage, the basic units (phonemes) of the spoken words, and not the words in their entirety, are identified before words can be accessed from the mental lexicon. In the second step, known as ‘contact’, what has been previously analysed in the verbal input is linked to the words stored in the mental dictionary. According to ‘The Cohort Model’, the words in the mental lexicon are primarily contacted by the first sounds of the words heard. In order to distinguish between the several words of the mental lexicon that have been activated by the beginning sounds of the spoken input and which might all be potential candidates, a further process of ‘selection’ intervenes. At this point, the appropriate word, that matches the heard one, is chosen. It is important to note that many factors influence the word recognition. One is the ‘frequency effect’, namely words that we hear or see often, are associated with a faster recognition and a greater accuracy. Another fundamental property is the one of ‘competition’, a notion according to which two words compete between each other, with the final result of one inhibiting the other. This concept is strongly related to the frequency effect, since the more a word is frequent, the higher its activation will be and the more likely it will inhibit its weaker competitor. After the selection of a unique candidate, the other aspects of the word, such as its grammatical information and meaning, are accessed from the mental lexicon.

As readers, we need to identify and recognize the written signal. This process requires the access to the meaning of words. This is possible thanks to the presence of a memory store known as ‘semantic system’, in which each word corresponds to a different lexical entry. The ‘semantic system’ is like a dictionary, that allows the reader and the speaker to access the meaning of the word which he is looking for. For this reason, we use the expression ‘lexical-semantic system’ to indicate the store where all the information regarding the form and the meaning of words can be found. Precisely, in the ‘semantic system’ is stored what we know about the meaning of words; while in the ‘lexical system’ is placed our knowledge of the word’s form. The latter is, in turn, made of four different components, which are all linked to the former, and that are: phonological input lexicon/orthographic input lexicon, phonological output lexicon/orthographic output lexicon. Within these components, words are organized on the basis of their morphology, grammatical features and frequency of use. Plus, there are

peculiar types of working memories, known as ‘buffers’, where the input is stored for as long as the next passage takes.

With regards to the process of visual words recognition, the phonological buffer input identifies the various graphemes of the written word, keeping them for as long as the next elaboration in the orthographic input lexicon takes. Here it is where the orthographic form of the word is recognized, allowing the access to the ‘semantic system’ which, in turn, allows the access to the word’s meaning. In addition to what has just been described, phoneme-to-grapheme and grapheme-to-phoneme conversion mechanisms are present as well. These are the mechanisms which allow readers to read and write new words and non-existing words. For this reason, the ‘lexical-semantic system’ is also defined as a ‘dual-routes model’, since we have the presence of a ‘lexical route’ (also known as ‘visual or direct route’) and a ‘non-lexical route’ (also called ‘phonological or indirect route’). The latter is responsible for the phoneme-to-grapheme or grapheme-to-phoneme conversion of new words and non-existing words, without involving the lexical and semantic systems.

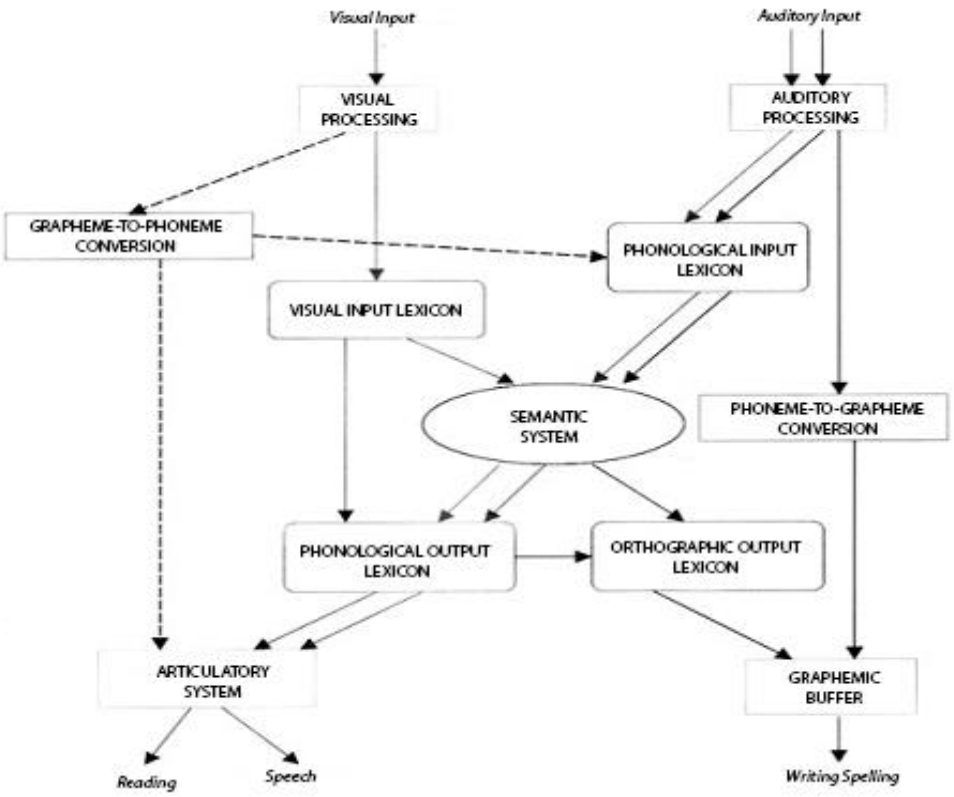

Fig. 3 ‘Dual-routes model’ of written comprehension and production.

1.3 Language Development

Children develop naturally their language abilities, thanks both to a specific biologic predisposition and to an adequate exposition to a linguistic environment, whose nature plays a fundamental role in language development.
As A. Moro states (2006):

> "Language is something which happens to a child, not something that the child does. In the same way, a spider doesn't learn to construct a web just because another spider particularly able in making webs teaches it how it has to be done. It simply knows that, because it has a spider's brain."

Before starting to speak (0-8 months), children communicate with what surrounds them through specific behaviours like postures, sneers and crying. These are signals which are not yet intentionally produced by children. For instance, the crying is at first triggered by physiological causes, like hunger and thirst. Only at a later stage, infants learn how to provoke and inhibit that on purpose.
Between 8 and 13 months starts what can be defined as an 'intentional communication'. It is, indeed, at this stage that children become aware of the effects that their signals have on the listeners. At first, intentional communication occurs through two different types of gestures: *deictic gestures*, *referential gestures*.
Deictic gestures (8-12 months) refer to an object, or event, which can be both found in the context where the communication happens. This implies that their meaning can be correctly understood only in the specific context in which the communication occurs.
These gestures are mainly used by children to ask something, to draw attention to themselves and to share their interests towards an event/object. Examples of deictic gestures are:
-Requesting something by using an open and closed grasping movement, or by pointing at the target object and simultaneously looking at the adult (*pointing*);
-Putting the adult's hand on an object which the child wants to draw attention to (*showing*);
-Pulling the adult's hand towards an item (*giving*).
Referential gestures (12-16 months) represent a specific referent. For this reason, their meaning doesn't change if the context does. By using these gestures, the child shows that he is able to use a non-verbal signal as a representative of a certain meaning. For instance, the infant shakes his head to express 'no'; he opens and closes his hand to say 'hi', and so on.

Deictic and referential gestures are precursors to children's first words. But the ability to communicate verbally develops later and slower than the ability to comprehend language. As a matter of fact, receptive language development starts between 8 and 13 months and it grows rapidly in the subsequent months. This fast growth is shown by the fact that, at 8-13 months of age, children understand about 30 words on the average, while at 18 months they comprehend 215 words on the average.

Initially, the ability to understand language is highly contextualized and only at a later stage it gradually becomes decontextualized. This is proven by the fact that, between 8 and 13 months, receptive skills are extremely ritualized, which means that the comprehension of verbal inputs occurs only within specific contexts in which the child, besides the linguistic input, receives other inputs whose nature is not verbal. For instance, the adult asks the child to throw the ball when the infant is already holding that. Only at later time the child will be able to comprehend language without any other extra-verbal helps. For instance, he will understand a sentence like "Fetch the ball", even if he is not holding the ball in that precise moment.

As children progressively become more expert at comprehending the meaning of what they are told, they also become more expert at expressing themselves through words. Like it happens with the receptive skills, the speaking skills either are initially highly contextualized.

At first, children use the words they know only within specific and ritualized contexts, that is while they are doing what those words refer to. For example, they say "Woof Woof" only when they are asked what the dog sounds like. As a consequence, first verbal expressions usually refer to familiar people, common objects and to situations in which children are often involved. Only at a later stage, infants use words to anticipate and remember their actions (e.g. they say 'ball' right before playing with that). Furthermore, they become able to use words not only within their usual context (e.g. they say 'ball' even when the ball is not there at that moment and they are looking for it in order to take it).

As previously mentioned, between 19 and 30 months of age the number of words that the child uses grows considerably if compared to the amount of 50 words used at an earlier stage. In this period children experience what is commonly known as 'vocabulary explosion', since they suddenly learn and consequently use words at a faster rate. In this period, fundamental changes occur. Children need fewer verbal inputs from people who surrounds them. Indeed, they spontaneously use new words and they show more interest in learning them. While at the

age of 8-13 months children's vocabulary includes an equal number of words and gestures, in the following months new gestures stop to be produced. Plus, the frequency with which they are used, as compared to words, decreases. At this stage, names are still the most predominant in children's vocabulary, but it is now that verbs, adjectives, articles, prepositions and pronouns as well start to be noticed in infant's oral production. The number of different verbal sounds that the child can make grows and, consequently, multisyllabic words appear. Together with the production of more complex words, the child makes a bigger number of mistakes, known as 'errors in early word use' or 'developmental errors', whose amount decreases as vocabulary continues to grow. The most noticeable errors in early word use are *overgeneralization*, *overextension*, *underextension*, and might be considered as learning strategies, rather than mistakes in the strict sense.

Examples of these errors are the following:

-*Overgeneralization*: the child calls 'dog' whatever animal that has four paws.

-*Overextension*: the child calls 'doll' only his favourite doll.

-*Underextension*: the child uses the verb 'open', not only with regard to the action of opening the door, but also to the action of turning on the light.

Between 12 and 18 months, children tend to express with a single word an entire semantic content, helped by the use of gestures and by the specific context in which the communication happens. These enunciations are known as 'holophrases', since single words are used to convey a complex message (e.g. 'bread', which stands for 'I want bread'). In the following months, precisely at around 18 months, two-word utterances begin to be produced and they are usually grammatically correct, commonly constructed by arranging words in the appropriate order (e.g. S+V 'Mommy eat'; V+O 'Bark dog'; S+O 'Emily water'; S+C 'Daddy hungry'). These utterances usually contain names, verbs and, less frequently, adjectives and adverbs. Other elements, such as pronouns, articles and prepositions, are generally omitted since they carry less information.

At the age of two, children start to produce utterances by combining three and four words. This period is known as 'telegraphic stage', since the utterances produced don't include elements as determiners, auxiliary verbs and prepositions. While some of the sentences that the child produces have all the grammatical elements needed (e.g. S+V+O 'Nancy loves mommy'), others are instead incomplete (e.g. 'Nancy bed now'). Even if some grammatical

elements are still often missing, more structures such as interrogatives and imperatives begin to be used.

Between two and three years of age, the child reaches the stage of multiple-word sentences, which appear to have a more complex grammatical structure, where morphemes such as prefixes and suffixes, as well as pronouns, conjunctions and prepositions, begin to be used.

The three to four-year-old child uses sentences of four to six words, where verb tenses as future and past are used, even if problems with irregular forms are still noticeable (e.g. ‘swimmed’ for ‘swam’).

At the age of 5, children are able to produce complete and complex sentences. Indeed, at this stage, they had already learnt many of the fundamental grammatical rules, although certain occasional errors are still made, since some rules haven’t been completely mastered yet.

In the following year starts what is considered a fundamental period for the development and enrichment of language skills. As a matter of fact, the exposition to the formal education at school allows children to acquire a deep understanding of all the components of language: *phonology*, *lexicon*, *semantics*, *grammar* and *pragmatics*. In addition to that, the development of other skills either, such as attention, memory and social skills, appears to be relevant to language growth. In the subsequent years, lexicon keeps growing, as well as the capability of using sophisticated sentences and metalinguistic awareness. This is particularly evident from the age of 6 years to puberty (around 12 years old). Nevertheless, the proficiency in receptive and production skills continues to grow until the adult age and appears to be significantly related to and influenced by advanced levels of schooling.

II. Bilingualism

"And still they gazed, and still the wonder grew,
that one small head should carry all it knew."
Oliver Goldsmith, *The Deserted Village*.

2.1 Definition and typologies of bilingualism

It is nowadays widely accepted that bilingual individuals should be 'classified' into different categories, since the univalent definition of who can be considered bilingual, such as a person that uses more than one language in everyday life, would be only partially fulfilling. In addition to the need of considering the various characteristics of bilingualism, it is also important to briefly introduce the concept of multiculturalism related to bilingualism, namely when a bilingual can be considered bicultural either. We use the term 'bicultural', in contrast to 'monocultural', when a second language learner identifies himself with the cultures of both the languages that he had been exposed to. The internalization of the culture associated to L2 is particularly common, but not exclusive, in those individuals who had been simultaneously exposed to the two languages since birth. It is interesting to note that a high bicultural identity seems to be associated to a higher fluency in the languages known and to a stronger likelihood that they will be both maintained. On the contrary, individuals who don't identify themselves with L2 culture are less likely to keep a high level in both languages learnt. As Benet-Martinez et al. (2002) state, the proficiency in the two languages spoken is strongly related to how the bilingual individuals 'perceive their mainstream and ethic cultural identities as compatible and integrated, vs. oppositional and difficult to integrate."

In view of the above, the current section will give a detailed description of the main typologies of bilingualism identified by researchers and their characteristics. This classification represents an attempt to categorize bilingual individuals in accordance with their degree of fluency and competence in all the languages spoken, as well as with the age/context/manner of language acquisition and with the organization of linguistic codes and meaning units.

2.1.2 Balanced and Dominant bilingualism

A ‘balanced bilingual’ is an individual whose linguistic competences in the languages spoken are equal or similar. Conversely, ‘dominant bilinguals’ are those who show higher degree of fluency and proficiency in one of the two languages known.

2.1.3 Early and Late bilingualism

In ‘early bilingualism’ the languages spoken have been acquired in an early phase of life, usually before the puberty, so that both languages are known as native-languages. In this definition are included both the acquisition of the two languages simultaneously, from birth, and the acquisition of L2 after the child has already been briefly exposed to L1.
‘Late bilingualism’ refers, instead, to the acquisition of the second language after the first is already mastered, namely during adolescence or adulthood.

2.1.4 Compound, Coordinate, Subordinate bilingualism

In ‘compound bilingualism’, different linguistic codes of the languages that the speaker knows (e.g. ‘dog’ and ‘cane’), are stored in the same meaning unit. This happens when the speaker has learnt the two languages simultaneously before the age of six, in the family context. Conversely, in ‘coordinate bilingualism’ each linguistic code corresponds to a specific meaning unit, namely there is a system of meaning for words of L1 and another for words of L2. This happens when L2 is learned before the puberty, but in a context other than the family (e.g. when the child moves, together with his family, to a country whose language is different than the one learnt from birth.). Finally, in ‘subordinate bilingualism’ it is assumed that L1 helps the speaker master L2. This implies that one of the two languages spoken, namely L1, keeps being used as the basic language through which L2 is understood and employed.

2.2 Neuroscience of bilingualism

Research into the field of cognitive neuroscience has studied for a long time the representation of different language systems in the brain, in order to compare the monolingual and bilingual individuals in the way they recruit brain areas during some language related tasks. There is a growing evidence that the exposure to more than one language has a great impact on the structure of the brain, modifying the neural organization for language. Learning a second language, especially when this happens early in life, affects how the brain both recruits and activates the regions involved in language related tasks, resulting in a greater brain activation and plasticity, compared to what observed in monolingual speakers. In this respect, useful insights have been gained by studies where monolingual and bilingual children and adults' brain activity was monitored during sentence processing. These findings showed that, unlike what occurs in monolinguals, in bilingual individuals there is a greater activation in the classic language areas located in the left hemisphere and in the corresponding areas of the right hemisphere.

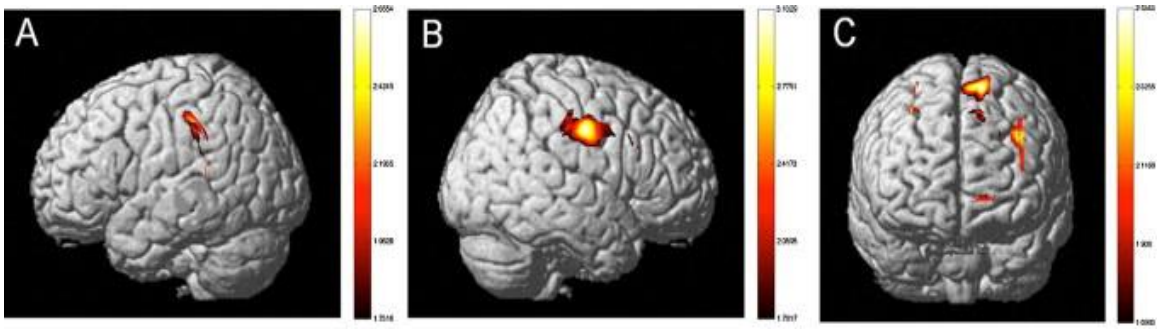

Fig. 4 Comparison between early bilingual children and monolingual children.
In early bilingual children a greater activation is shown in the left (a) and in the right (b) hemispheres, and in frontal lobes (c), as compared to monolingual children.

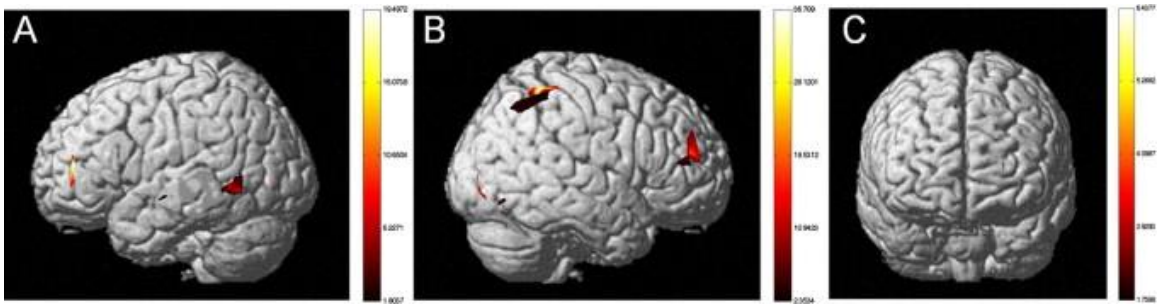

Fig. 5 Comparison between early bilingual adults and monolingual adults.
In early bilingual adults a greater activation is shown in the left (a) and in the right (b) hemispheres, as compared to monolingual adults. There are instead no differences between the two groups in the activation of the frontal lobe.

Several studies have also tried to understand the differences and similarities between the areas activated in bilingual brain during the use of both L1 and L2. The findings showed that similar areas are activated during the use of the first and second language, when the latter is learned early in life. It was found that the activation of specific brain areas and the connection between them appear to be affected by the age of acquisition of L2 and its degree of proficiency. As a matter of fact, early bilinguals show almost the same activation in parts of Broca's area and left inferior lobe when using either one of the two languages they fluently speak. On the contrary, in late bilinguals different parts of Broca's area are recruited when using L1 and L2, while no substantial differences have been observed in the activation of Wernicke's area during the use of the two languages known. Another difference related to both the age of acquisition of L2 and its degree of proficiency concerns the activation of those brain areas associated with phonological working memory and located in the left insula and left inferior frontal gyrus. Early bilinguals seem to use working memory more than late bilinguals whose proficiency in the second language is lower than that in the native language. With regards to language comprehension, in highly proficient bilinguals the brain areas recruited in the analysis of the auditory input have been found to be comparable between L1 and L2 and they involve the ventral pathways bilaterally and the dorsal pathway. Conversely, in less proficient bilinguals the auditory processing of L2 is associated to reduced activations in the dorsal pathway and in some brain areas encompassing the ventral pathway bilaterally.

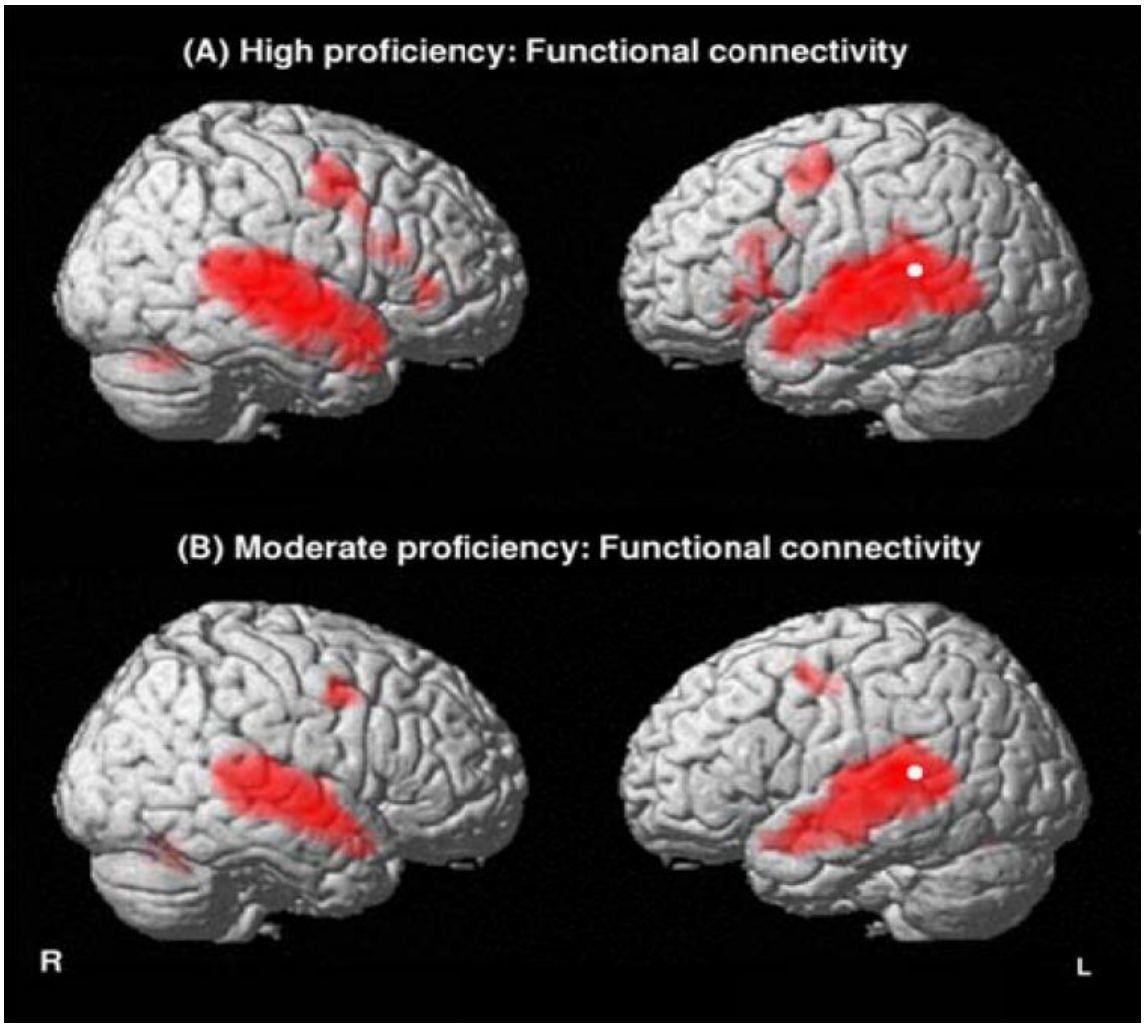

Fig. 6 Brain areas involved in L2 comprehension in highly proficient L2 subjects (A) and in moderate proficient L2 subjects (B).

2.3 Cognitive advantages related to bilingualism

Despite the growth of bilingualism all over the world, the question whether it has positive or negative effects on children's language development, is still a matter of debate, since misconceptions about it are still prevalent. Nevertheless, the approach to bilingualism has significantly changed in recent years, since nowadays the cognitive advantages related to

learning more than one language are starting to be recognized by a larger portion of society. As a consequence, an increasing number of parents decide to raise their children as bilinguals. Conversely, in the past, raising children as bilinguals was often discouraged, and sometimes even forbidden by parents and educators, because considered as able to prevent children from fully mastering L1. This attitude is perfectly depicted in the following excerpt from the book 'Hotel on the Corner of Bitter and Sweet':

> "Young Henry Lee stopped talking to his parents when he was twelve years old. Not because of some silly childhood tantrum, but because they asked him to. That was how it felt anyway. They asked him to stop speaking their native Chinese. It was 1942, and they were desperate for him to learn English.
>
> 'No more. Only speak your American.' The words came out in Chinglish.
>
> 'I don't understand' Henry said in English.
>
> 'Hah?' his father asked.
>
> Since Henry couldn't ask in Cantonese and his parents barely understood English, he dropped the matter, grabbed his lunch and book bag and headed down the stairs and out into the salty fishy air of Seattle's Chinatown."

In contrast to the belief that learning a second language might confuse children, several studies have instead found that the exposition to more than one language doesn't cause distress, requiring an overwhelming cognitive effort. It contributes, instead, to a stronger and healthier brain. In spite of that, among parents and educators, is still persistent the idea that exposing children to more than one language might delay their speech and cognitive development. As a consequence, the tendency is still to expose children to L2 only after L1 is fully mastered. This approach is in contrast with the assumption that L1 and L2 should be both acquired during the 'critical period', that is the most fertile period in terms of brain plasticity. According to Knudsen (2004), within the 'critical period' can be identified three further different sub-periods. The first goes from the birth to the age of 3; the second from 4 to 8 years old, while the last from 9 years old onwards. The two first periods are those where children exposed to L2 will encounter less difficulties in its acquisition, whose nature won't then differ from the one of L1. Thus, it is clear that 'early bilingualism' should be encouraged and promoted by both parents and educators, since it implies the spontaneous acquisition of L2 as native language, unlike what happens instead in 'late bilingualism'.

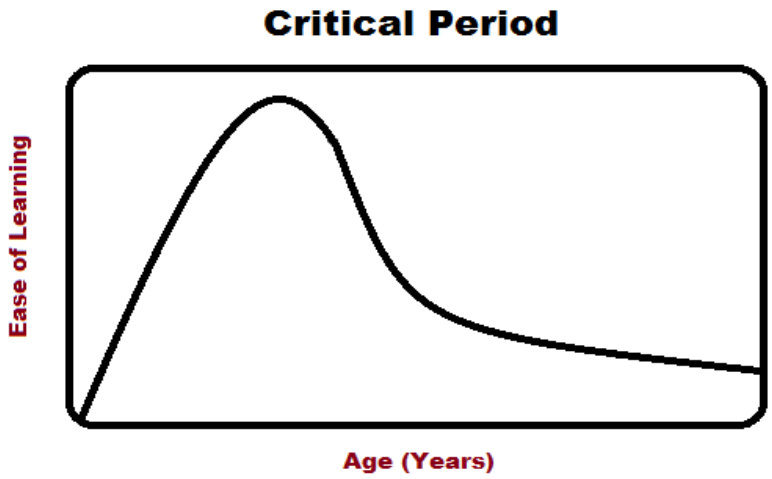

Fig. 7 Graphic of 'Critical Period' related to second language acquisition.

In opposition to bilingualism detractors, various studies that compared monolingual and bilingual children's language production have showed evidence of similar developmental patterns in the two groups, which appear to reach language milestones at the same rate. Moreover, it is well accepted that learning a second language might positively restructure the brain, as it is shown by some changes in its structural plasticity. It has been argued that the acquisition of L2 is related to an increase in grey and white matter density, as a consequence of the cognitively demanding skills which appear to involve the bilingual more than the monolingual individuals. Bialystok et al. (2012) tried to explain the reason why bilingualism is related to better performances in cognitive functions, such as problem solving, attention and working memory:

> "Lifelong experience in managing attention to two languages reorganizes specific brain networks, creating a more effective basis for executive control and sustaining better cognitive performances throughout the life span."

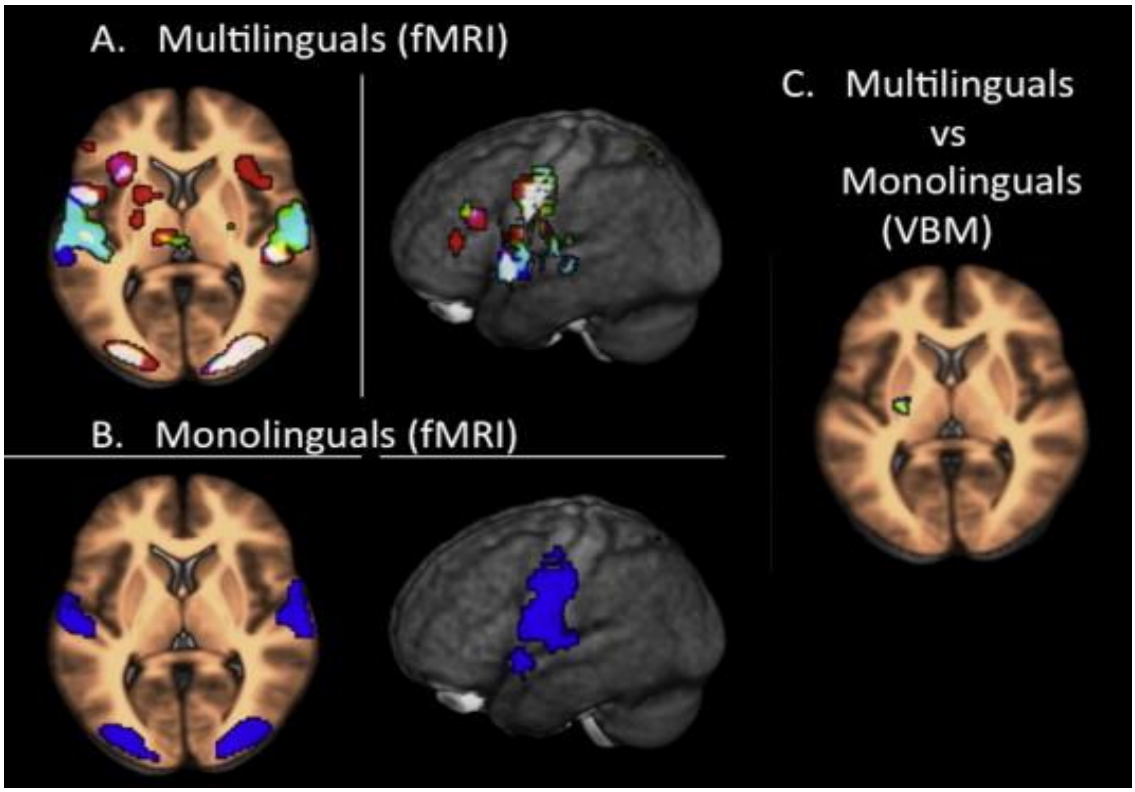

Fig. 8 'Bilingualism benefits'

fMRI (Functional Magnetic Resonance Imaging) of the brain in multilinguals (A) and monolinguals (B).

Health benefits of bilingualism on the brain are also evident from a variety of studies investigating the protective effects that knowing another language have from cognitive impairments in Alzheimer's disease and, in general, in the aging brain. The results showed that bilingualism and multilingualism might delay the onset of symptoms, in people with dementia and other age-related impairments, by about 4-5 years. This further finding supports the conviction that the acquisition of more than one language might both strengthen and protect the brain, respectively by reworking its structure and by leading to use its energy in a more efficient and conservative way.

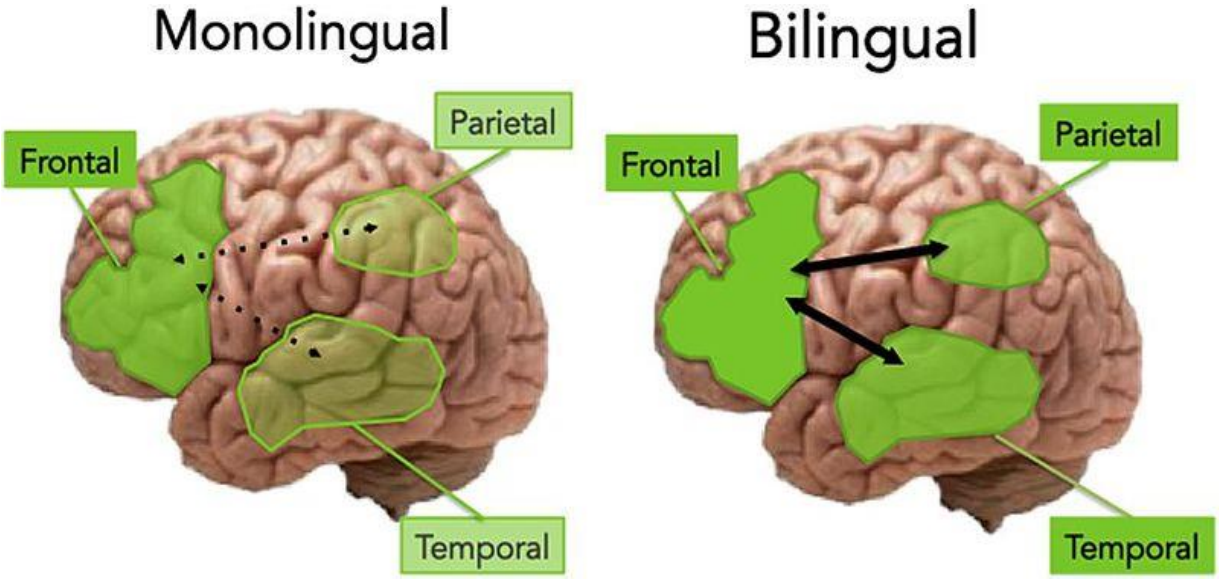

Fig. 9 Illustration of the monolingual and bilingual aging brain.

The above picture shows how bilingualism aids in the building up of cognitive reserves in the brain.

In monolinguals aging appears to be related to a higher reliance on the frontal regions of the brain than on the posterior ones. In bilinguals, instead, we can observe a preservation of both the posterior and frontal regions and an increased connectivity between frontal and posterior areas.

III. Bilingualism in Sardinia

"I was born in a farmers and shepherds village, between Goceano and Logoduro, in northern Sardinia and,
during my childhood, I was exposed to and I spoke only Sardinian language.
In first grade the teacher, a strict man always dressed in black,
forbade us to speak the only language we knew and obliged us to talk only in Italian,
'Homeland language,' he said.
This is how, as lively and smart as we were, we all became foolish and sad."
Frantziscu Màsala, *Poesias in duas limbas*.

3.1 Sa Limba Sarda: history, linguistic system and stereotypes

Sa Limba Sarda (Sardinian Language) is considered by many as the most conservative Romance language, whose origins can be complex to define due to the different languages that might have influenced the various parts of the island at different times. But if on one hand this view of Sardinian as linguistically deriving from Latin is common, on the other hand it is hard to generalize into just one language the big amount of varieties spoken in the island since, as Virdis (1978, 9) states:

"There is a minimum of two up to an imprecise and unpredictable maximum that would coincide if
not with every single town, at least with each geographical circumscription."

According to the main researchers in the field, Sardinian language might be subdivided into seven varieties, which belong to three different linguistic systems:

1. Campidanese, Nuorese, Logudorese (Sardinian Linguistic System);
2. Sassarese, Gallurese, Tabarkino-Carlofortino (Italian Linguistic System);
3. Algherese-Catalan (Catalan Linguistic System).

As it is shown above, within Sardinian Linguistic System, it is possible to distinguish further linguistic varieties, which from the north to the south are:

a. *Logodurese Sardinian*, which includes all the different varieties spoken in north-central part of Sardinia (except Sassarese, Gallurese and Algherese);

b. *Nuorese Sardinian*, which includes all the different varieties spoken in Nuoro province;

c. *Campidanese Sardinian*, which includes all the different varieties spoken in southern Sardinia;

d. *Central Sardinian*, which includes all the varieties spoken in central Sardinia and that have many traits in common with Logudorese, Nuorese and Campidanese Sardinian. These varieties are also referred to as 'Sa Limba Sarda de Mesania';

e. *Ogliastrino Sardinian*, which includes all the varieties spoken in central eastern Sardinia and that have many traits in common with both Campidanese and Nuorese Sardinian.

Fig. 10 Sardinian language varieties

As previously mentioned, the varieties of Sardinian language can significantly diverge from one to another. Some scholars believe that this might be due to the considerable number of dominants arrived in Sardinia over the centuries and whose languages might have consequently influenced the different parts of the island. Others, like Bolognesi (2001), reject instead this point and argue that all the varieties of Sardinian have traits both conservative, from Latin, and innovator, which seem to be related to a spontaneous linguistic change, rather than to the different languages introduced in the island by its dominants. This might be proven by the fact that, even if Sardinia was linguistically isolated for over 2000 years, in any case all its linguistic varieties have evolved with the passing of time. As a consequence, its linguistic evolution is not due to the contact with other languages, also because in many parts of the island no contacts with dominants occurred for a long period of time. Furthermore, many of the dominants, as the Pisans and the Iberians, occupied Sardinia not as long as needed to significantly influence the language spoken until their arrival. In addition to the above aspects, another fundamental fact considerably limited the spread of the dominants' languages. Indeed, at that time the number of illiterate people was large. Consequently, the new languages introduced in the territory, at different times, weren't learned at school. This means that the only way of learning was to linguistically interact with the dominants, something which seems unlikely that had happened, considering the low tendency of the dominants to interact with their subjects. In light of this, the contacts between Sardinians and the speakers of other languages might have been restricted to those Sardinians who were literate and who represented only a small minority.

Bolognesi's hypothesis finds some support even amongst Le Lannou (1941), who was firmly convinced that the number of colonizers in the island wasn't significant enough to justify the potential big influence on Sardinian language:

> "To tell the truth, Sardinia doesn't attract the colonizer, namely the true inhabitant. Throughout history, Sardinia had never known actual colonizations, namely thosethat promote population and urban development, as well as the growth of rural areas."

According to both Wagner (1951) and Bolognesi (2001), the only colonizations that had a significant linguistic influence on Sardinian inhabitants took place in Alghero (Catalan), Gallura (southern Corsican) and in the islands of S.Pietro and S.Antioco (Tabarkino). Nonetheless, considering that the people who arrived in those areas were actually entire

communities which occupied mainly uninhabited places, their languages didn't come into a deep contact with Sardinian. Thus, it is correct to affirm that, except for some occasional loan words, no concrete linguistic mixtures occurred between those languages and Sardinian.

In view of the above, it is undeniable that the different varieties of Sardinian were influenced by dominants' languages, but these influences seem to be restricted to the lexicon, while the evolution of other aspects such as phonology, morphology and syntax appears not to be related to the phenomenon of linguistic contact. An example of the spontaneous linguistic change supported by Bolognesi (2001) and mentioned in his study, can be observed in the existence, among the various Sardinian dialects, of nine different pronunciations of the sentence '*su kanɛ̱'* ('the dog'), whose lexical representation is instead the same in all of them. Thus, these distinct pronunciations are due to phonological spontaneous changes which have affected some Sardinian varieties, rather than to phonemic loans deriving from the several languages introduced in the island over the centuries.

Nevertheless, despite what Bolognesi (2001) claims concerning the spontaneous linguistic change as the main responsible for the diversity between the various Sardinian dialects, have been several the linguists who have considered Sardinian simply as an archaic language slightly more evolved than Latin. To mention just an example, this is what Blasco Ferrer (1984) states:

> "Sardinian is an archaic language, due to its precocious latinisation, its isolated location and its inadequate capability to accept innovations from the mainland. These characteristics can be found in the same linguistic structure of Sardinian."

This view of Sardinian as an archaic language implies the absence of the linguistic change that Bolognesi (2001) instead asserts and, in his opinion, it is strictly related to an equally archaic view of the island as an underdeveloped place. The anthropologist Peter Odermatt (1994) seems to be on the same page:

> "For Italian people, folklore is symptomatic of their anachronistic idea of Sardinia. Still in the 70's, both the politicians and the mass media described a scenario of chaos and underdevelopment. Even these days Sardinia is considered as a place of bandits and shepherds."

Summarizing, the view of Sardinian as an archaic language, that has kept most of the Vulgar Latin features, appears to be obsolete. As a matter of fact, it has been proven that the number of certain conservative traits in Sardinian dialects is extremely modest. In the same way, the idea that Sardinian has been deeply affected by the contact with the dominants' languages seems to be inconsistent, since the main responsible for the diversity between the various Sardinian dialects appears to be the spontaneous linguistic change that has occurred over the centuries. The only language whose structures have deeply affected Sardinian varieties at multiple levels is, most certainty, Italian language. This close linguistic contact has produced a condition known as 'bilingualism with diglossia', which will be better explained in the next section.

3.2 Duas est mègius: the state and value of bilingualism in Sardinia

As briefly mentioned in the previous section, the linguistic situation in Sardinia is what can be defined as a 'bilingualism with diglossia', since most of the people who live in the island use the official language, namely Italian, in formal contexts. Conversely, Sardinian language in all of its varieties is mainly used informally. With this regard, it is important to specify that Sardinian represented for almost four centuries the official language spoken by the inhabitants of the island, precisely until 1410. As a matter of fact, it was from that moment on that, due to the loss of independence, it started its relegation to a subordinate language. This was a slow process since, although the loss of its status of official language, Sardinian continued to be spoken by the most of its inhabitants for a considerable period of time. The attempts to relegate Sardinian became to be noticeable in the XVI century, when the dominants tried to replace it with a cultured language, and continued after the introduction of Italian language in the island, in 1760. The result was paradoxical. Sure enough, on one hand the efforts to linguistically analyse and scientifically recognize Sardinian status were significant. But on the other hand, the process of its disowning and relegation became more evident and this led to its assimilation, both linguistically and legally, to one of the many Italian dialects.

Over the years, various were the attempts to politically recognize Sardinian language, preserving the condition of bilingualism in the island. Nevertheless, only in 1997 and 1999 the recognition was made official by a regional and national law, respectively. The latter, in

particular, has recognised Sardinian as one of the twelve 'historical language minorities' of Italy. On one side, this law supports a number of measures such as the possibility to teach Sardinian at school, if requested by parents, or to translate into Sardinian some official records. On the other side, it hasn't reduced the dispersion of Sardinian linguistic heritage, since it doesn't promote the principle of language equality, according to which several measures should be taken in order to prevent language minorities from vanishing. These measures involve, for instance, the need to offer an efficient programme of education, at least partially, in the minority language, as well as to make that language equally recognized in public and legal services. At present, all these aspects seem very far from being achieved. On this matter, the situation in Sardinia is quite complex. The absence of a unique Sardinian language and the presence, instead, of different varieties diverging from one to another, especially in their phonology, has made it hard the definition of a standard version. For these reasons, the question 'Which Sardinian?' is still a matter of debate.

The first attempt to standardize Sardinian languages goes back to 2001. The linguistic version, called LSU (Limba Sarda Unificada), was somehow employed, although restricted to a few contexts, but it failed in its purpose of being the standard language. Furthermore, its linguistic structure was perceived as too close to the northern dialects, ignoring the other varieties spoken in the island. This was the main reason why another form of standard language was suggested, namely 'Limba de Mesiana', which appeared to be something in between the varieties spoken in the northern and southern Sardinia, but which didn't receive any public recognition. It was not until 2006 that the official recognition of a standard version, known as LSC (Limba Sarda Comuna), occurred. Nevertheless, even in this case the acknowledgment by local administrations and native speakers hasn't been full, since this version seems not to take into account all the varieties of Sardinian language spoken in the island. It is then clear that the debate in relation to Sardinian standardization is still open and controversial. As Bolognesi (2013) states:

> "Addressing the problem of the definition of a standard version of Sardinian Language means to address the problem of the relationship between Sardinian people and their language […] Sardinian has become a language used with friends, within 'the peer group', an informal inclusive language. In the situation of bilingualism with diglossia in which Sardinian language has found itself for centuries, it has been right this function that had allowed its survival […] Depriving Sardinian language of this function strongly emotional would mean to condemn that to rejection.

The highly emotional refusal of the LSC in the south of the island comes right from the emotional connection that Sardinian people have with their own local dialect."

According to Bolognesi (2013), each of the three varieties proposed over the years has failed to be the standard version of Sardinian language, since they all have ignored the relationship between Sardinian people and their respective local dialects. In his opinion, a standard version is undoubtedly needed, but possible only in the written form. Plus, the standardization mustn't be exasperated, chasing a purity which is not doable in a variegated linguistic reality as it is the one in Sardinia. Sure enough, Bolognesi emphasizes the importance of preserving the different linguistic expressions of Sardinian varieties, suggesting a standard version where all these forms coexist, as far as possible, and their respective, related identities are preserved:

"To standardize a language without relying on stretches that would lead to its rejection, means to determine what are the grammatical differences between its varieties, suggesting at the same time to go beyond these differences by means of an unifying proposal that deviates as little as possible from the different linguistic varieties."

Similarly, the project 'Sardinian Language at school', that took place between 1995 and 1997 in many kindergartens and elementary schools, didn't suggest to teach the same Sardinian language all over the island. On the contrary, it was adopted the local variety spoken in the community of each school involved in the project. In this regard, Pinna Catte (1997) claims:

"Which Sardinian language is adopted in this project? Obviously, the local variety spoken in the community where the school is. Imposing another variety would be a violence, not less serious than the one that has happened until now at school in Sardinia with the imposition of Italian language. Even in the case of children who have learnt Italian as first language, the Sardinian variety which has to be learnt and used at school must be the local variety, a linguistic and cultural tool that is essential to understand the local context and to actively take part in that."

The importance and utility of the role of Sardinian language in children's education and development, either linguistic and cultural, was already clear several years ago, as it is proven in the following excerpt from "The Prison Notebooks" by Antonio Gramsci (1927), where he writes to his sister the subsequent words:

> "You must write to me about your children, if you have time, or at least let Carlo or Grazietta write to me. Franco seems very perky and smart: I think he already speaks fluently. What language does he speak? I hope you allow him to speak Sardinian […] In my case, I made a mistake not allowing Edmea to speak Sardinian freely when she was a little girl. This has damaged her intellectual education and put her fantasy in straitjackets […] I heartily recommend you not to make the same mistake with your children, letting them instead free to absorb all Sardinian that they want and to grow spontaneously in the natural environment where they were born."

Considering the above, it is clear that the debate around the standardization of Sardinian language cannot be separated from the one around the state and value of bilingualism in Sardinia. As previously discussed, the difficulty to find a standard language able to satisfy all the speakers of the different Sardinian varieties, is strictly related to how Sardinian people use and perceive their own dialects, and to the cultural and emotional value that they give to them. In this regard, Lupinu et al. (2007) conducted a valuable survey in order to determine the state of bilingualism in the different parts of Sardinia. The data analysed were collected from questionnaires administered to a large and representative sample (2.438 adults, 277 children). The results are quite interesting and somehow surprising. A big percentage (68,4%) of the people interviewed claimed to be fluent in one of the varieties of Sardinian, while a smaller percentage (29%) declared to be able only to understand it. Finally, just the 2,7% of the sample stated that Sardinian varieties were completely unknown to them. This result shows how the various dialects spoken in the island have an important role in the linguistic repertoire of Sardinian people. More detailed information collected from the questionnaires included sex, age, level of education and employment situation, as well as the contexts where the conversations in Sardinian languages tend to occur. It was observed that employed men with a low level of education and a higher age are more likely to be proficient. The percentage of women who are fluent in one of the Sardinian varieties is significantly lower if compared to men. In the same way, the percentage of the conversations in Sardinian between lovers appears to be extremely low (3,8%). These facts don't seem due to a hostile attitude of women towards Sardinian. As a matter of fact, the majority (90%) of them supports the knowledge of Sardinian languages and their use in contexts such as schools (78,9%) and churches (62,3%). Plus, they consider that as a fundamental part of their identity. This apparent contradiction between the high value given by women to Sardinian varieties and their actual scarce use in every-day life, could be a consequence of the low status and low

social prestige that they have if compared to Italian, which is still the most widespread language in Sardinia. On this matter, it is interesting to note that Italian is dominant especially in formal contexts, like schools (82%), churches (80,6%) and public offices (82,1%), as a proof of its high status and social prestige. The situation appears to be instead different in rural areas, where Italian doesn't represent the dominant language.

In conclusion, it can be said that the state of bilingualism in Sardinia is a complex phenomenon, since contrasting data about its characteristics and perception have arisen. If on one hand, a big portion of inhabitants of the island appears to be proficient in at least one of the Sardinian varieties, on the other hand the contexts where the communication in Sardinian languages occur are restricted if compared to those in which, instead, Italian is used. This aspect, in particular, seems to be strongly related to the tendency of considering the minority languages as able to negatively influence the social status and prestige. This is also reflected in the lower percentage of women who speak one of the Sardinian varieties since, according to several studies, they are more likely than men to use the language considered more prestigious. In contrast with the significant dominance of Italian language in the island, the majority of its inhabitants refers anyway a strong bond with Sardinian languages, both emotional and cultural. As a matter of fact, the 94,2% of the sample supports the use of Sardinian varieties in the family context, as well as at school (78,5%) and in public offices (58,5%). Moreover, the 42,6% believes that being bilingual in Sardinian and Italian might have more benefits than disadvantages.

In view of the above, the competences and linguistic use are clearly heterogeneous among the people who live in the island. Despite this, the general opinion about the preservation and spread of Sardinian varieties, as well as the promotion of a higher social status, appear to be extremely consistent.

IV. Acquired Language and Communication Disorders

"When I cannot see words
curling like rings of smoke round me,
I am in darkness. I am nothing."
Virgina Woolf, *The Waves*.

4.1 History of aphasia

In 1861 the physician Pierre Paul Broca described the case of a man, Lois Victor Leborgne, who had lost the ability to speak when he was 30 years old, after trying to commit suicide. As a consequence of the trauma, the only syllable that he was able to pronounce was 'Tan', the reason for which he has been known for a long time as 'Mr. Tan', until his real identity was discovered. Broca (1861) described the language disorder observed in that man with the following words:

> "He could no longer produce but a single syllable, which he usually repeated twice in succession; regardless of the question asked him, he always responded: tan, tan, combined with varied expressive gestures. This is why, throughout the hospital, he is known only by the name Tan."

Except for his inability to speak, together with left hemiplegia, Mr. Tan didn't show any other sign of physical and cognitive impairments. As a matter of fact, his behaviour seemed to be quite appropriate, as well as his language comprehension and other mental faculties:

> "He first made with his left index finger a short horizontal gesture which meant he had understood, then he showed successively his tongue, his right harm, and his right leg. This was perfectly correct."

The meeting between Broca and Monsieur Leborgne occurred 21 years after the latter was admitted to Bicêtre Hospital outside Paris in 1940 due to the trauma that he had inflicted himself, but just some days after their encounter the patient died because of pulmonary complications. The detailed examination that Broca conducted on Mr. Tan's brain during the

autopsy, revealed a huge lesion in the posterior inferior gyrus of the left frontal lobe, an area that would have been later named ‘Broca’s area’. This finding led Broca to assume that the damage of a specific area of the brain could cause specific language disorders and, as consequence, that certain brain areas controlled language abilities. He named the loss of articulated speech observed in Monsier Leborgne ‘aphimia’, which is today known as ‘Broca’s aphasia’.

Mr.Tan wasn’t the only aphasic that Broca encountered during his career. Sure enough, were many others the patients who showed a similar pattern of symptoms and whose autopsy post mortem always confirmed the lesion of the left frontal lobe. At first, Broca’s surprise was evident, as it can be read below:

> “I will not deny my surprise bordering on stupefaction when I found that in my second patient the lesion was rigorously occupying the same site as in my first.” (Broca, 1861)

Nevertheless, in contrast to the large loss of the ability to speak observed in Monsieur Leborgne, other patients met by Broca appeared to be less severely impaired and, consequently, able to say a higher number of words carrying a real meaning. The second patient mentioned above was encountered just a few months after Mr.Tan’s death. His name was Monsieur Lelong and he was 84 years old. His language was damaged as a consequence of a stroke that he had suffered one year before. The differences between these first two patients concerned the number and type of words that they were able to pronounce after the trauma. While Mr. Tan could say only the non-existing word ‘Tan’, Monsieur Lelong was able to produce a higher number of words, precisely five, and whose meaning was real: ‘Lelo’ (used instead of his name), ‘oui’ (yes), ‘non’ (no), ‘tois’ (used instead of ‘troi’, namely ‘three’), ‘toujours’ (always).

In addition to the finding that speech production was localized in a specific area of the left frontal lobe, Broca noted that the majority of aphasics that he encountered showed an improvement of their symptoms with the passing of time. Thus, he reached the conclusion that certain functions lost by the left hemisphere after a trauma could be somehow replaced by the other hemisphere. For all the discussed reasons, his contribution to cognitive neurosciences has been considered fundamental, especially as concerns the localization of language abilities in certain areas and the notion of the lateralization of the brain for language.

The other great contribution to aphasiology was the one made by the German physician Carl Wernicke. In 1874, he described the case of a patient who had suffered a stroke and whose language impairments were different than the ones described by Broca until then. The man was able to speak fluently with a normal rate, rhythm and intonation, but the content of his speech was often difficult to comprehend. Furthermore, he could barely understand what he was told, although his hearing was perfectly intact, and his ability to understand written words appeared to be impaired either. The autopsy post mortem that Wernicke conducted on the man's brain, revealed a lesion in the posterior section of the superior temporal gyrus (STG) in the left hemisphere, close to the auditory cortex on the lateral sulcus. This finding led Wernicke to assume that the region damaged could be the one responsible for language comprehension. Thus, he named the language disorder related to its impairment 'sensory aphasia', which is also known today as 'Wernicke's aphasia'. Plus, he hypothesized the existence of a third type of aphasia, 'conduction aphasia', resulting from the disconnection between Broca's area and Wernicke's area. In this aphasic syndrome, both language articulation and comprehension appeared to be undamaged, while the ability to use and repeat words correctly were impaired. On the basis of these findings and assumptions, Wernicke developed the first neurolinguistic model that informed research for almost 150 years and which is summarized by Basso (2005) as it follows:

> "Wernicke considered language as a sensory-motor function; acoustic memories of words are located in the posterior section of the superior temporal gyrus (STG) in the left hemisphere, close to the primary auditory cortex; while motor memories of words are located in the frontal area close to the primary motor cortex […] and these two areas are connected."

Anyway, according to Basso (2005), the language model that Wernicke developed is incomplete since it doesn't consider the symbolic aspects of language:

> "Wernicke's interpretation considers only the sensory-motor aspects of language; there is a sensory center, a motor center and a pathway that connects them. The symbolic aspect of language is completely ignored. Apparently, according to Wernicke, hearing a word and understanding it are equal."

The symbolic aspect of language that Basso mentioned, was taken into account for the first time by Lichtheim. As a matter of fact, in 1885, the German physician proposed a new model of language that represented a development of Wernicke's model. It was postulated the existence, in the left hemisphere, of a third center called ‘conceptual center’, where the representations of concepts were formulated and stored. This center was connected to both the sensory and motor center involved in language comprehension and production, respectively. Precisely, the sensory center was considered as an input lexical store, in which the auditory word images were stored. The motor center was considered, instead, an output lexical store, where the motor word images were kept. In turn, the two of them were connected through a band of fibers.

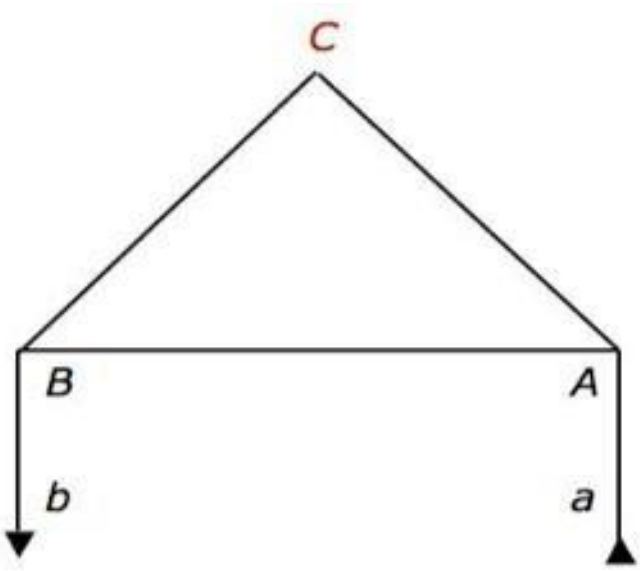

Fig. 11 Simple representation of Lichteim’s ‘house-diagram’
‘C’ is the ‘conceptual center’:
‘A’ is the ‘input lexical store’ (auditory word images);
‘B’ is the ‘output lexical store’ (motor word images);
‘a’ is the ‘auditory analysis;
‘b’ is the ‘articulatory planning’

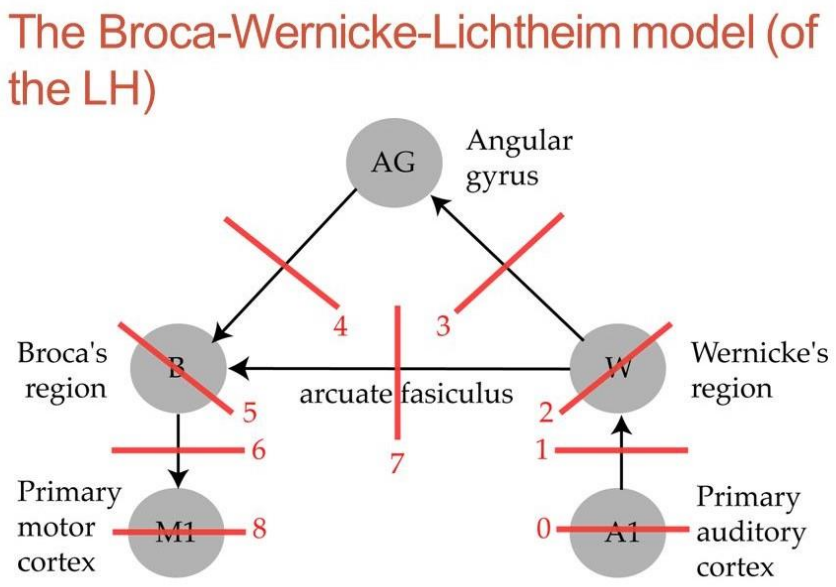

Fig. 12 Detailed representation of Broca-Wernicke-Lichtheim language model of the left hemisphere

In Lechtheim's model it was assumed the existence of seven distinct types of aphasia, depending on what part was damaged by the trauma:

- *Broca's aphasia*: caused by the damage of Broca's area;
- *Wernicke's aphasia*: caused by the damage of Wernicke's area;
- *Conduction aphasia*: caused by the disconnection between Broca's and Wernicke's areas;
- *Transcortical sensory aphasia*: caused by the damage of the connection between the 'conceptual center' and Wernicke's area;
- *Transcortical motor aphasia*: caused by the damage of the connection between the 'conceptual center' and Broca's area;

- *Subcortical sensory aphasia*: caused by the damage of the pathway that goes from the periphery to Wernicke's area;
- *Subcortical motor aphasia*: caused by the damage of the pathway that goes from the periphery to Broca's area.

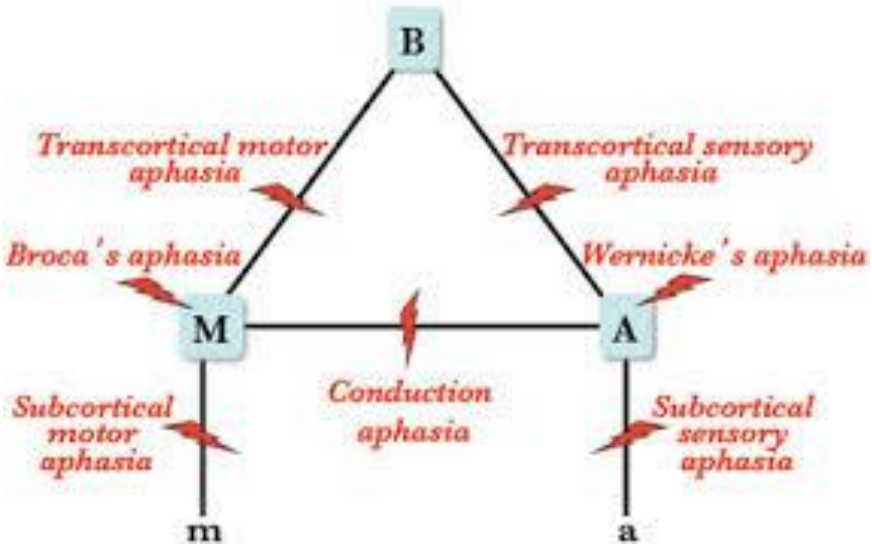

Fig. 13 Types of aphasia predicted from Leichtheim's model
'M' stands for 'motor language center' (Broca's area);
'A' stands for auditory language center (Wernicke's area);
'B' stands for 'conceptual center'
Small letters at the bottom stand for motor and auditory periphery.

Despite Lichtheim's model still represents the basis of aphasias classification, it has been subject to criticism, since it doesn't provide any anatomical region corresponding to the 'conceptual center' whose existence was assumed by Lichtheim and took for granted.

In view of the above, it is evident that Broca, Wernicke and Lichteim all considered language as an autonomous function located in specific areas of the brain, but although their undeniable contribution to the development of cognitive sciences, many scholars in both the 19th and 20th century rejected their theories.

In particular, Pierre Marie (1906) believed that Broca's aphasia could be caused by lesions located not only in the posterior inferior gyrus of the left frontal lobe, as Broca had thought, but also in the insula and basal ganglia. Furthermore, he suggested the existence of a unique form of aphasia, namely Wernicke's aphasia, given that he considered Broca's aphasia just a type of Wernicke's aphasia, caused by the loss of a special kind of intelligence. Marie believed that the comprehension deficit was the core of the aphasic syndrome, even if other symptoms either could arise, due to the damage of other brain areas. According to him, there wasn't any connection between Broca's aphasia and the damage of Broca'a area, whose lesion could cause only a disorder called anarthria, namely the impairment of the ability to articulate language, whereas the inner speech and the general intelligence appeared to be instead undamaged.

Another opponent of the localizationist model proposed by Broca, Wernicke and Lichtheim, was the neuropsychiatrist Kurt Goldstein, considered one of the major representatives of the holistic movement in the 20th century. He strongly rejected the localization hypothesis and he applied, instead, to language disorders the principle according to which when something affects a part, the whole is affected either:

> "The individual speech performance is understandable only from the aspect of its relation to the function of the total organism in its endeavor to realize itself as much as possible in the given situation." (Goldstein, 1948)

According to Goldstein, aphasic individuals lost their capability to 'abstract', namely to use language symbolically. He related the variety of aphasic symptoms, such as the loss of the representational function and the confinement to a concrete attitude, to a general intellectual impairment and to a particular way of being in the world.

Goldstein's assumptions have undoubtedly stimulated research and significantly contributed to the finding that the various aphasic syndromes cannot be explained in terms of homogeneous disorders caused by the selective damage of specific brain areas, or by the lesion of the connection between them. Nowadays, the idea that just an area could be responsible for an entire cognitive function seems to be unlikely, as it is proven by the high variability of the symptoms within the same clinical syndrome. Over the last two decades, a much more complex functional architecture of mental processes has been suggested, in place of the classic model of language proposed by Broca, Wernicke and Lichtheim. The

assumption that linguistic resources could be spread in the brain, rather than placed in restricted regions, implies a holistic view of the human mind, according to which language would rely on other cognitive resources, such as memory and attention. Thus, the brain is seen as a neural network where the various functions are interconnected and activated differently, depending on the specific activity. From this perspective, language disorders are not due to the damage of particular brain regions specifically involved in language abilities, but to the loss or lesion of one of the general cognitive resources on which language depend. As Moro (2006) states:

> "Today we believe that things are not so simple: it doesn't exist a single 'language area in the same way it doesn't probably exist any area involved in anything: the brain activates complex neural networks and the 'areas' are just parts preferentially involved, but not absolutely involved with regard to a certain function."

4.2 Aphasia features and classification

Affecting 0,02-0,06% of the population in the developed world, aphasia is an acquired language disorder following brain damage. It mostly occurs in middle age and older individuals, even if children can be affected either. Although men and women appear to be affected equally, some differences have been found between the two groups, depending on type and severity of the specific aphasic syndrome. As a matter of fact, while Broca's aphasia appears to be more frequent in men, Wernicke's and global aphasia are instead more common in women.

The etiology of aphasia is vascular (ischemic, or hemorrhagic stroke) in 80% of cases, but it can be caused by any other brain injury such as traumatic brain injury, brain tumors, infections, brain surgery and degenerative neurological processes like dementia. For most people (90%) the damage occurs in the left hemisphere, which proves its dominance for language. Nevertheless, in a smaller portion of individuals the hemisphere affected is the right one (crossed aphasia).

Aphasia rarely occurs as an isolated symptom, involving instead a multitude of other signs, whose severity can be influenced by many elements, such as the location of the lesion and its extent. For this reason, aphasic syndromes can be highly heterogenous, since different aspects

of language, such as phonology, syntax, semantics, pragmatics, might be altered as a consequence of the lesion. As Basso et al. (2011) state:

> "Because language is complex, the term 'aphasia' covers heterogeneous disorders that may have little in common. Indeed, it can be argued that the ways of being aphasic are practically infinite. Besides varying from one person to the other, aphasia is far from static in any given patient and is susceptible to changes, both spontaneously and as a result of rehabilitation."

Language related symptom	Explanation
Literal (phonematic) paraphasia	Words with false or left out sounds
Verbal (semantic) paraphasias	Wrong or inadequate words
Neologisms	Non-existent words
Anomia	Word retrieval difficulties
Agrammatism	Syntactically incomplete sentences, telegram style
Stereotypes	Repetitive set phrases
Dysarthria	Disturbance of articulation
Dysprosody	Disturbance of speech melody or rhythm
Agraphia	Disturbance of reading
Alexia	Disturbance of writing

Fig.14 Language related symptoms in aphasias

The classification of aphasia subtypes is still a matter of debate, since nowadays there is no consensual agreement on the system that should be used to describe the different expressions of this language acquired disorder. The classic and most common system continues to be the localisationist model, according to which two main categories of aphasia can be identified depending on the characteristics of verbal expression: fluent and non-fluent aphasias.

In fluent aphasias, as the name suggests, patients speak fluently and apparently easily, with a normal rate, rhythm and intonation, but the content of their speech is often difficult to comprehend due to the use of incorrect words and neologisms, for instance. Furthermore, the ability to understand verbal language is impaired. On the contrary, non-fluent aphasias are characterized by a relatively good level of verbal comprehension, while speech appears to be effortful, halting and with a varying number of errors involving not only the articulation of

words, but also substitutions of sounds or of entire words and difficulty in finding words (anomias), just to make some examples.

In both categories, impairments might affect not only spoken language expression and comprehension, but also the ability to write and to comprehend reading. At any rate, it is important to clarify that the difficulties experienced in both fluent and non-fluent aphasias, as well as in other aphasic syndromes don't included in those categories, may occur to varying degrees and significantly differ from person to person. This implies that a patient's symptoms might not fit systematically into a single aphasia type.

For all these reasons, the following classification might be susceptible to changes and, thus, should be considered just as an attempt to classify aphasias in terms of major characteristics remembering that, as Basso et al. (2011) claim, "the ways of being aphasic are practically infinite."

-*Fluent aphasias*: conduction aphasia, anomic aphasia, Wernicke's aphasia, transcortical sensory aphasia;

-*Non-fluent aphasias*: Broca's Aphasia, transcortical motor aphasia, global aphasia.

Crossed aphasia, subcortical aphasia and primary progressive aphasia (PPA) are considered 'other aphasic syndromes', given that they cannot be encompassed neither in the most common system of classification mentioned above, nor in others.

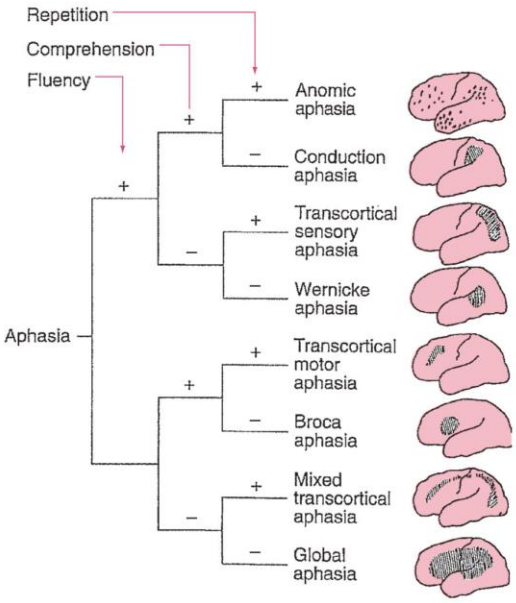

Fig.15 Localization of cortical aphasias

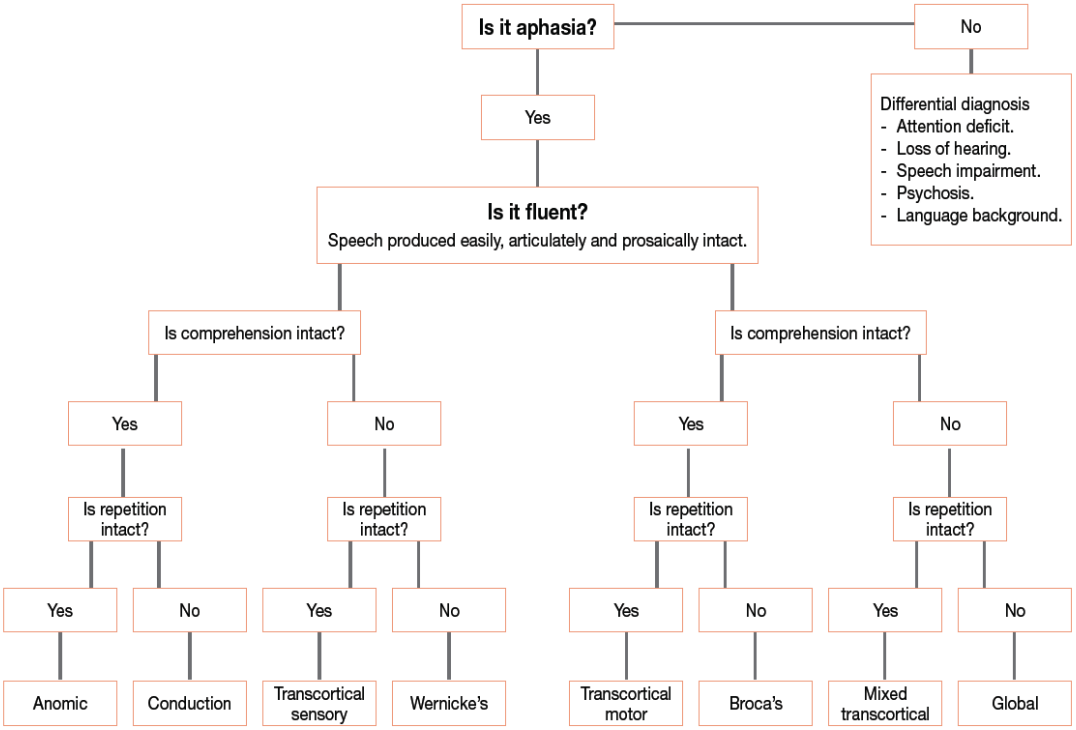

Fig.16 Aphasias flowchart

In order to have a better understanding of the different expressions of aphasic syndromes, the main characteristics of each type will be here described.

4.2.1 Non-fluent Aphasias

Broca's aphasia

In severe forms of Broca's aphasia language production is severely compromised, resulting in a telegraphic speech, while in more moderate cases the elements omitted in sentence construction are fewer. In its most classic manifestation, this type of aphasia is characterized by effortful, halting and telegraphic speech, reduced syntactic complexity and paucity of verbs. Precisely, sentences produced are often fragmented and agrammatic, namely not syntactically well-formed, since they mainly contain content words and lack, instead, function words. Common errors include inserting words in the wrong order during sentence construction, difficulty in producing phrases involving the movement of elements (e.g. passive and wh-questions) and problems with verbal inflections (e.g. 'Yesterday Jane <u>speaks</u> with her mother.') As a matter of fact, the verbs produced contain often the wrong inflectional affixes, but not all verb inflections appear to be affected in the same way. According to Faroqi-Shah and Thompson (2006):

> "What makes the verb inflection deficit in agrammatism interesting is that not all verb inflections are equally impaired. In contrast to inflectional morphemes that mark number agreement, or case, tense morphology is known to be especially vulnerable to disruption in agrammatic aphasia."

Broca's aphasics might also find it very hard to retrieve words, especially verbs, from their mental lexicon (phenomenon known as 'anomia'). As a consequence, finding the right words while speaking is often a strenuous process. Repetition and reading out loud are commonly laborious. Plus, impairments in written expression are frequent either. Indeed, the ability to write spontaneously, as well as the dictation might be affected, while copying written sounds, words and sentences is generally maintained. Verbal comprehension can be relatively preserved, especially when the subject of the conversation is familiar to the patient and its

grammatical structure is simple. Despite this, the ability to understand the spoken input might be impaired either, as it can be frequently observed in the case of sentences with more complex grammatical structures, such as passive and reversible sentences. According to Richardson et al. (2010) the difficulties in comprehending semantically reversible sentences is related to their peculiar properties:

> "[…] there are additional properties that can increase sentence complexity. A prominent class of such sentence types is semantically reversible sentences (e.g., 'The leopard races the young lion'). These sentences have an interesting property in that when the subject (e.g., leopard) and the object (e.g., lion) are swapped or reversed (e.g., 'The lion races the young leopard'), these sentences remain meaningful, although the exact meaning of the sentence is changed (for instance, the animal doing the racing changes). By contrast, in a non-reversible sentence (e.g.,'The dog chews the bone'), swapping the subject (e.g., dog) and the object (e.g., bone) results in a sentence with no real meaning ('The bone chews the dog')."

Concurrent motor speech impairments (dysarthria, oral apraxia and, less frequently, ideomotor apraxia) and motor deficits like hemiplegia and hemiparesis, are often found in Broca's aphasics.

Transcortical motor aphasia

This is a rare aphasic syndrome, due to the damage of the left convexital prefrontal, where the patients show good repetition, reading and writing skills. The verbal and written comprehension are generally intact either. Despite this, there is a strong tendency not to speak spontaneously, showing a significant lack of verbal initiative. Furthermore, when they answer the questions that they are asked, transcortical motor aphasics tend to talk effortfully and haltingly, making errors such as paraphasias, perseverations and other grammatical mistakes. All these symptoms observed in spontaneous speech and during conversations, resemble the ones that may be found in Broca's aphasics, but the latter show poor performances in repetition skills as well. Ardila (2010) argues that the defect in verbal initiative, rather than in verbal knowledge, makes this type of aphasia closer to a prefrontal syndrome, than a primary aphasic syndrome.

> "The impairment in extra-Sylvian (transcortical) motor aphasia does not affect language

> understanding, and fundamental linguistic processes are preserved […] And finally, it could be argued that the prefrontal cortex does not participate in basic cognition, but rather in metacognition […] In consequence, extra-Sylvian (transcortical) motor aphasia does not necessarily have to be interpreted as a primary aphasic syndrome, but rather as a language disturbance due to a more general intellectual impairment (dysexecutive syndrome). Extra-Sylvian (transcortical) motor aphasia could indeed be referred to as ‘‘dysexecutive aphasia.”

Concurrent motor speech impairments, such as dysarthria and apraxia, and other motor deficits as hemiplegia and hemiparesis, can occur in transcortical motor aphasia.

Global aphasia

This is the most severe form of aphasia, often caused by lesions to multiple areas of the brain involved in language faculties, usually placed in the left middle cerebral artery territory. In global aphasia all the aspects of expressive and receptive language are critically affected. The speech is non-fluent, restricted to few words real, or non-existing and not always used in the right context. In some cases the damage is so extensive that the patients can only produce some syllables (e.g. ‘Tan-Tan’), or neologisms (e.g. ‘Doopid’), often repeated in each situation in which they want to communicate something (perseverations). Oral and written comprehension are severely compromised, as well as written production. This type of aphasia is commonly observed immediately after the trauma that had caused the lesion and it might be susceptible to improvements. Nevertheless, these improvements are often restricted to the ability to understand the verbal output, while the other language faculties usually continue to be critically damaged.

Concurrent motor speech impairments, such as oral and ideomotor apraxia are common in global aphasics, as well as hemiplegia and hemianopsia. Despite this, in some cases the hemiplegia is transient or absent, a rare condition known as ‘Global aphasia without hemiplegia’ (GAWH). Its rareness is due to the dissociation between the intact motor function and the severely impaired language abilities. According to Corijin (2005), GAWH patients are similar on neurological examination, but they differ in lesion localisation and recovery of language function, whose degree depends on lesion localisation and extent.

> “GAWH-patients with multiple lesions in both the anterior and the posterior language areas show the most severe global aphasia and the least recovery. This is in contrast to the GAWH patients

where a single lesion, either anterior or posterior, causes the global aphasia that show much better language recovery. Accordingly, it is claimed that lesion site and the initial severity of language deficits can predict the outcome in patients with GAWH."

Thus, the predictive factor of linguistic outcome is not the preserved motor function, but the extent and the site of the lesion:

"After 3 months of speech-therapy post-onset the patients with different lesion profiles evolve into different aphasia-subtypes. Lesion analysis showed that persistent GAWH was related to lesioning of the left superior temporal gyrus. Patients with acute GAWH who evolved into a transcortical motor aphasia had lesioning of the left inferior frontal gyrus and adjacent subcortical white matter in common. Patients who evolved into a Wernicke's aphasia were characterised by lesioning of the left precentral and postcentral gyri."

4.2.2 Fluent Aphasias

Conduction aphasia

This type of aphasia was classically considered as the consequence of the damage to the arcuate fasciculus, which connects Wernicke's and Broca's areas. Despite this, more recent studies have instead shown that the lesion of the arcuate fasciculus don't always determine conduction aphasia and that other regions either, such as the left superior temporal gyrus and/or the left supramarginal gyrus, might be involved.

The oral production is fluent, but frequently interrupted by numerous anomias and paraphasias with attempts at self-correction, resulting in increasingly closer approximations to targets, a phenomenon known as 'conduite d'approche. As Buchsbaum at al. (2011) argue:

"The phonological production deficits in conduction aphasia are linked to articulatory planning load, so that picture naming or repetition of multi-syllabic words, sentences, and phrases is especially impaired […] Due to their relatively preserved auditory comprehension, conduction aphasics are capable of accurately monitoring -- and attempting to correct -- their own errors in speech output. This self-correcting behaviour often results in repeated unsuccessful efforts to correct a phonological speech error (e.g., "baselaw, lacelaw, basecall, casecall ..." for baseball), a behaviour that is sometimes referred to as conduite d'approche."

The same types of errors produced during the oral production, are present in repetitions and reading out loud either, and they can be so abundant that the patients cannot read, nor repeat correctly what they are told. Oral comprehension appears to be intact.
Concurrent motor deficits are common, while hemianopsia and motor speech impairments such as ideomotor and ideational apraxia, can be found less frequently.
Caramazza et al. (1981) reports the case of a relatively pure conduction aphasic with the following words:

> "On first impression, MC's language disability appears to be minor. He is attentive in social situations and seems to communicate without difficulty in casual conversation. However, close scrutiny of his verbal output in structured conversation reveals moderate word-finding difficulties and occasional paragrammatism […] and, of course, he exhibits a striking inability to repeat words presented aurally."

Anomic aphasia

In this form of aphasia the difficulty in finding the appropriate words is the main symptom and might affect both the oral and written production. The speech is fluent and grammatically correct, but often interrupted by pauses due to the abundant anomias. These hesitations during the spoken output are frequently filled by circumlocutions (e.g. 'the thing that is used to write', for 'pen'), or by more generic fillers (e.g. 'the thing'). Several factors, such as word frequency and imageability, have been suggested to influence word retrieval and, consequently, the related difficulties. The factors that might determine, instead, difficulties in verbs retrieval are less clear. Whit this regard, Jonkers and Bastiaanse (1996) investigated the effect of instrumentality (when the verb refers to an action for which a man-made instrument is required) and transitivity aspects of verbs on Broca's and anomic aphasics:

> "Both anomic and Broca's aphasics have significantly more problems in action naming, in comparison to object naming […] Instrumentality has no effect on action naming for Broca's aphasics, but for anomics a significant effect is observed. Post-hoc analysis revealed that this is especially due to the fact that name-related instrumental verbs are significantly easier than non-instrumental verbs […] Transitivity has effect on action naming for Broca's aphasics: transitive

verbs are significantly easier to retrieve than intransitive verbs; for anomics no such an effect is found."

Other errors, such as phonemic or verbal paraphasias (e.g. 'papple' for 'apple'; 'car' for 'van') can occur in anomic aphasics, but less frequently. Oral and written comprehension, as well as repetition and reading out loud, are preserved.

Since anomia is the symptom common to all the other non-fluent aphasic syndromes, it is hard to identify the specific area whose lesion can cause anomic aphasia. For the same reason, it is hard to assert which concurrent non-linguistic symptoms can be found in this type of aphasia.

Wernicke's aphasia

This is a type of aphasia where the patients tend to speak fluently with a normal rate, rhythm and intonation. Nevertheless, the content of their speech is often difficult to comprehend, due to the presence of numerous errors such as paraphasias, neologisms and phonemic jargon. This abundant production of senseless sentences is often accompanied by patients' apparent unawareness of what they are saying. The written production is frequently impaired as much as the oral one and characterized by the same types of errors. Oral comprehension, as well as repetition, reading out loud and dictation are severely affected. As Hartman et al. (2017) claim:

> "Both anomic and Broca's aphasics have significantly more problems in action naming, in comparison to object naming […] Instrumentality has no effect on action naming for Broca's aphasics, but for anomics a significant effect is observed. Post-hoc analysis revealed that this is especially due to the fact that name-related instrumental verbs are significantly easier than non-instrumental verbs […] Transitivity has an effect on action naming for Broca's aphasics: transitive verbs are significantly easier to retrieve than intransitive verbs; for anomics no such an effect is found."

Concurrent motor deficits are rare, while motor speech impairments such as ideomotor and ideational apraxia, as well as hemianopsia, are very common.

Transcortical sensory aphasia

This is an uncommon and severe form of aphasia, caused by the damage to the posterior cerebral artery territory, or to the area between middle cerebral and posterior cerebral arteries. The speech is fluent, with a frequent and abundant production of verbal and semantic paraphasias and neologistic jargon, so that it is often impossible to understand it. Oral and reading comprehension, as well as writing production, are severely disturbed. Reading out loud can be preserved, but paraphasias are present. The repetition of words and sentences is not impaired, even if the patients often don't understand their meaning. Plus, there is a strong tendency to repeat most of the interlocutor's phrases (echolalia), with apparent unawareness of their meaning. Interestingly, many transcortical sensory aphasics seem able to identify grammatical errors. Basso (2005) quotes the studies of Whitaker (1976) and Davis et al. (1978), where some patients were asked to repeat sentences containing grammatical errors, such as 'The children was back from the trip':

> "Many patients repeated the sentences correcting their grammatical error, suggesting thus the functional independence of semantics (compromised in these individuals) and grammar (apparently preserved, regardless of the meaning)."

Concurrent motor speech impairments, such as ideomotor and ideational apraxia are frequent, as well hemianopsia and anosognosia (deficit of self-awareness, where the patients are unaware of their impairments).

4.2.3 Other Aphasic Syndromes

Crossed aphasia

This type of aphasia occurs in those individuals whose hemisphere dominant for language is the right one, whereas in most people is the left. The precise incidence is still unknown, while two different types of this language disorder have been described. As Garcia-Caballero et al. (2007) state:

> "Crossed aphasia is a term coined by Bramwell in 1899 to refer to language dysfunction appearing after right hemispheric brain lesions in dextrals. The precise incidence of this type of anomalous language lateralisation is unknown, ranging from 1% to 13% of all patients with aphasia and being present in up to 38.5% of neurologically intact dextrals. Two types of crossed dysphasia have been

described, with either dissociated or simultaneous language and visuospatial deficit due to reversed representation of hemisphere-specific functions or transfer of most cognitive functions to the right hemisphere."

Subcortical aphasia

This is a rare form of aphasia caused by the lesion of subcortical brain regions, like basal ganglia, white matter tract, or thalamus. The spoken output, characterized by an abundant production of anomias, is generally poor and sometimes accompanied by dysarthria. Written production can be more compromised than the oral one, while repetition, reading out loud and oral comprehension are usually well preserved. Oral apraxia is common.

The symptoms above described may vary according to the affected subcortical region. As Kang et al. (2017) report:

> "Striato-capsular aphasia is associated with impaired executive language functions such as word fluency and sentence generation, but it largely spares responsive language functions such as comprehension, repetition, and naming. Thalamic aphasia may produce dysfunction at the prelinguistic level, such as impairments in concept generation and dysfunction in the control of preformed speech patterns. For aphasia related to white matter lesions, the primary language dysfunction is an impairment in speech motor output."

Primary progressive aphasia (PPA)

The term refers to the inevitable and progressive loss of language observed in some degenerative neurological diseases, such as Alzheimer's disease, or frontotemporal lobar degeneration. Unlike the other aphasic syndromes, in this case the impairment of language capabilities is slow and gradual, not sudden, and it might vary from person to person, starting sometimes as fluent aphasia and, other times, as non-fluent aphasias (depending on what parts of the left hemisphere are more susceptible to deteriorate due to the illness).

Concurrent symptoms which often occur are memory and executive functions impairments.

Filley et al. (2006) report the case of a Chinese- and English- speaking woman with PPA, the first case of this type of aphasia to be reported in a bilingual patient:

> "This 76-year-old right handed patient has had slowly progressive language disturbance for six years. Her first symptom was subtle word finding impairment, followed by articulatory deficits

and paraphasic errors […] Spoken output in both languages was marked by word-finding pauses, occasional articulatory awkwardness, and broken-off phrases that disturbed the melodic line, but was otherwise fluent […] Repetition and word finding were characterized by a predominant pattern of phonemic paraphasias in both languages […] Paraphasias were more evident in English, but repetition and conversation were more impaired in Chinese. The disparity in repetition between the two languages was not sufficiently large to permit a confident conclusion that a true difference existed."

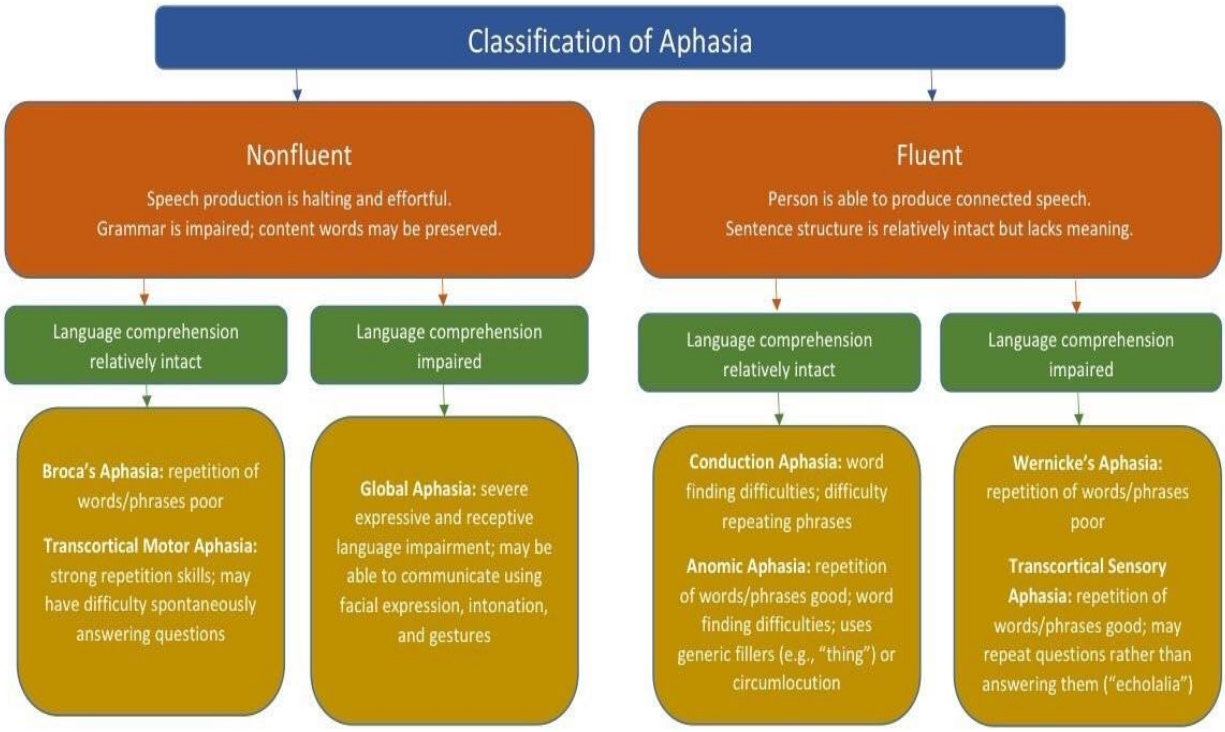

Fig.17 Common classification of aphasias

V. Bilingual aphasia

"'It's like having a head full of holes,
in which the perfect repository of
words have shamed themselves',
he lamented."
Diane Ackerman, *One Hundred Names for Love*.

Over the years, several studies have demonstrated how bilingual individuals with aphasia might show recovery patterns different from the ones observed in monolingual aphasics. Precisely, it has been argued that all the languages spoken prior to the brain damage might be impaired with the same degree of severity and recover simultaneously in some cases, while in others they might be affected differently and, consequently, exhibit a different and not concurrent pattern of recovery. As Fabbro (2001) states:

> "The most common patterns of recovery, described by Pitres (1895) in the first monograph on bilingual aphasia ever published, are (1) parallel recovery, when both languages are recovered simultaneously; (2) selective recovery, when only one language slowly comes back and the other is never recovered; and (3) successive recovery, when one language improves before the other(s)."

It is important to clarify that the possibility of exhibiting a non-parallel pattern of impairment and recovery, doesn't mean that different types of aphasia in each of the languages known can occur. Indeed, according to Fabbro (2001):

> "Aphasic disorders may or not may vary across languages in one and the same patient; they may be classified as typical of a single aphasic syndrome, though with different degrees of symptomatic severity according to the language. On the other hand, the hypothesis of the existence of a clinical picture of differential aphasia, namely a type of aphasia in one language (e.g., Wernicke's aphasia) and another type (e.g., Broca's aphasia) in another language, still lacks sufficient corroborating data."

With regard to which language is susceptible to show the best recovery, there is evidence that some variables have a crucial role, like the age of acquisition, the level of proficiency, the frequency of use and the linguistic context, as well as the similarities and differences between the languages spoken. Of all these variables, evidence from a number of studies suggests that the frequency of use is the one that influences more saliently recovery rate and pattern. Nevertheless, as Goral and Conner (2013) claim:

> "There is no consensus about their relative roles and the manner in which they interact. For example, whereas in several reports comparable impairment was evident in all languages of multilinguals speakers who acquired aphasia, for other individuals it was their first-acquired language that was more accessible to them than their learned languages. As well, there have been reports of later-learned languages demonstrating milder impairments than earlier-acquired languages. The differential abilities may be manifested in overall languages abilities or in selective language skills, such as comparable comprehension impairment but differential production abilities."

Sure enough, this topic is still a matter of debate. Some scholars, like Paradis (2004), argue that the language which usually recovers first and better than the other languages known is L1, while others like Goldstein (cited in Paradis 2004, p.69) and Minkowski (1983) state that bilingual individual with aphasia show a first and better recovery not necessarily in L1, but in the language most useful to them or to which they are more affectively tied, respectively.
What is sure is that several studies have reported a variety of recovery patterns, some of which are observed more frequently than others, but all of them likely to occur in bilingual aphasics. The more significant patterns will be described in detail as it follows.

5.1 Parallel and differential recovery

As previously mentioned, bilingual or polyglot individuals with aphasia might show the same degree of severity and, subsequently, of recovery in all the languages spoken prior to the brain damage. This phenomenon is known as 'parallel recovery', since all the languages recover concurrently and equally, and it implies that the language which was stronger before the trauma, will be the stronger one after the trauma either. It is widely accepted that parallel recovery is the most common in bilingual or polyglot aphasics, but not the only one. As a

matter of fact, there are other cases where aphasics tend to recover better one of the languages known and this language often appears to be the one that they were more familiar with before the brain damage. As Fabbro (1996) states:

> "With the exception of early bilinguals, first-language is often the most familiar one, the most automated and the one preferred to 'think' (basic language). By analyzing all the clinical cases of aphasia in bilinguals and polyglots that have been published until now I estimated that around 40% of patients shows a parallel recovery of the two languages, 32% shows a better recovery of first-language, while the residual 28% of patients shows a better recovery of second-language."

An early clinical case of first-language recovery in aphasia is the one cited in Fabbro (1996), who mentions the study conducted by Denès (1914) on a theater ballet dancer whose language abilities had been severely impaired after a stroke that she had suffered in 1905. Her L1 was French, but she was also fluent in Italian. Shortly after the brain injury, the only word that she was able to say was 'oui' (yes), but by the passing of time she gradually improved in both verbal production and comprehension. Nevertheless, the recovery in the languages that she spoke before the brain damage didn't occur to the same extent, showing instead a different pattern of impairment. As a matter of fact, L1 recovered much better than L2. The deficits observed in both languages were similar, but her second language (Italian) appeared to be more critically compromised than the first one (French).

According to Pitres (1895), who was the first to publish a monograph on bilingual aphasia, the cases in which one language, either L1 or L2, is recovered better and sooner than the other, might mean that the other is somehow inhibited. As Fabbro (1996) says:

> "According to Pitres, the patient usually showed a better recovery in the most familiar language because it kept the connections with the neural elements in a more stable manner. If the patient had become aphasic due to a sort of 'numbness' of language areas, these pathological inhibitory phenomena should have impaired especially the languages whose connections with the neural elements were weaker. These hypotheses found either supporters and detractors (for instance the concept of the more automated language proposed by Pick, or the one of basic language proposed by Chlenov), and even now there isn't a univocal rule that can be applied to all the cases observed."

The first significant studies focused on the reasons for which some bilingual and polyglot aphasics recovered better and sooner their second-language instead of their one, were conducted in the early decades of the 1900's by the Swiss neurologist Mieczyslaw Minkowski. According to him (1927) several variables had a crucial role in determining second-, in place of first-language recovery, and they were all related to neurophysiological factors, instead of the anatomical ones (e.g. the existence of specific brain regions for each language known):

> "If we don't assume different cortical centers or areas for each different language, but we assume instead that within the same cortical area the same elements are active, although differently combined and differently interacting between each other […], it is easy to account for the phenomena observed in polyglot aphasias."

As Pitres already assumed before him, Minkowski supported the idea that 'differential recovery' observed in bilingual and polyglot aphasics, where one language is preserved more than the other/s, could be due to the impairment of the neural connections underlying the normal balance between all the languages spoken prior to the brain damage. But, unlike Pitres, Minkowsi focused his studies on the reasons that could determine the differential recovery, identifying a variety of factors that could cause a better recovery in second-language and not in L1 or in the most familiar language. These factors include visualizability, orthography, affectivity, relevance of the environment to the language recovered and its degree of automatism, the context of acquisition and the severity of aphasia.

The first case of second-language recovery described by Minkowski (1927) was a 22-year-old mechanic whose brain injury was the consequence of a car accident. His first-language was Swiss German, but he was also fluent in Standard German, as well as in French and Italian. Shortly after the trauma, he lost the ability to comprehend and speak in his L1 (Swiss German), as well as in French and Italian, while his competences in Standard German appeared to be preserved:

> "When he was asked about this strange incapability of talking in his mother tongue, he said that his strategy was to visualize internally the words that he wanted to pronounce and, since he had learnt how to read only in Standard German, he was able to visualize the words only in this language, but not in Swiss German. In the following months he talked only in Standard German.

> In a short period of time, his ability to comprehend Swiss German recovered, but oddly, one year after the trauma, he could still not talk in this language […] With regard to French and Italian, immediately after the accident he couldn't understand, nor talk in these languages. Slowly, these deficits improved and the patient recovered the ability to understand and translate simple expressions in both these languages. (Fabbro, 1996).

5.2 Selective recovery

Selective recovery takes place when patients recover only one of the languages they spoke prior to the brain damage. In other words, only one language is critically impaired and doesn't show any significant sign of improvement by the passing of time, while the other or others don't present aphasic symptoms. This is in contrast to both parallel recovery, where all the languages spoken are affected, but they recover at the same time and to the same extent; and non-parallel (differential) recovery, where all the languages are affected either, but only one recovers sooner and better than the other/s.

The selective loss of one language ('selective aphasia') might prove that the different languages spoken are placed in different areas of the brain. However, there is still no consensual agreement on this topic. As a matter of fact, if on one hand some scholars have suggested that languages may be located in different anatomical regions of the brain, on the other hand the majority has argued that the separation between the various languages might be only functional, not involving different anatomical brain areas. As Fabbro (1996) says:

> "Almost all neurologists in the past strongly rejected this rather simplistic interpretation. Penfield and Roberts summarized efficaciously their clearly opposite position by saying 'There isn't any reason to hypothesize that a specific brain area is used to support a certain language, and a different area is used to support another language."

The first one who tried to explain the mechanisms underlying differential and selective recovery was the clinician Pitres (1895). With regard to selective recovery, he didn't believe in the existence of different brain areas for each language known, supporting instead the idea of physiological and not anatomical factors involved in selective recovery. He rejected what some neurologists, like Scoresby-Jackson (1867), claimed, namely that the lesion of a specific cortical area could determine an aphasic syndrome of the language located in that area,

sparing instead another language located in a different brain region. Contrary to this view, Pitres considered, as factor responsible for selective aphasia, the permanent physiological inhibition of one of the languages spoken. According to Paradis (2004), the most likely hypothesis is the one which explains selective recovery in terms of control over limited resources, that is the factor which may determine the inhibition of one language or the other:

> "In the activation threshold hypothesis, this inhibition is viewed as subject to degree (commensurate with variable amounts of available resources) rather than an absolute on/off phenomenon."

In accordance with this view, the language impaired is not lost, but only selectively inhibited by neurophysiopathological phenomena caused by the brain damage. Consequently, as Fabbro (1996) states:

> "According to Paradis and Goldblum the languages known by a bilingual or polyglot individual are simply separated on a functional level, not anatomical. So that each language is a neurofunctional system isolated and independent from the other languages."

5.3 Successive and antagonistic recovery

The physiological inhibition, suggested by Pitres, Paradis and others as the factor responsible for selective recovery, may explain other two kind of recovery observed in bilingual and polyglot aphasics: successive and antagonistic recovery.

In successive recovery one language begins to recover only when the other is completely recovered but, unlike what happens in selective recovery, the physiological inhibition that causes successive recovery is temporary and not permanent.

In antagonistic recovery, instead, one language regresses as the other recovers and this phenomenon may be explained by hypothesizing a physiological inhibition that is neither permanent nor temporary, but rather alternating. This accounts also for a particular type of antagonistic recovery, namely 'alternating antagonism', where patients can access only one of their languages in spontaneous speech for alternating periods of time. Fabbro (1996) describes the case of a 23-year-old man bilingual in French and English and whose recover appeared to

have the characteristics of an alternating antagonism. For a certain number of weeks after the trauma, the man showed aphasic symptoms alternatively in the two languages he spoke prior to the brain lesion:

> "During the first week he couldn't say any word in French, while he was able to speak in English […] The comprehension was preserved in both languages. In the second week the patient recovered French, but he was no more able to speak in English, which was the language spoken by the nurses at the hospital and with whom he wasn't able to communicate anymore. In the third week he recovered again English."

The study of antagonistic recovery has had a fundamental role in the understanding of the underlying factors that determine aphasic syndromes. What has been observed in patients showing this recovery pattern can't be explained in terms of 'losing a language' and 'preserving the other', since it wouldn't be possible to restore a language that was lost just the day before. What seems, instead, likely is that the language unavailable in a given moment can be available in another because it hadn't been lost, but only inhibited.

5.4 Mixed/Blended recovery

This pattern of recovery is characterized by the inappropriate and unconscious mixing of two or more languages, and/or by the frequent tendency to switch between the languages known. As a consequence of this phenomenon, patients appear unable to use only one linguistic code at a time. It is important to clarify that, unlike what happens in pathological mixing and switching, the common practice of code switching and mixing in bilingual and polyglot individuals is an intentional act which follows specific rules. As Fabbro (1996) claims:

> "Usually, when they talk, bilingual individuals use only one language at a time, without mixing the languages that they know. This rule is rigorously followed when the interlocutor comprehends only one language. In this case, if a bilingual individual really wants to communicate, he has to use the language shared by both speakers. Nevertheless, this rule is not needed if all the interlocutors share two or more languages; in this case they can switch between languages, mixing many or few elements of the languages mutually known."

The elements involved in pathological mixing might interest several levels of language: phonological, lexical, syntactical and grammatical. The neurolinguist Perecman (1984), cited in Fabbro (1996), describes the case of a man whose pathological mixing, caused by the brain trauma that he had suffered, was significant. His L1 was German, but he was also fluent in French and English:

> "Mixing phenomena involved different levels of language. As a matter of fact, H.B. mixed the languages on a phonological level: '…*standing that means* ständing ständing führen…', on a lexical level: 'Ja ja *c'est difficile*', *The eggs were* verschwunden'; on a syntactical level: Therapist: *'Haben Sie auf Deutsch die Bücher gelesen* (Did you read the books in German?), H.B. '*Yes, I read I read some German books.'*"

5.5 Paradoxical recovery

Interestingly, it is not uncommon to find bilingual or polyglots aphasics who recover a language that they never used to communicate, such as a dead language like Latin, or a second-language restored with a degree of competence higher than the one they had prior to the brain damage. This pattern of recovery is known as 'paradoxical recovery'.

Fabbro (1996) reports the case of an aphasic woman, who recovered a language with a level of proficiency that she didn't know she had before the stroke. Her L1 was an Italian dialect (Veronese) typical of the region where she was born and raised. Since her childhood and during all her life she had spoken only in Veronese. She was briefly exposed to Italian for three years, when she attended the elementary school, a period in which she learned how to read and write in that language. When she restarted speaking after the stroke that she had suffered when 70-year-old, surprisingly she was fluent only in Italian, while she had lost her ability to speak in Veronese. With regard to paradoxical recovery of a dead language, Fabbro (1996) describes the case of a polyglot aphasic observed in 1902 by the physician Hinshelwood. The man's first-language was English, but he knew very well even French, Latin and Ancient Greek. When he was 34-year-old he became global aphasic due to an infective disease:

> "Within a few days he recovered the ability to produce and comprehend the oral speech, while his difficulties in reading were still severe. In English he could only read out loud the

letters of the alphabet and a few words, while paradoxically he was able to read Ancient Greek slowly, but without committing mistakes. He found it harder to read in Latin than in Greek, but anyway better than in French and English […] Aphasia had clearly impaired all the modern languages learnt through auditory-verbal strategies, while it had spared those languages acquired only through reading."

Paradoxical recovery has been partially clarified by recent studies conducted on the types of memories involved in language acquisition, precisely, implicit and explicit memory. It is now widely accepted that these two types of memory are represented in different brain structures: subcortical structures and delimited cortical areas (implicit memory), and wide cortical territories (explicit memory). Paradis (2004) has suggested that first-language might be mainly represented in subcortical areas and delimited cortical territories, since it is learnt informally and unconsciously. On the contrary, second- and other languages, if acquired explicitly, might be widely represented in cortical areas of the brain. The above mentioned case of a dead language like Latin, is an example of a language memorized in an explicit memory system, since it is usually learnt formally at school, even if never used to communicate verbally. In the same way, other languages as well are 'stored' in explicit memory systems, such as active languages learnt consciously in whatever context and actively or not actively employed, with a varying degree of proficiency.

According to Paradis' hypothesis, the brain damage can selectively affect either explicit or implicit memory systems. Nevertheless, the impairment of the languages learnt implicitly (implicit memory systems) is far more common. It is then not surprising to find bilingual or polyglot aphasics who recover better and/or sooner those languages acquired and used mainly explicitly and/or in which they had a lower level of competence before the brain lesion.

Recovery pattern	Language characteristics
Parallel recovery	Recovery of languages parallels the premorbid relative abilities. If one language were stronger premorbidly, it would return to being stronger.
Differential recovery	One language is recovered much better than the other compared to premorbid abilities.
Antagonistic recovery	One language is initially available, and as the other language recovers, the initially available language disappears.
Alternating antagonism	Repetition of the above pattern with languages alternating in availability. This may occur within cycles ranging from 24 hr to several months.
Blending recovery	Uncontrollable mixing of words and grammatical constructions of two or more languages even when attempting to speak in only one language. This should not be confused with the common bilingual practice of code switching.
Selective aphasia	Language loss only in one language with no measurable deficit in the other.
Successive recovery	The recovery of one language before the other(s).

Note. Adapted from Paradis (2004) and Fabbro (2001a).

Fig.18 Recovery patterns in bilingual aphasia

VI. Effects of treatment provided in both languages to a bilingual Sardinian-Italian speaker with aphasia: A case study

"If only we knew,
as the carver knew, how the flaws
in the wood led
his searching chisel to the very core,
we would smile too
and not need faces immobilized
by fear and the weight of things undone."
David White, *The Faces at Braga*.

6.1 Abstract

The majority of people in the world speak more than one language, thus language and communication disorders among multilingual population is an increasing phenomenon. As a consequence, the interest in bilingual aphasia and in its recovery represents nowadays an important line of research. Nevertheless, little is known about the best practices for language and communication therapy in bilingual aphasia, since research in this field is still at an early stage. Among the various theories, it seems no longer acceptable that bilingual or polyglot aphasics are assessed and treated in only one of the languages they know, even if this is still the tendency that appears to be the most common. This is due to several reasons. One is the idea according to which bilingual therapy might lead to increased mixing and/or switching phenomena, determining confusion in the patient and the possibility of repressing the recovery of one language. Another reason, is the restricted availability of multilingual speech-language pathologists and bilingual co-workers as a support during the therapy sessions.

Following the call for more reflection on bilingual aphasia in different languages, the current study aims to determine whether all languages spoken by an aphasic prior to a brain damage

should be assessed and treated and if treatment conducted in all languages may facilitate the recovery.

This paper reports the effects of treatment provided in both languages to a bilingual Sardinian-Italian speaker male with aphasia, who had suffered two strokes in 2015 and 2017, respectively. The therapy sessions were mediated by a bilingual co-worker, since no bilingual speech-language pathologists were available. Despite patient's first-language is Sardinian, previous therapy following the first stroke was provided exclusively in L2 (Italian), mainly because this is the language spoken by most of the people in the region (Sardinia) where the patient has been living since his birth and in which it is not easy to find bilingual Sardinian-Italian speech-language pathologists.

Pre-treatment assessment on the BAT, conducted after the second stroke, showed an almost equal impairment in both languages known by the patient, while the results of post-treatment assessment showed a mild improvement of oral expression in Sardinian. Nevertheless, in the informal context of the therapy sessions and domestic environment, concurrently with the progression of treatment, the patient's performance in oral production appeared to be characterized by a higher level of accuracy than the one observed during the assessment on the BAT. What was observed is that he improved significantly better in Sardinian than in Italian (differential recovery), showing thus a partial recovery in at least one of the languages known before the brain damage. A similar outcome wasn't reached when treatment was provided exclusively in one language (Italian). In that case, only auditory comprehension significantly recovered in both Italian and Sardinian and to the same extent, while the spontaneous speech output didn't show any significant improvement in either language known.

The results of this study confirmed the prediction according to which bilingual population with aphasia should receive a comparable assessment in all languages spoken prior to onset of symptoms, in order to determine the degree of impairments in either language, which is in turn the fundamental prerequisite to plan an adequate treatment. Another assumption proved to be exact, namely that treatment should be offered to all affected languages, since a therapy that purposely focuses on one language excluding the other might deprive bilingual aphasics of the possibility to reach a satisfying recovery.

6.2 Introduction

Despite the growth of bilingualism all over the world, the question whether it has positive or negative effects on cognitive abilities is still a matter of debate, since misconceptions about it are still prevalent. Nevertheless, the approach to bilingualism has significantly changed in recent years, since nowadays the cognitive advantages related to learning more than one language are starting to be recognized by a larger portion of society. As a matter of fact, it is well accepted that learning a second language might positively restructure the brain, as it is shown by some changes in its structural plasticity. It has been argued that the acquisition of L2 is related to an increase in grey and white matter density, as a consequence of the cognitively demanding skills which appear to involve the bilingual more than the monolingual individuals. There is a growing evidence that the exposure to more than one language has a great impact on the structure of the brain, modifying the neural organization for language. Learning more than one language, especially when this happens early in life, affects how the brain both recruits and activates the regions involved in language related tasks, resulting in a greater brain activation and plasticity, compared to what observed in monolingual speakers. Bialystok et al. (2012) tried to explain the reason why bilingualism is related to better performances in cognitive functions, such as problem solving, attention and working memory. They assumed that "lifelong experience in managing attention to two languages reorganizes specific brain networks, creating a more effective basis for executive control and sustaining better cognitive performances throughout the life span" (Bialystok et al., 2012).

Health benefits of bilingualism on the brain are also evident from a variety of studies investigating the protective effects that knowing another language have from cognitive impairments in Alzheimer's disease and, in general, in the aging brain. The results showed that bilingualism and multilingualism might delay the onset of symptoms, in people with dementia and other age-related impairments, by about 4-5 years. This further finding supports the conviction that the acquisition of more than one language might both strengthen and protect the brain, respectively by reworking its structure and by leading to use its energy in a more efficient and conservative way.

Together with an increasing interest in bilingual brain and in the cognitive benefits related to knowing more than one language, the interest in the presentation of aphasia and language control in a multilingual brain has arisen either. As a matter of fact, the growth of

bilingualism worldwide implies to face a growing number of multilingual people suffering from acquired language and communication disorders. Despite this, there is still a paucity of information on bilingual aphasia, especially regarding its assessment and treatment, but also its recovery. Sure enough, one important phenomenon observed in bilingual aphasics is the possibility of facing various recovery patterns of languages after the brain damage. It has been demonstrated that bilingual individuals with aphasia might show recovery patterns different from the ones observed in monolingual aphasics. Precisely, it has been argued that all the languages spoken prior to the brain damage might be impaired with the same degree of severity and recover simultaneously in some cases, while in others they might be affected differently and, consequently, exhibit a different and not concurrent pattern of recovery (Fabbro, 2001). With regards to which language is susceptible to show the best recovery, there is evidence that some variables have a crucial role, like the age of acquisition, the level of proficiency, the frequency of use and the linguistic context, as well as the similarities and differences between the languages spoken. Of all these variables, evidence from a number of studies suggests that the frequency of use is the one that influences more saliently recovery rate and pattern. Nevertheless, there is still no consensus about their relative roles and the manner in which they interact (Goral, Conner, 2013). For this reason, this topic is still a matter of debate. Some scholars, like Paradis (2004), argue that the language which usually recovers first and better than the other languages known is L1, while others like Goldstein (cited in Paradis 2004, p.69) and Minkowski (1983) state that bilingual individuals with aphasia show a first and better recovery not necessarily in L1, but in the language most useful to them or to which they are more affectively tied. What is sure is that several studies have reported a variety of recovery patterns, some of which are observed more frequently than others, but all of them likely to occur in bilingual aphasics.

With regards to which speech-language therapy should be provided to bilingual aphasics, there is still limited research concerning the most effective treatment, especially regarding which language to treat and if all languages known by a person before a brain damage should be treated. Some scholars have assumed that treating bilingual aphasics in their second-language might yield good outcomes in their first-language either (Edmonds, Kiran, 2006; Kohnert 2004). Others report, instead, a possible inhibition of the stronger language when the therapy is provided in the weaker language (Goral, 2012). It is clear that there is still no consensual agreement on how to select the language to treat. For some researchers, the

language that should receive treatment is the first one; for others it is the least impaired and others again assume that the therapy should be provided to the language that is worst impaired. In any event, at present only one language is usually rehabilitated, since the common tendency is still to think that bilingual therapy might lead to increased mixing and/or switching phenomena, determining confusion in the patient and the possibility to suppress the recovery of one language (Hemphill, 1976; Lebrun, 1988). Another reason is the lack of speech-language pathologists who speak all languages spoken by their bilingual or polyglot patients. It is, then, clear that treating bilingual aphasics poses evident challenges, such as the previously mentioned scarce availability of bilingual speech-language pathologists, as well as a general disagreement on whether to focus on a single language or to include all languages in treatment. Despite this, an increasing number of studies have pointed out that the best choice is to provide bilingual therapy, assuming that the inclusion of either language in the therapy might make the bilingual aphasics able to use all possible communicative strategies available to them. (Ansaldo et al., 2008; Kohnert, 2004). In line with this assumption is the approach called Switch-back through Translation (SBT), whose aim is to integrate into treatment pathological switching and mixing, together with translation. In this way these pathological phenomena are transformed into a rehabilitation method, where target words are accessed by means of translation (Ansaldo et al., 2008).

To address the need for information regarding bilingual rehabilitation, the current study investigates the effects of intervention provided in both languages to a bilingual Sardinian-Italian speaker, 63-year-old right-handed aphasic man. Assessment on the Sardinian and Italian version of the Bilingual Aphasia Test (Paradis, Libben, 1987) was conducted pre- and post-treatment. Both the assessment and the speech-language therapy in Sardinian and Italian were mediated by a bilingual co-worker (participant's daughter), since no bilingual speech-language pathologists were available when this study took place.

The aims of this study are to determine whether all languages spoken by an aphasic prior to the brain damage have to be assessed and treated and if treatment conducted in all languages may facilitate the recovery.

The first prediction of the current work is that bilingual aphasics should receive comparable assessment in all languages used prior to onset of symptoms, in order to determine the degree of impairments in all affected languages, which is the fundamental prerequisite to plan the most efficient treatment. The other main prediction of this study is that therapy should be

offered in either language, since this might increase the probability of recovery and consequently improve the quality of life, considering that a treatment which purposely focuses on one language excluding the other might deprive bilingual aphasic clients of the possibility to optimize communication and isolate them from their social networks.

6.3 Research hypotheses

This study is based on the hypothesis that bilingual aphasics should receive comparable assessment in all languages used prior to onset of aphasia, since several studies have shown that bilingual aphasics don't always exhibit the same degree of impairment in all their languages. Thus, a comprehensive evaluation is fundamental in order to plan the most efficient treatment for both languages. The other main prediction of the present work is that treatment should be provided in either language, since this might increase the probability of recovery, considering that limiting speech-language therapy to only one language might be equivalent to treat only one language level in monolingual aphasic individuals.

6.4 Aims

This study has the purpose to address the following questions:

1. Do all languages spoken by a person prior to a brain damage have to be assessed and treated?
2. May treatment conducted in both languages increase the probability of recovery?

6.5 Methods and procedures

Selection criteria for articles and books

A variety of articles, including some systematic reviews and literature, were discussed in order to provide details on: monolingual and bilingual brain, with a focus on similarities and

differences; characteristics of acquired language and communication disorders in monolingual and bilingual adult individuals; recovery patterns in monolingual and bilingual adults with aphasia; assessment and treatment of exclusively one language in bilingual and polyglot adults with aphasia; assessment and treatment of all languages in bilingual and polyglot adults with aphasia. These studies were examined for the questions that addressed and the answers that provided. Several books on the above mentioned topics, either in Italian or English, were included in the search.

Search strategy for articles

The research articles for this study were obtained by conducting a computer database search. These databases included: Scholars Portal, Google Scholar and PubMed. The following search terms were used: language acquisition; bilingualism; monolingual and bilingual aphasia features; monolingual and bilingual aphasia assessment, treatment and recovery.

Informed consent

The participant and his relatives were informed about all aspects of this research project (e.g. purpose of the study, procedures to be undertaken, obligations of research participation, participant's right of withdrawing consent any time during the study, etc.).

Informed consent was obtained prior to initiation of this study by administering the participant the informed consent form (see 'annexes'), where the subject provided his consent on participate voluntary to this study, in written, by signing the informed consent form.

Case details

M.C. is a bilingual Sardinian-Italian speaker, 63-year-old right-handed male, with severe non-fluent expressive aphasia following a left hemisphere stroke occurred in 2015, at the age of 61. In 2017, four months before entering this study, the patient suffered a second cerebrovascular accident (CVA). In both cases, the MRI-scan showed the presence of a left nucleo-capsular ischemia extended to corona radiata. Medical findings noted intima-media thickening in carotid artery associated with presence, at the point where the left common

carotid artery (CCA) bifurcates, of hypoechogenic plaque extended to the origin of internal carotid artery (ICA), without significant stenosis.

After the first stroke, M.C. initially presented with a global aphasia and oral apraxia, that later resolved to a severe expressive non-fluent aphasia and residual oral apraxia. Concurrent right hemiplegia of the upper and lower limbs was observed since onset of symptoms. He didn't have any auditory and visual problems before and after the stroke. In the years following the first cerebrovascular accident, he received speech-language therapy in Italian (his second-language), in individual setting. Shortly after the second cerebrovascular accident happened, a mild worsening of the previous aphasic symptoms was reported. Nevertheless, this aggravation of language abilities recovered soon and, at the time of participation in this study, the overall clinical picture appeared to be the same observed prior to the second brain damage, namely a severe non-fluent expressive aphasia and concurrent oral apraxia.

Language history: assessment of language proficiency and experience in Sardinian and Italian prior to the brain damage

M.C. was born and has been living since his birth in Busachi, a small village in the Province of Oristano, in the Italian region Sardinia, where he currently resides with his wife and his two children. In order to characterize his language acquisition and use experiences prior to the brain damages that he had suffered, two family members (wife, daughter) were interviewed and asked to complete the comprehensive questionnaire 'Language Experience and Proficiency Questionnaire LEAP-Q' (Marian, Blumenfeld, Kaushanskaya, 2007). Domains assessed by the LEAP-Q covered the following information specific to each language: (a) acquisition history; (b) contexts of acquisition; (c) present language use; (d) language preference; (e) language proficiency ratings across the four domains of language use (speaking, understanding, reading, and writing); (f) accent ratings. Additional information regarding patient's history of bilingualism were obtained by administering his wife and daughter the section of the Bilingual Aphasia Test regarding pre-morbid language history (Part A, first 17 questions of Part B).

According to what reported in the LEAP-Q, in the Part A and in the first 17 items of the Part B of the BAT, M.C. was exposed from infancy to Central Sardinian, which is one variety of Sardinian language spoken in central Sardinia where he was raised. Both his parents were

monolingual Central Sardinian speakers, reason for which this was the only language spoken at home during his childhood and it kept being so after he got married either. As a matter of fact, his wife and daughter reported that they had always communicated at home in Sardinian, considered as the household language, although all the family members are fluent in Italian as well. No frequent code-switching phenomena between Central Sardinian and Italian were reported before the CVA. At the age of 6, in concomitance with the exposition to formal education at primary school, M.C. learned Italian language, which is currently the first-language spoken by the majority of people living in Sardinia. Nevertheless, at the time where M.C. was six years, Sardinian in all its different varieties was the predominant language in rural areas of the island, like the one which the participant of the current study comes from. Nowadays, it is instead commonly, but not exclusively, used among families and friends. Thus, Italian was learnt formally at school and spoken mainly in that context during his childhood. After living school at the age of 11, M.C. started working as a farmer and continued to do this job until the first stroke occurred. With regard to this aspect, it has to be specified that the predominant language at work was still Central Sardinian, although Italian language as well was commonly used by him on a daily basis, especially in formal contexts like public offices, hospital and church. Plus, he has always received a constant exposition to Italian via television and the general community. Hence, M.C. was pre-morbidly very fluent in both spoken Sardinian and Italian and very good in reading either languages, while his writing was grammatically more correct in Italian, given that he received formal education only in this language. Nevertheless, according to his wife and daughter, Sardinian has always been the language to which M.C. is more affectively tied.

Previous speech-language intervention in Italian (L2)

Prior to participation in this study, M.C. received speech-language therapy exclusively in Italian (L2) at an Italian-speaking neuro-rehabilitation center in Sardinia, Italy. Treatment started at 1month post-onset and comprised a total of 20 months. During the five months of the first hospitalization the therapy consisted of five sessions per week, most of which lasted for 45-55 minutes, and it was provided in individual setting by a native Italian-speaking speech-language pathologist. The intervention continued on an outpatient basis, two times a week, for 45-55 minutes each session, until the second stroke occurred (June 2017). After that

episode, M.C. was hospitalized again for two weeks, receiving speech-language assessment and treatment, since he showed a mild worsening of the previous language and communication disorders, that soon resolved. At the moment of the discharge, the overall clinical picture was the same observed before the second brain damage. The speech-language therapy continued to be provided on an outpatient basis exclusively in Italian until the present study started (October 2017). Assessment and treatment in Sardinian language were never administered before this work.

The initial speech-pathology report following the first stroke described a case of severe global aphasia, with concurrent oral apraxia. The speech was non-fluent, so critically impaired that M.C. was able to produce only some syllables, often repeated in each situation in which he wanted to communicate something (perseverations). Oral and written comprehension were severely compromised, as well as picture naming, spontaneous written production, written copy and oral repetition. Concurrent oral apraxia was reported either.

Speech-language intervention in Italian focused on oral and writing production, on auditory and reading comprehension and on compensatory strategies. Oral apraxia, by means of various exercises which were aimed to increasing M.C. articulatory abilities, was treated as well. Treatment lasted 20 months, at the end of which recovery in the comprehension of the verbal output, as well as mild improvements in single-word reading, copy and repetition, were noted. The ability to write spontaneously was possible only for his name and surname, and picture naming always needed phonological cueing. Spontaneous output kept being extremely reduced and severely effortful, but the use of gestures as augmentative and alternative method of communication significantly improved. The clinical picture of global aphasia and oral apraxia initially observed in M.C., resolved thus to a severe non-fluent expressive aphasia, with residual oral apraxia and right hemiplegia of the upper and lower limbs.

Pre-treatment assessment of language impairments in Sardinian (L1) and Italian (L2): general considerations

Prior to initiation of this treatment protocol, the BAT test and the CETI questionnaire were administered to assess speech-language abilities, semantic knowledge, reading and writing skills and communication effectiveness. Furthermore, in order to monitor participant's improvements and to compare the pattern of recovery in all languages known at the end of

treatment, in concomitance with the beginning of the speech-language therapy and until its end, his wife and daughter were asked to fill a daily diary reporting each verbal output spontaneously produced by M.C every day, in both Italian and Sardinian.

As previously mentioned, because of the need to measure not only language abilities, but also functional communication, in addition to the BAT, the Communicative Effectiveness Index - CETI- (Lomas et al., 1996) was administered either and completed by M.C.'s wife and daughter, since the participant wasn't able to complete it when this study commenced.

The CETI is a questionnaire consisting of 16 communication situations, rated from 'Not at all able' (rated 1) to 'As able as before' (rated 7). The total score is obtained by dividing the sum of the individual ratings by the total number of items rated. A high score indicates a better performance, while a low score indicates a poor performance. The questionnaire is appositely intended to be filled by both stroke survivors and their significant others, who are considered extremely reliable since they spend enough time with the aphasic individuals to make accurate judgement of their communication performance. In the current study, the CETI was used to document M.C.'s evolution of both language and not-language ability to solve communication problems of daily-living activities. For this reason, it was administered prior and after the speech-language therapy. The total score - 2,75 - obtained by M.C. in pre-treatment assessment showed a severe impairment of communication skills in many of the 16 communication situations reported on the CETI (see Figure 19).

Getting somebody's attention	6
Getting involved in group conversation that are about him	1
Giving yes and no answers appropriately	6
Communicating his emotions	5
Indicating that he understands what is being said to him	6
Having coffee-time visits and conversations with friends and neighbours (around the bedside or at home)	1
Having a one to one conversation with you	1
Saying the name of someone whose face is in front of him	2
Communicating physical problems such as aches and pains	5
Having a spontaneous conversation (e.g. starting the conversation and/or changing the subject)	1
Responding to or communicating anything (including yes and no) without words	5
Starting a conversation with people who are not close family	1
Understanding writing	1
Being part of a conversation when it is fast and a number of people are involved	1
Participating in a conversation with strangers	1
Describing or discussing something in-depth	1

Fig. 19– 16 Items of the Communicative Effectiveness Index (CETI) of M.C.'s assessment pre-treatment

With regards to the assessment of residual language abilities in M.C., the Italian and Sardinian versions of the Bilingual Aphasia Test -BAT- (Paradis, Libben, 1987) were administered. This test, in both versions, consists of three different parts: Part A, Part B, Part C.

Part A

It is a questionnaire consisting of 50 items (1-50) regarding patient's language history of each language known prior to the brain damage. It can be administered to relatives and friends either.

Part B

It consists of two different sections: a questionnaire (items 1-17), which examines the pattern of use and the degree of literacy in all languages; 32 subtests assessing different linguistic domains (phonology, morphology, syntax, lexicon, semantics) at different language levels (word, sentence, paragraph) and at different levels of spontaneity (spontaneous speech, writing to dictation and so on). All the four modalities of language are assessed in this section (hearing, speaking, reading, writing).

Part C

It consists of 58 items, which assess the translation abilities and detection of interference in each language pair.

In line with the purpose of this study, all the parts of the BAT were administered. During the assessment, M.C.'s daughter mediated as a bilingual Sardinian-Italian co-worker, since no bilingual speech-language pathologists were available.

Each version of the BAT was administered in four sessions, of one hour each.

The Part A and the first 17 questions of the Part B, concerning language history in either language pre-morbidly spoken, were completed by two family members (wife, daughter). With regards to the different linguistic domains, although all the various subtests of Part B and Part C were administered, many of them were not possible due to the severity of M.C.'s aphasic syndrome. Despite this, the BAT enabled the comparison of relative ability in each language known by M.C. and the assessment of the therapy effects (post-treatment evaluation). In other words, it was used to assess the severity of language impairments in Sardinian and Italian and to compare the performance on each linguistic domain (phonology, morphology, syntax, lexicon, semantics) in both languages, before and after the speech-language therapy.

Pre-treatment assessment results (BAT)

BAT Part B

1	**Spontaneous speech**

Number of items: 5 items (18-22)

	Italian	Sardinian
Number of utterances		
Total number of words		
Average lenght of utterances		
Average lenght of the most length utterances		
Number of different words		
Type/token ratio		
Number of phonemic paraphasiae in real words		
Number of perseverations		
Number of paragrammatisms		
Number of verbs in the utterances		
Number of pauses		
Number of stereotypes		
Word finding difficulties		
Related in a coherent manner		

The evaluation of both Sardinian and Italian ‘spontaneous speech’ was not possible.

2 Pointing

Number of items: 10 items (23-32)

Italian

All 10 items were correct

Sardinian

All 10 items were correct

3 Orders

A Simple orders

Number of items: 5 items (33-37)

Italian

4 items were correct

Sardinian

4 items were correct

The only item incorrect was the one reporting the order 'stick out your tongue'. Instead of doing what requested, the participant opened his mouth. This was probably due to his oral apraxia, rather than to an impairment of auditory comprehension, considering that all the other subtests assessing receptive abilities obtained good performance.

B Semi-complex orders

Number of items: 5 items (38-42)

Italian

All 5 items were correct

Sardinian

All 5 items were correct

C Complex orders

Number of items: 5 items (43-47)

Italian

2 items were correct

Sardinian

2 items were correct

The items incorrect were the same in Sardinian and Italian.

4 Verbal auditory discrimination

Number of items: 18 items (48-65)

Italian

16 items were correct

Sardinian

17 items were correct

5 Comprehension of syntactic structures

Number of items: 87 items (66-152)

Italian

85 items were correct

Sardinian

All 87 items were correct

6 Semantic categories

Number of items: 5 items (153-157)

Italian

All 5 items were correct

Sardinian

4 items were correct

7 Synonyms

Number of items: 5 items (158-162)

Italian

2 items were correct

Sardinian

3 items were correct

8 Antonyms

Number of items: 10 items (163-172)

Italian

8 items were correct

Sardinian

9 items were correct

9 Grammaticality judgment

Number of items: 10 items (173-182)

Italian

All 10 items were correct

Sardinian

All 10 items were correct

10 Semantic judgment

Number of items: 10 items (183-192)

Italian	**Sardinian**
9 items were correct	All 10 items were correct

11&12 Repetition of real words and non-words, and related lexical decision

Number of items: 60 items

Italian	**Sardinian**
45 items were correct	47 items were correct

The patient was always able to recognize if a word was a real word, or a non-word. Despite this, he made both phonemic paraphasiae and neologisms while repeating all the non-words and some of the real words. The mistakes made were equivalent in Italian and Sardinian.

13 Sentence repetition

Number of items: 7 items (253-259)

Italian	**Sardinian**
…	…

The assessment of ‘sentence repetition’ was not possible in either language.

14 Series

Number of items: 3 items (260-262)

Italian	**Sardinian**
…	…

During this section some phenomena of language switching occurred in the assessment of both Italian and Sardinian. None of the three series was said completely.

Italian: in the first series (days of the week) the patient named correctly the first two days of the week; the other answers given were, instead, perseverations ('martedì', 'mertedì', 'martedì', corresponding to the English 'Tuesday', repeated three times, one of which with a phonemic paraphasia→ 'mertedì'). In the second series (counting from 1 to 25) M.C. named correctly the numbers from 1 to 8, then he stopped and started to count correctly from 10 to 11, while from 17 to 21 he counted in Sardinian (in this case, two phonemic paraphasiae were made). In the third series (months of the year) M.C. said only the first month of the year.

Sardinian: in the first series the patient said the first day of the week in Italian, then he stopped and said the fourth day of the week in Italian, followed by the Italian version of the month 'February'. He finally said 'Thursday' in Sardinian. In the second series, he named correctly the numbers from 1 to 6, then he stopped and said the following numbers: eleven, fourteen, eighteen, nineteen, twenty, twenty-one. No phonemic paraphasiae were made. In the third series, M.C. said the first month of the year in Italian and the second in Sardinian.

15 Verbal fluency

Number of items: 6 items (263-268)

Italian	**Sardinian**
1 word with 't'; 0 words with 'm'; 0 word with 'p'	0 word with 't'; 1 word with 'm'; 0 word with 'p'

16 Naming

Number of items: 20 items (269-288)

Italian	**Sardinian**
4 items were correct	6 items were correct

17 Sentence construction

Number of items: 25 items (289-313)

Italian	**Sardinian**
…	…

The evaluation of ‘sentence construction’ was not possible either in Sardinian, or in Italian.

18 Semantic opposites

Number of items: 10 items (314-323)

Italian	**Sardinian**
…	…

The assessment of ‘semantic opposites’ was not possible either in Sardinian, or in Italian.

19&20 Derivational morphology & Morphological opposites

Number of items: 20 items (324-343)

Italian

…

Sardinian

…

The evaluation of 'derivational morphology and morphological opposites' was not possible in either language assessed.

21 Description of a story through pictures

Number of items: 3 items (344-346)

	Italian	Sardinian
Number of utterances		
Total number of words		
Average lenght of utterances		
Average lenght of the most length utterances		
Number of different words		
Type/token ratio		
Number of phonemic paraphasiae in real words		
Number of perseverations		
Number of paragrammatisms		
Number of verbs in utterances		
Number of pauses		
Number of stereotypes		
Word finding difficulties		
Related in a coherent manner		

The evaluation of ‘description of a story through pictures’ was not possible in either language assessed.

22 Mental arithmetic

Number of items: 50 items (347-361)

Italian	**Sardinian**
…	…

The assessment of ‘mental arithmetic’ was not possible in either language.

23 Text listening comprehension

Number of items: 5 items (362-366)

Italian	**Sardinian**
…	…

Due to M.C.’s severe impairment in verbal expression, it was not possible to assess his ability to understand a text, since he couldn’t give the requested answers to the questions made.

24 Reading words aloud

Number of items: 10 items (367-376)

Italian	**Sardinian**
…	…

All the items were read incorrectly in both languages.

25 Reading sentences aloud

Number of items: 10 items (377-386)

Italian	**Sardinian**
…	…

The evaluation of ‘reading sentences’ aloud was not possible in either language assessed.

26 Text reading comprehension

Number of items: 6 items (387-392

Italian	**Sardinian**
…	…

The evaluation of ‘text reading comprehension’ was not possible in either language assessed.

27 Copying of words

Number of items: 5 items (393-397)

Italian	**Sardinian**
All 5 items were correct	All 5 items were correct

28 Dictation of words

Number of items: 5 items (398-402)

Italian	**Sardinian**
All 5 items were incorrect	All 5 items were incorrect

The patient wrote down all the words read by the therapist, but none of them was correct. Some of them contained phonemic paraphasiae, while others were neologisms.

29 Dictation of sentences

Number of items: 5 items (403-407)

Italian	**Sardinian**
…	…

The evaluation of ‘dictation of sentences’ was not possible in either language assessed.

30 Word reading comprehension

Number of items: 10 items (408-417)

Italian	**Sardinian**
3 items were correct	3 items were correct

31 Sentence reading comprehension

Number of items: 10 items (418-427)

Italian

All items were incorrect

Sardinian

All items were incorrect

32 Spontaneous writing

Time limit: 5 minutes

Italian

Name and surname; date of birth

…

Sardinian

Name and surname; date of birth

…

When he was told to write whatever he wanted, M.C. wrote his name and surname, together with his date of birth, during the assessment of both Sardinian and Italian.

When he was asked, instead, to write something about his illness, the patient wasn't able to write anything in either language assessed.

BAT Part C

1 Word recognition

Number of items: 10 items: Sardinian-Italian 428-432
Italian-Sardinian 433-437

Sardinian-Italian

…

Italian-Sardinian

…

The evaluation of ‘word recognition’ in both Sardinian-Italian and Italian-Sardinian was not possible due to the impairments in reading comprehension.

2 Translation of words

Number of items: 20 items: Sardinian-Italian 438-447
Italian-Sardinian 448-457

Sardinian-Italian	**Italian- Sardinian**
7 items were correct	5 items were correct

The translation was not possible for much of the items administered, although M.C. showed more difficulties in translating from Italian to Sardinian than vice versa. It was unclear whether this difficulty was the consequence of impaired translation abilities, or rather of the well-known impaired oral expression.

3 Translation of sentences

Number of items: 24 items: Sardinian-Italian 458-469
Italian-Sardinian 470-481

Sardinian-Italian	**Italian- Sardinian**
…	…

The evaluation of ‘translation of sentences’ was not possible either for Sardinian to Italian, or from Italian to Sardinian.

4 Grammatically judgement

Number of items: 32 items (458-481)

Sardinian	**Italian**
…	…

M.C. was always able to indicate if a sentence, either in Sardinian or Italian, was grammatically correct. Nevertheless, as a consequence of his severely restricted speech-output, the correction of the grammatical errors wasn't possible.

The clinical picture observed after pre- and post-treatment assessment on the Sardinian and Italian versions of the BAT, didn't differ much from the one described in the speech-language report filled at the end of treatment previously provided for 20 months. Although in that case only Italian language residual abilities post-treatment were specified, what observed in the patient at the beginning of intervention in the present work was similar. Sure enough, M.C. showed a very good level of auditory comprehension in both Sardinian and Italian. The ability to write spontaneously was possible only for his name and surname, together with his date of birth. Single-word copy was efficient, as well as single-word repetition (even if sporadic phonemic paraphasiae occurred), in either language. Non-word repetition was impaired, indeed many phonemic paraphasiae and neologisms were made. Reading words and sentences aloud was not possible, while word reading comprehension was possible, even if for a limited number of items. Picture naming was possible only for a restricted number of items.
In the light of the above, M.C. exhibited a parallel pattern of impairment in both Sardinian and Italian language. At the time of participation in this study, the overall clinical picture appeared to be the same observed prior to the second brain damage, namely a severe non-fluent expressive aphasia and concurrent oral apraxia (assessed by clinical judgement).

Speech-language intervention in Sardinian (L1) and Italian (L2): general considerations

For the purpose of this study, M.C. received two consecutive treatment blocks, in individual setting: the first in Sardinian (L1), since it was the language never treated before, and the second in Italian (L2). It was decided to conduct speech-language therapy in Sardinian for a period of time longer (4 months) than the one provided to Italian (2 months) for two main reasons. Firstly, because, unlike Italian language, Sardinian didn't receive any assessment or treatment prior to the present study. Thus, it seemed reasonable to give it the priority and a bigger number of sessions, considering also that it is participant's L1. Secondly, because according to what M.C.'s wife and daughter reported, M.C. seemed to have easier access to words in Sardinian than in Italian, although this aspect wasn't confirmed by pre-treatment assessment. It has to be clarified that during both treatments in Sardinian and Italian and outside the therapy room, M.C. was always encouraged to verbally express himself in either language known, in order to facilitate the recovery of oral expression. Thus, it was frequent the use of Sardinian language even during the Italian treatment and vice versa.

Both treatment blocks were administered by a speech-language pathologist whose mother tongue is Italian and who is also proficient in auditory comprehension of the Sardinian variety (Central Sardinian) spoken by the participant prior to the CVA. The mediation of M.C.'s daughter (bilingual Sardinian-Italian speaker) as a co-worker during the therapy delivery was considered needed in order to offer a comprehensive treatment in participant's first-language.

A total of 48 sessions, 1 hour each, were provided over 6 months, two days a week. Treatment started in October 2017 and was conducted on an outpatient basis in the same neuro-rehabilitation center where M.C. was hospitalized after the first (October 2015) and second (June 2017) cerebrovascular accident and where he received the prior speech-language therapy on an inpatient and outpatient basis. The initial plan was to provide an intensive treatment consisting of 5 weekly sessions, 1 hour each, once a day. But neither the participant nor the family members, whom he has been dependent on since the first stroke occurred, were able to engage in such a similar demanding schedule. For this reason, it was decided to organize the therapy into two sessions per week, 1 hour each.

At the time when this study started, M.C.'s speech production profile was still consistent with severe non-fluent expressive aphasia in both languages spoken before the CVA and significant oral apraxia.

Treatment stimuli

The material used during the treatment in Sardinian and Italian was based on a selected set of Sardinian and Italian words and sentences. It included pictures of the target words and actions, as well as written words and sentences related to these pictures. A Semantic Feature Analysis chart (Boyle, 2010) in A4 format was used (Fig.18).

Treatment procedure

The main therapy aims of this study were to improve words retrieval, that appeared to be severely impaired in M.C., and to enable him to speak at least in short and/or simple sentences in both languages treated. Speech-language intervention focused also on writing production, reading comprehension and repetition of both words and non-words.

One of the approaches used was based on Semantic Feature Analysis (SFA) applied to treatment of words retrieval impairments in aphasic individuals (Boyle, 2010). This method assumes that lexical retrieval might be reinforced by improving the access to the semantic network where meanings of words are represented as sets of semantic features. In the mental lexicon, words are supposed to be linked to other related words, not only on the base of their meaning, but also on the base of other characteristics, such as their phonological form and context of use. This implies that the access to semantically or phonologically related concepts, might ease the activation of a given word. Applying this assumption to an individual, we deduce that when someone attempts to name a picture, the features (e.g. shape, colour, function, etc..) of the object depicted are activated, activating in turn related concepts, among which the one receiving the highest activation is selected, together with its phonological representation. In normally conditions, this usually results in naming the target object.

The further finding that treatment of single words through SFA approach might determine an improvement not only in words retrieval, but also in discourse (Nicholas, Brookshire, 1993), was crucial for the adoption of this type of approach, since the main purposes of treatment offered in this study was to improve both words retrieval and discourse abilities.

The same therapy protocol was used during both treatments in Sardinian and Italian, with no differences.

Considering the clinical picture of M.C., SFA treatment was developed as it follows. A Semantic Features Analysis chart in A4 format (as shown in Figure 20) was given to the participant during the sessions in order to assist him in lexical retrieval while involved in

naming tasks. Pictures depicting objects and actions were used. Under the guidance of the speech-language pathologist, M.C. was asked at first to generate at least 6 semantic features belonging to the target word/scene. Each of these features belonged, in turn, to a specific class: group (e.g. 'It is a…'); use ('You use it to/for…'); action (e.g. 'What does it do?'); properties (e.g. 'Describe it'); location (e.g. 'You find it…'); association (e.g. 'It reminds me of a…'). Less and different classes of features were used when the target pictures depicted scenes and not single objects. When M.C. showed difficulties in producing a feature, which happened most of the times especially during the first phases of treatment, phonemic or orthographical cueing were given by the therapist. Features production was also facilitated with open-ended questions (e.g. 'Is it a fruit?', 'Is it found at the supermarket?'). In case either phonemic/orthographical cueing, or open-ended questions didn't help the participant to find the correct feature, this was provided by the therapist. Only when all the semantic features were given (most of the times by the speech-language pathologist), M.C. was asked to produce the target word/scene.

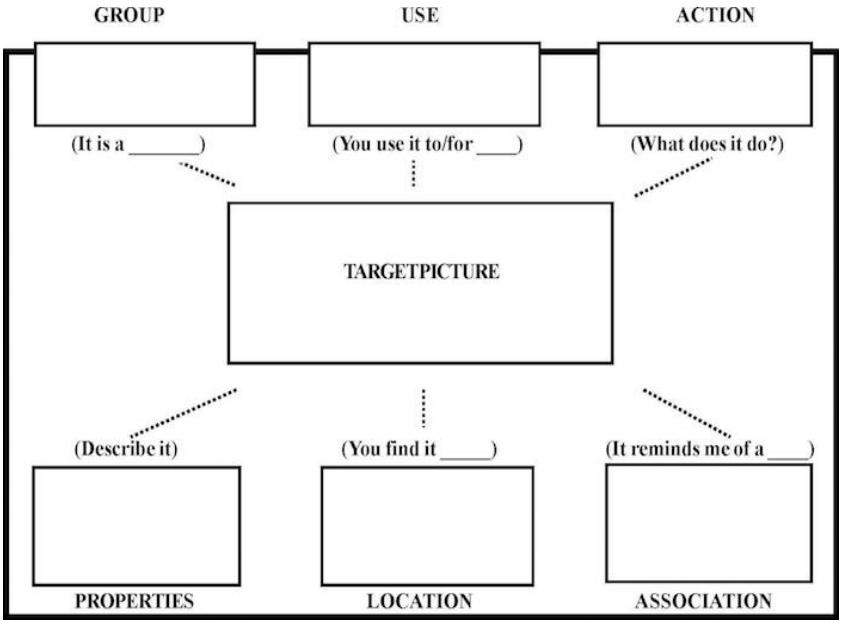

Fig.20 Semantic Features Analysis chart (Boyle, 2010)

In the initial phases of the therapy, M.C. exhibited sometimes nervousness during the use of SFA technique; therefore, other approaches as well were used in order to improve

spontaneous speech output, such as simple picture naming, with or without orthographical and phonological cueing; written copy and repetition of both words and non-words. Regarding picture naming task, the participant was asked to name pictures depicting single objects, presented one at a time. If it was named inaccurately or not named at all, the next step was to give him orthographical cueing. When M.C. failed anyway in providing the target word, phonological cueing was given. In case the correct word was still not uttered, this was named by the therapist, who also set below the picture a card with the written form, that the participant was asked to copy.

During both treatments in Sardinian and Italian and outside the therapy room, M.C. was always encouraged to verbally express himself in either language known prior to CVA, in order to facilitate the recovery of oral expression. For this reason, the bilingual Sardinian-Italian co-worker took part in both Sardinian and Italian therapy delivery. In line with this approach, there was never the attempt to inhibit pathological language switching, but it was instead integrated into the therapy, together with translation. This method, known as 'Switch-back through Translation (SBT), was used with the purpose of encouraging M.C. to use voluntary language-switching during therapy sessions, in particular when he experienced difficulty in retrieving a word in the target language (for instance Italian). Every time an episode of pathological switching (LS) occurred, M.C. was always encouraged by the speech-language pathologist to translate it from the non-target language (in which LS happened), by providing him a semantic cueing, such as 'Which means..', so that he was prompted to translate from the non-target language (e.g. Sardinian) to the target one (e.g. Italian). It is important to clarify that, as M.C. became more readily able to use words and simple sentences, Sardinian appeared to be the language most frequently used (consistent with his pre-stroke language dominance pattern), even when treatment was conducted in Italian. This happened either during picture naming tasks, or in answering short simple questions asked by the therapist. Phenomena of switching between the two languages, often occurred during the therapy sessions and at home, as reported by M.C.'s wife and daughter. When it wasn't possible to return to the language of the ongoing treatment/conversation, since SBT was not always successful, M.C. was encouraged to use language switching even if not integrated into translation, in line with the principle according to which anomia in one language might be resolved by 'borrowings' from the other language. As a matter of fact, when translation was

temporary not possible, it was decided that accepting borrowings from the non-target language was a better compromise than interrupting the verbal output by blocking them.

6.6 Results

Post-treatment assessment results – CETI –

The CETI questionnaire was administered to M.C.'s wife and daughter, not only prior to, but also after the speech-language therapy provided in this study, in order to determine incremental changes in communication effectiveness. The total score - 3,68 - obtained by M.C. in post-treatment evaluation showed a mild improvement of both language and not-language ability to solve communication problems of daily-living activities, as it can be observed in Figure 21. It has to be clarified that pre-treatment results of the CETI concerned both Italian and Sardinian, since they appeared to be impaired to the same extent at the time when the preliminary assessment took place. On the contrary, post-treatment results of the specific items of the CETI involving language production refer only to Sardinian, given that this was the only language where M.C. showed significant improvements in the spoken output after the therapy.

Getting somebody's attention	6
Getting involved in group conversation that are about him	2
Giving yes and no answers appropriately	7
Communicating his emotions	5
Indicating that he understands what is being said to him	7
Having coffee-time visits and conversations with friends and neighbours (around the bedside or at home)	3
Having a one to one conversation with you	3
Saying the name of someone whose face is in front of him	3
Communicating physical problems such as aches and pains	6
Having a spontaneous conversation (e.g. starting the conversation and/or changing the subject)	3
Responding to or communicating anything (including yes and no) without words	6
Starting a conversation with people who are not close family	2
Understanding writing	2
Being part of a conversation when it is fast and a number of people are involved	1
Participating in a conversation with strangers	2
Describing or discussing something in-depth	1

Fig. 21 – 16 Items of the Communicative Effectiveness Index (CETI) of M.C.'s assessment post-treatment

Post-treatment assessment results – BAT –

M.C. was assessed on the Italian and Sardinian version of the BAT after the therapy provided to him in both languages, in order to measure and compare the outcomes reached in either language treated. Assessment in each language was conducted by the same speech-language pathologist who administered both the preliminary evaluation and the therapy. As it happened during pre-treatment assessment, M.C.'s daughter mediated in post-treatment evaluation either as a bilingual Sardinian-Italian co-worker, since no bilingual speech-language pathologists were available.

Each version of the BAT was administered in four sessions, of one hour each.

The Part A and the first 17 questions of the Part B, concerning language history in either language pre-morbidly spoken, weren't administered during post-treatment assessment, since all the information needed were already present in the equivalent parts filled by M.C.'s wife and daughter prior to initiation of treatment. With regards to the different linguistic domains, although all the various subtests of Part B and Part C were administered, many of them were not possible due to the severity of M.C.'s aphasic syndrome, as it happened during pre-treatment assessment as well. Nevertheless, post-treatment evaluation was characterized by a mild improvement in some sessions of the BAT, as it is reported hereafter.

BAT Part B

1	**Spontaneous speech**

Number of items: 5 items (18-22)

	Italian	Sardinian
Number of utterances		
Total number of words		
Average lenght of utterances		
Average lenght of the most length utterances		
Number of different words		
Type/token ratio		
Number of phonemic paraphasiae in real words		
Number of perseverations		
Number of paragrammatisms		
Number of verbs in the utterances		
Number of pauses		
Number of stereotypes		
Word finding difficulties		
Related in a coherent manner		

The evaluation of both Sardinian and Italian 'spontaneous speech' was not possible.

2 Pointing

Number of items: 10 items (23-32)

Italian	**Sardinian**
All 10 items were correct	All 10 items were correct

M.C.'s performance in this section was equivalent to the one observed in pre-treatment assessment.

3 Orders

A Simple orders

Number of items: 5 items (33-37)

Italian	**Sardinian**
4 items were correct	4 items were correct

As it happened during pre-treatment assessment on the BAT, even in this case the only item incorrect was the one reporting the order 'stick out your tongue'. Instead of doing what requested, the participant opened his mouth. This was probably due to his oral apraxia, rather than to an impairment of auditory comprehension, considering that all the other subtests assessing receptive abilities obtained good performance.

B Semi-complex orders

Number of items: 5 items (38-42)

Italian	**Sardinian**
All 5 items were correct	All 5 items were correct

M.C.'s performance in this section was equivalent to the one observed in pre-treatment assessment.

C Complex orders

Number of items: 5 items (43-47)

Italian	**Sardinian**
2 items were correct	2 items were correct

The items incorrect were the same in Sardinian and Italian. M.C.'s performance in this section was equivalent to the one observed in pre-treatment assessment.

4 Verbal auditory discrimination

Number of items: 18 items (48-65)

Italian	**Sardinian**
17 items were correct	17 items were correct

M.C.'s performance in this section was very similar to the one observed in pre-treatment assessment.

5 Comprehension of syntactic structures

Number of items: 87 items (66-152)

Italian	**Sardinian**
85 items were correct	87 items were correct

M.C.'s performance in this section was equivalent to the one observed in pre-treatment assessment.

6 Semantic categories

Number of items: 5 items (153-157)

Italian	**Sardinian**
All 5 items were correct	All 5 items were correct

M.C.'s performance in this section was very similar to the one observed in pre-treatment assessment.

7 Synonyms

Number of items: 5 items (158-162)

Italian	**Sardinian**
2 items were correct	2 items were correct

M.C.'s performance in this section was very similar to the one observed in pre-treatment assessment.

8 Antonyms

Number of items: 10 items (163-172)

Italian	**Sardinian**
8 items were correct	9 items were correct

M.C.'s performance in this section was equivalent to the one observed in pre-treatment assessment.

9 Grammaticality judgement

Number of items: 10 items (173-182)

Italian	**Sardinian**
All 10 items were correct	All 10 items were correct

M.C.'s performance in this section was equivalent to the one observed in pre-treatment assessment.

10 Semantic judgment

Number of items: 10 items (183-192)

Italian	**Sardinian**
9 items were correct	9 items were correct

M.C.'s performance in this section was very similar to the one observed in pre-treatment assessment.

11&12 Repetition of real words and non-words, and related lexical decision

Number of items: 60 items

Italian	**Sardinian**
45 items were correct	52 items were correct

The patient was always able to recognize if a word was a real word, or a non-word. As it was observed during pre-treatment assessment, M.C. made frequent phonemic paraphasiae and occasional neologisms especially while repeating most of the non-words. Instead, the repetition of real words was rarely affected by phonemic paraphasiae. Nevertheless, in this section of the BAT he repeated correctly a larger number of non-words and real words in Sardinian, if compared to pre-treatment assessment.

With regards to the performance in Italian, this was equivalent to the one observed during pre-treatment evaluation.

13 Sentence repetition

Number of items: 7 items (253-259)

Italian	**Sardinian**
…	1 item was correct

Unlike what happened during pre-treatment assessment, the evaluation of 'sentence repetition' was instead possible in Sardinian when post-treatment assessment occurred. Although M.C. repeated correctly only one sentence, numerous were the attempts to repeat the other sentences either, resulting in the production of four sentences. Some of them were agrammatical (e.g. 'Su nau tirau', instead of 'Su camiu no este tiratu dae sa macchina', '*The truck is not pulled by the car*'); others were somehow different from the target or incomplete, but grammatically correct and very close in their meaning to the target sentences (e.g. 'Su cane mossicata su gattu', instead of 'Este su cane chi mossicata su gattu', '*It is the dog that bites the cat*').

With regards to the performance in Italian, this was equivalent to the one observed during pre-treatment evaluation.

14 Series

Number of items: 3 items (260-262)

Italian	**Sardinian**
…	…

During this section phenomena of language switching occurred in the assessment of both Italian and Sardinian, as it happened in pre-treatment assessment, but less frequently. None of the three series was said completely, nevertheless in Sardinian a larger number of correct words than the one said during preliminary evaluation was given.

Italian: M.C.'s performance was very similar to the one observed in pre-treatment evaluation. In the first series (days of the week) the patient named correctly only the first two days of the week. In the second series (counting from 1 to 25) he named correctly the numbers from 1 to 8, then he stopped and started to count correctly from 8 to 11 in Sardinian. In the third series (months of the year) M.C. said only the first month of the year.

Sardinian: it was observed a mild improvement in M.C.'s performance, if compared to pre-treatment assessment. Although the first series wasn't said completely, the participant named the first three days of the week in Sardinian. Instead, in pre-treatment evaluation he said the first day of the week in Italian, then he stopped and said the fourth day of the week in Italian, followed by the Italian version of the month 'February' and by the Sardinian version of the word 'Thursday'. In the second series, he named correctly the numbers from 1 to 17, then he stopped and said the number 20, 22 and 23. In pre-treatment assessment, instead, he said the number from 1 to 8, followed by the numbers: eleven, fourteen, eighteen, nineteen, twenty, twenty-one. In the third series, M.C. named the first three months of the year in Sardinian, while in pre-treatment evaluation he said the first month of the year in Italian and the second in Sardinian.

15 Verbal fluency

Number of items: 6 items (263-268)

Italian	**Sardinian**
1 word with 't'; 0 words with 'm'; 0 word with 'p'	1 word with 't'; 1 word with 'm'; 1 word with 'p'

M.C.'s performance in Italian was equivalent to the one observed in pre-treatment assessment. In Sardinian, instead, a mild improvement was noted; the correct words given were three, while in preliminary evaluation only one word was said.

16 Naming

Number of items: 20 items (269-288)

Italian	**Sardinian**
6 items were correct	10 items were correct

M.C.'s performance in both Sardinian and Italian exhibited a mild improvement.

Italian: the correct items were 6, while in preliminary assessment 4.

Sardinian: the improvement in Sardinian was more evident than in Italian. As a matter of fact, 10 objects were named, while in pre-treatment assessment 6.

In either language, numerous were the attempts to name the objects shown, but many of them were affected by mistakes such as phonemic paraphasiae and neologisms; thus, they weren't included among the correct items.

17 Sentence construction

Number of items: 25 items (289-313)

Italian	**Sardinian**
…	…

As observed in pre-treatment assessment, the evaluation of 'sentence construction' was not possible either in Sardinian, or in Italian.

18 Semantic opposites

Number of items: 10 items (314-323)

Italian	**Sardinian**
1 item was correct	5 items were correct

While prior to intervention the evaluation of ‘semantic opposites’ was not possible either in Sardinian, or in Italian, in post-treatment assessment M.C. showed a significant improvement, although only in Sardinian. The items correct in this language were 5, while in Italian only 1.

19&20 Derivational morphology & Morphological opposites

Number of items: 20 items (324-343)

Italian	**Sardinian**
…	…

As already observed in preliminary assessment, the evaluation of ‘derivational morphology’ and Morphological opposites was not possible in post-treatment assessment either.

21 Description of a story through pictures

Number of items: 3 items (344-346)

	Italian	Sardinian
Number of utterances		
Total number of words		
Average lenght of utterances		
Average lenght of the most length utterances		
Number of different words		
Type/token ratio		
Number of phonemic paraphasiae in real words		
Number of perseverations		
Number of paragrammatisms		
Number of verbs in utterances		
Number of pauses		
Number of stereotypes		
Word finding difficulties		
Related in a coherent manner		

As already observed in preliminary assessment, the 'description of a story through pictures' was not possible in post-treatment assessment either.

22 Mental arithmetic

Number of items: 50 items (347-361)

Italian

…

Sardinian

2 items were correct

Unlike what happened in pre-treatment assessment, the evaluation of ‘mental arithmetic’ was instead possible in post-treatment assessment, although for a limited number of items. During post-treatment assessment in Sardinian, M.C. gave the correct answers to the first two arithmetic questions. No correct answers were given in Italian, although the attempts were numerous in this language either.

23 Text listening comprehension

Number of items: 5 items (362-366)

Italian	**Sardinian**
…	…

As well as in pre-treatment assessment, ‘text listening comprehension’ was not possible. There is a high likelihood that M.C.’s poor performance was due to his impairment in verbal expression, rather than to his ability to understand a text. Indeed, in this section he was asked to give the requested answers to the questions made, something that he obviously found it hard as a consequence of his severely restricted speech output.

24 Reading words aloud

Number of items: 10 items (367-376)

Italian	**Sardinian**
4 items were correct	6 items were correct

While prior to intervention ‘reading words aloud’ was not possible in either language assessed, in post-treatment assessment M.C. showed a significant improvement in Sardinian, as well as in Italian. The items correct were 6 and 4, respectively.

With regards to the mistakes made when the items were considered incorrect, they were mainly neologisms and, less frequently, phonemic paraphasiae.

25 Reading sentences aloud

Number of items: 10 items (377-386)

Italian	**Sardinian**
…	…

As observed in preliminary assessment, in post-treatment assessment as well the evaluation of 'reading sentences aloud' was not possible in either language assessed.

26 Text reading comprehension

Number of items: 6 items (387-392

Italian	**Sardinian**
…	…

Just as much as in pre-treatment assessment, in post-treatment assessment as well the evaluation of 'text reading comprehension' was not possible in either language assessed.

27 Copying of words

Number of items: 5 items (393-397)

Italian	**Sardinian**
All 5 items were correct	All 5 items were correct

28 Dictation of words

Number of items: 5 items (398-402)

Italian	**Sardinian**
All items were incorrect	2 items were correct

As it happened during preliminary evaluation, even during post-treatment assessment in Italian the patient wrote down all the words read by the therapist and none of them was correct; indeed they were all affected by mistakes such as phonemic paraphasiae and neologisms. On the contrary, M.C.'s performance in Sardinian was better in post-treatment assessment. Two words were written correctly, while the remaining were written with phonemic paraphasiae, or they were neologisms.

29 Dictation of sentences

Number of items: 5 items (403-407)

Italian	**Sardinian**
…	…

As observed in preliminary assessment, in post-treatment assessment as well the evaluation of 'dictation of sentences' was not possible in either language assessed.

30 Word reading comprehension

Number of items: 10 items (408-417)

Italian	**Sardinian**
3items were correct	4 items were correct

M.C.'s performance in both languages during post-treatment assessment was very similar to the one observed in preliminary evaluation.

31 Sentence reading comprehension

Number of items: 10 items (418-427)

Italian	**Sardinian**
All items were incorrect	All items were incorrect

M.C.'s performance in both languages during post-treatment assessment was equivalent to the one observed in preliminary evaluation.

32 Spontaneous writing

Time limit: 5 minutes

Italian	**Sardinian**
Name and surname; date of birth	Name and surname; date of birth
…	…

M.C.'s performance in both languages during post-treatment assessment was equivalent to the one observed in preliminary evaluation.
When he was told to write whatever he wanted, M.C. wrote his name and surname, together with his date of birth, during the assessment of both Sardinian and Italian.
When he was asked, instead, to write something about his illness, the patient wasn't able to write anything in either language assessed.

BAT Part C

1 Word recognition

Number of items: 10 items: Sardinian-Italian 428-432
Italian-Sardinian 433-437

Sardinian-Italian	**Italian-Sardinian**
…	…

The evaluation of 'word recognition' in both Sardinian-Italian and Italian-Sardinian was not possible due to the impairments in reading comprehension.

2 Translation of words

Number of items: 20 items: Sardinian-Italian 438-447
Italian-Sardinian 448-457

Sardinian-Italian	**Italian- Sardinian**
9 items were correct	6 items were correct

As it happened during preliminary evaluation, during post-treatment assessment as well the translation was not possible for much of the items administered. Nevertheless, a mild improvement in M.C.'s performance during translation from Sardinian to Italian was observed (9 items were correct, while in pre-treatment assessment the items correct were 7).

3 Translation of sentences

Number of items: 24 items: Sardinian-Italian 458-469
Italian-Sardinian 470-481

Sardinian-Italian	**Italian- Sardinian**
…	…

As well as in pre-treatment assessment, during post-treatment assessment either the evaluation of 'translation of sentences' was not possible either for Sardinian to Italian, or from Italian to Sardinian.

4 Grammatically judgement

Number of items: 32 items (458-481)

Sardinian	**Italian**
…	…

M.C.'s performance in this section was equivalent to the one observed in preliminary evaluation. He was always able to indicate if a sentence, either in Sardinian or Italian, was grammatically correct. Nevertheless, as a consequence of his still restricted speech-output, the correction of the grammatical errors wasn't possible.

Pre- and post-treatment assessment results (BAT): Summary

BAT Part B

1	**Spontaneous speech**

Number of items: 5 items (18-22)

	Italian		Sardinian	
	Pre-	Post-	Pre-	Post-
Number of utterances	-	-	-	-
Total number of words	-	-	-	-
Average lenght of utterances	-	-	-	-
Average lenght of the most length utterances	-	-	-	-
Number of different words	-	-	-	-
Type/token ratio	-	-	-	-
Number of phonemic paraphasiae in real words	-	-	-	-
Number of perseverations	-	-	-	-
Number of paragrammatisms	-	-	-	-
Number of verbs in the utterances	-	-	-	-
Number of pauses	-	-	-	-
Number of stereotypes	-	-	-	-
Word finding difficulties	-	-	-	-
Related in a coherent manner	-	-	-	-

2 Pointing

Number of items: 10 items (23-32)

Italian		**Sardinian**	
Pre-	Post-	Pre-	Post-
10 items correct	10 items correct	10 items correct	10 items correct

3 Orders

A Simple orders

Number of items: 5 items (33-37)

Italian		**Sardinian**	
Pre-	Post-	Pre-	Post-
4 items correct	4 items correct	4 items correct	4 items correct

B Semi-complex orders

Number of items: 5 items (38-42)

Italian		**Sardinian**	
Pre-	Post-	Pre-	Post-
5 items correct	5 items correct	5 items correct	5 items correct

C Complex orders

Number of items: 5 items (43-47)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
2 items correct	2 items correct	2 items correct	2 items correct

4 Verbal auditory discrimination

Number of items: 18 items (48-65)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
16 items correct	17 items correct	16 items correct	17 items correct

5 Comprehension of syntactic structures

Number of items: 87 items (66-152)

Italian		Sardinian	
Pre-	Post-	Pre-	Post
85 items correct	85 items correct	87 items correct	87 items correct

6 Semantic categories

Number of items: 5 items (153-157)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
5 items correct	5 items correct	4 items correct	5 items correct

7 Synonyms

Number of items: 5 items (158-162)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
2 items correct	2 items correct	3 items correct	2 items correct

8 Antonyms

Number of items: 10 items (163-172)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
8 items correct	8 items correct	9 items correct	9 items correct

9 Grammaticality judgment

Number of items: 10 items (173-182)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
10 items correct	10 items correct	10 items correct	10 items correct

10 Semantic judgment

Number of items: 10 items (183-192)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
9 items correct	9 items correct	10 items correct	9 items correct

11&12 Repetition of real words and non-words, and related lexical decision

Number of items: 60 items

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
45 items correct	45 items correct	47 items correct	52 items correct

13 Sentence repetition

Number of items: 7 items (253-259)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	1 item correct

14 Series

Number of items: 3 items (260-262)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	-

15 Verbal fluency

Number of items: 6 items (263-268)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
1 word with ‘t’; 0 words with ‘m’; 0 word with ‘p’	1 word with ‘t’; 0 words with ‘m’; 0 word with ‘p’	0 word with ‘t’; 1 word with ‘m’; 0 word with ‘p’	1 word with ‘t’; 1 word with ‘m’; 1 word with ‘p’

16 Naming

Number of items: 20 items (269-288)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
4 items correct	6 items correct	6 items correct	10 items correct

17 Sentence construction

Number of items: 25 items (289-313)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	-

18 Semantic opposites

Number of items: 10 items (314-323)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	1 item correct	-	5 items correct

19&20 Derivational morphology & Morphological opposites

Number of items: 20 items (324-343)

Italian		**Sardinian**	
Pre-	Post-	Pre-	Post-
-	-	-	-

21 Description of a story through pictures

Number of items: 3 items (344-346)

	Italian		Sardinian	
	Pre-	Post-	Pre-	Post-
Number of utterances	-	-	-	-
Total number of words	-	-	-	-
Average lenght of utterances	-	-	-	-
Average lenght of the most length utterances	-	-	-	-
Number of different words	-	-	-	-
Type/token ratio	-	-	-	-
Number of phonemic paraphasiae in real words	-	-	-	-
Number of perseverations	-	-	-	-
Number of paragrammatisms	-	-	-	-
Number of verbs in utterances	-	-	-	-
Number of pauses	-	-	-	-
Number of stereotypes	-	-	-	-
Word finding difficulties	-	-	-	-
Related in a coherent manner	-	-	-	-

22 Mental arithmetic

Number of items: 50 items (347-361)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	2 items correct

23 Text listening comprehension

Number of items: 5 items (362-366)

Italian		Sardinian	
Pre-	Post	Pre-	Post-
-	-	-	-

24 Reading words aloud

Number of items: 10 items (367-376)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	4 items correct	-	6 items correct

25 Reading sentences aloud

Number of items: 10 items (377-386)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	-

26 Text reading comprehension

Number of items: 6 items (387-392

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	-

27 Copying of words

Number of items: 5 items (393-397)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
5 items correct	5 items correct	5 items correct	5 items correct

28 Dictation of words

Number of items: 5 items (398-402)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
All 5 items incorrect	All 5 items incorrect	All 5 items incorrect	2 items correct

29 Dictation of sentences

Number of items: 5 items (403-407)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	-

30 Word reading comprehension

Number of items: 10 items (408-417)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
3 items correct	3 items correct	3 items correct	4 items correct

31 Sentence reading comprehension

Number of items: 10 items (418-427)

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
All items incorrect	All items incorrect	All items incorrect	All items incorrect

32 Spontaneous writing

Time limit: 5 minutes

Italian		Sardinian	
Pre-	Post-	Pre-	Post-
Name and surname; date of birth	Name and surname; date of birth	Name and surname; date of birth	Name and surname; date of birth
-	-	-	-

BAT Part C

1 Word recognition

Number of items: 10 items: Sardinian-Italian 428-432
Italian-Sardinian 433-437

Sardinian-Italian		Italian-Sardinian	
Pre-	Post-	Pre-	Post-
-	-	-	-

2 Translation of words

Number of items: 20 items: Sardinian-Italian 438-447
Italian-Sardinian 448-457

Sardinian-Italian		**Italian- Sardinian**	
Pre-	Post-	Pre-	Post-
7 items correct	9 items correct	5 items correct	6 items correct

3 Translation of sentences

Number of items: 24 items: Sardinian-Italian 458-469
Italian-Sardinian 470-481

Sardinian-Italian		**Italian- Sardinian**	
Pre-	Post-	Pre-	Post-
-	-	-	-

4 Grammatically judgement

Number of items: 32 items (458-481)

Sardinian		**Italian**	
Pre-	Post-	Pre-	Post-
-	-	-	-

6.7 Discussion

The results obtained through the Sardinian and Italian versions of the BAT and the CETI questionnaire administered after the intervention provided in this study, showed a mild improvement in some tasks, compared to what observed during preliminary evaluation, while in others no significant changes were observed in M.C.'s performance.

Similarities between pre- and post-treatment evaluation

M.C. showed a very good level of auditory comprehension in both Sardinian and Italian, as it was observed in every subtest of the Part B of the BAT involving receptive abilities and in which the participant obtained excellent, almost equivalent results, in pre- and post-treatment assessment ('pointing'; 'orders'; 'verbally auditory discrimination'; 'comprehension of syntactic structures'; 'semantic categories'; 'antonyms'; 'grammaticality judgment'; 'semantic judgment'). The tasks that were, instead, not possible, due to the severity of M.C.'s clinical picture, in both pre- and post-treatment evaluation, are the following: 'spontaneous speech'; 'sentence construction'; 'derivational morphology & morphological opposites'; 'description of a story through pictures'; 'text listening comprehension'; ''reading sentences aloud'; 'text reading'; 'dictation of sentences'; 'sentence reading comprehension.'

With regards to 'text listening comprehension', although it was not possible to evaluate it, there is a high likelihood that M.C.'s poor performance in this task was due to his impaired verbal expression, rather than to his ability to understand an oral text, considering that he never showed any difficulty in verbal comprehension. Since in this section he was asked to give the requested answers to the questions made, this is probably the reason for which he couldn't complete the task, namely due to his severely restricted speech output and not because of an impaired comprehension of what he was asked to do.

The other subtests of Part B of the BAT which showed an almost equal result in pre- and post-treatment assessment are 'word reading comprehension' and 'spontaneous writing'. Concerning the first, it has to be clarified that in Sardinian a mild improvement was observed, since 4 items were correct in post-treatment evaluation (while in pre-treatment assessment only 3 items were correct). Nevertheless, the ability to understand written words either in Italian or in Sardinian didn't improve significantly after the intervention provided in this study, as it was observed also during the therapy sessions. Therefore, although 1 additional

item was correct in this subtest of the BAT after the treatment, in the light of the above this was considered irrelevant.

Eventually, as regards to 'spontaneous writing', no differences were found between pre- and post-treatment evaluation. In both of them, M.C. was able to write spontaneously only his name and surname, together with his date of birth. When he was asked, instead, to write something about his illness, he wasn't able to write anything, either in Italian, or in Sardinian.

As far as it concerns the Part C of the BAT, the following subtests didn't show any improvement after the intervention: 'word recognition'; 'translation of sentences'; 'grammaticality judgment'. Regarding the latter, it has to be clarified that M.C. was always able to indicate if a sentence, either in Sardinian or Italian, was grammatically correct. Despite this, the correction of the grammatical errors wasn't possible at the time when post-treatment assessment occurred, as a consequence of his still restricted speech-output, something that was particularly evident in the formal context of a standardized evaluation and less evident, instead, during the last phases of the therapy sessions.

Differences between pre- and post-treatment evaluation

As already mentioned, after the intervention provided in this study M.C. showed a mild improvement in some subtests of both the Part B and Part C of the BAT, as well as in the CETI questionnaire. With regards to the latter, the score obtained in post-treatment assessment (3,68), showed an improvement in both language and not-language ability to solve communication problems, as compared to the score obtained in pre-treatment evaluation (2,75).

Concerning the dissimilarities between the evaluation conducted on the Part B and C of the BAT prior to and after the therapy, these regarded basically only Sardinian language, while the performance on the Italian version of the BAT didn't show any significant difference between pre- and post-treatment assessment.

-*Repetition of real words and non-words, and related lexical decision*: as observed during pre-treatment evaluation, in post-treatment assessment either the patient was always able to distinguish between a real word and a non-word. Similarly, he made frequent phonemic paraphasiae together with occasional neologisms while repeating most of the non-words, while the repetition of real words was rarely affected by errors. Despite this, after the therapy M.C. repeated correctly a larger number of non-words and real words in Sardinian (52 items

over the total number of 60 were correct, while in pre-treatment assessment were 47). With regards to the performance in Italian, this was equivalent to the one observed during pre-treatment evaluation (45 items were correct).

-*Sentence repetition*: unlike what happened in pre-treatment assessment, after the therapy the evaluation of 'sentence repetition' was possible in Sardinian. Furthermore, although M.C. repeated correctly only one sentence, it is important to report that numerous were the attempts to repeat the other sentences either, while in pre-treatment assessment no attempts were observed. This resulted in the production of 4 sentences. Some of them were agrammatical (e.g. 'Su nau tirau', instead of 'Su camiu no este tirau dae sa macchina', '*The truck is not pulled by the car*'). Others were different or incomplete, but grammatically correct and very close in their meaning to the target sentences (e.g. 'Su cane mossicata su gattu', instead of 'Este su cane chi mossicata su gattu', '*It is the dog that bites the cat*').

As regards to the performance in Italian language, no differences were found between pre- and post-treatment evaluation.

-*Series*: phenomena of language switching occurred after the treatment of both Italian and Sardinian, but less frequently than it was observed during pre-treatment evaluation. Although none of the three series was said completely, in Sardinian a larger number of correct words than the one in preliminary evaluation was given. As a matter of fact, in the first series (days of the week), M.C. said correctly the first days of the weeks, without phenomena of pathological switching, that were instead observed during pre-treatment assessment. During post-treatment evaluation, the participant said the first day of the week in Italian (although the assessment was in Sardinian), followed by the Italian version of the month 'February' and by the Sardinian version of the word 'Thursday'. In the second series (counting from 1 to 25), M.C. named correctly the numbers from 1 to 17, then he stopped for a while and said the numbers 20, 22 and 23. In pre-treatment evaluation the performance was more confusing, since M.C. started by saying the numbers from 1 to 8, followed by the numbers 11, 14, 18, 19, 20, 21. In the third series (months of the year), the participant named correctly the first three months of the year in the language assessed (Sardinian), while during preliminary evaluation he said the first month of the year in Italian and the second in Sardinian.

As regards to the performance in Italian language, no significant differences were found between pre- and post-treatment evaluation.

-*Verbal fluency*: in Sardinian it was observed a mild improvement, given that the correct words produced were three: 1 with ‘t’, 1 with ‘m’ and 1 with ‘p’. In preliminary evaluation only 1 word was produced.

In Italian, M.C.’s performance was equivalent to the one in pre-treatment assessment, namely 1 word was produced (with the letter ‘t’).

-*Naming*: M.C. performed better during post-treatment assessment in both Sardinian and Italian, but while in the latter the correct items were 6 over 20 (in the preliminary assessment were 4), in Sardinian the improvement was more evident. Sure enough, the participant named correctly 10 items, while in pre-treatment evaluation 6.

-*Semantic opposites*: while prior to intervention the evaluation of ‘semantic opposites’ wasn’t possible in either language assessed, in post-treatment evaluation M.C. showed a significant improvement, although only in Sardinian, where the items correct were 5. In Italian, instead, only 1 was correct.

-*Mental arithmetic*: unlike what happened in pre-treatment assessment, the evaluation of ‘mental arithmetic’ was instead possible after the therapy, although for a limited number of items. During post-treatment assessment in Sardinian, M.C. gave the correct answers to the first two arithmetic questions. No correct answers were given in Italian, although the attempts were numerous in this language either, something that wasn’t observed instead in preliminary evaluation.

-*Reading words aloud*: while prior to intervention ‘reading words aloud’ was not possible in either language assessed, in post-treatment assessment M.C. performed significantly better in Sardinian, as well as in Italian, where the items correct were 6 and 4, respectively.

With regards to the mistakes made when the items were considered incorrect, they were mainly neologisms and, less frequently, phonemic paraphasiae.

-*Dictation of words*: while before the treatment the ‘dictation of words’ was not possible in either language assessed, in post-treatment evaluation M.C.’s performance showed a mild improvement. Indeed, two words were written correctly, while the remaining contained phonemic paraphasiae, or they were neologisms.

In Italian, M.C.’s performance was equivalent to the one in pre-treatment assessment.

-*Translation of words (Part C)*: as it happened during preliminary evaluation, in pre-treatment assessment as well the translation was not possible for the majority of the items administered. Despite this, a mild improvement in M.C.’s performance during the translation from

Sardinian to Italian was observed. As a matter of fact, 9 items were correct, while in pre-treatment assessment the items correct were 7.

No significant differences were, instead, found during the translation from Italian to Sardinian.

Effects of treatment

The present study investigated the effects of treatment provided in both languages to a bilingual Sardinian-Italian speaker male with a severe form of non-fluent aphasia. Specifically, it was examined if all languages spoken by the person prior to the brain damage have to be assessed and treated, and whether treatment provided in either language known might increase the probability of recovery.

The main finding of this work is that assessment and treatment should be offered in all languages spoken. With this regard, pre-treatment assessment provided to M.C. in either language represented the basic prerequisite for the following diagnosis and treatment plan of this study. Sure enough, the systematic evaluation of Sardinian and Italian, conducted through standardized tests, such as the BAT, and questionnaires, like the CETI, furnished fundamental information regarding the participant's language history, as well as his residual language and communication abilities after the brain damages he had suffered. Although pre-treatment assessment on the BAT didn't show any significant dissimilarities between Sardinian and Italian, which appeared to be impaired to the same extent, the information concerning language proficiency and experience prior to the CVA showed, instead, relevant differences between the two languages. As a matter of fact, even if M.C. was perfectly fluent in both languages, his first-acquired language most commonly used before the brain damage, as well as the one to which he has always been more affectively tied, appeared to be Sardinian. Therefore, it is clear that the two languages didn't have the same weight in the participant's life. This implies that the relative weight of the languages known should be always measured, especially when providing bilingual therapy is not possible, in order to choose as best as possible which language to treat. This choice requires the investigation of a large number of factors, that only a comprehensive evaluation can guarantee. In light of the above, pre-treatment evaluation should be always offered in both languages, even in those cases in which bilingual rehabilitation can't be an option because of the poor availability of bilingual speech-language services.

As concerns the participant to this study, the only comprehensive evaluation that he received in either language was the one provided prior to intervention in the current work, since in the previous treatment only Italian (his second-language) was evaluated and subsequently treated for 20 months, while Sardinian didn't receive any kind of attention, although M.C.'s evident preference for this language.

The question that now arises is whether an early treatment provided to M.C.'s in his first-language either, not only in his L2, would have determined an earlier and better recovery than the one reached after the therapy administered for six months in the current work. Interestingly, M.C. showed a better recovery right of the language whose treatment was ignored for almost two years, but we will never know if a simultaneous treatment of both Italian and Sardinian, beginning immediately after the first stroke, might have facilitated the recovery, restoring or improving a number of language abilities larger than the one which appeared improved after the therapy provided in this study.

As far as concerns as the effects of this treatment on both the trained languages, as previously mentioned, M.C. recovered better Sardinian than Italian (differential recovery), even though the outcomes reached were more evident in the therapy sessions, than during the formal evaluation on the BAT. A further evidence of M.C.'s improvements in Sardinian, especially concerning his expressive abilities, was given by his relatives, who were supported in their report also by the daily diary which they filled throughout the six months of speech-language therapy. M.C.'s wife and daughter reported that Sardinian gradually improved in concomitance with the progression of the therapy, as it is noticeable in the diary either, where the number of spontaneous sentences and single words significantly increased by the passing of time. Although he still continues to have severe word-finding difficulties, M.C. seems to have now an easier access to words in Sardinian, as confirmed by his improved ability to speak spontaneously during the therapy sessions, at home and with his friends. His speech output is still considered non-fluent, marked by frequent pauses, and consisting in short sentences often agrammatical and containing frequent phonemic paraphasiae, while neologisms are produced mainly during more complex conversations in which he still struggles to be involved. Despite this, the content of his verbal messages is most of the times intelligible, especially when what he wants to communicate is simple and strictly related to the context where the conversation happens.

With regards to Italian spontaneous speech output, unlike Sardinian, this appears to be still severely impaired, not showing any significant improvement as compared to the initial phases of treatment. As a matter of fact, during and immediately after the period of this study, there were no relevant changes in M.C.'s communication effectiveness in Italian. Therefore, despite the 20 months of previous treatment plus the 6 months of therapy provided in the current study, there were only very limited benefits to Italian, as compared to Sardinian, although the latter started to be rehabilitated 20 months after the first cerebrovascular accident occurred and only for six months.

6.8 Conclusion

Clinical implications

The participant to this study received speech-language therapy firstly in his first-language (Sardinian), since this was the language never treated before, and then in his second-language (Italian). At the time when this study commenced both languages appeared to be impaired to the same extent, thus the choice of treating one language (L1) before and longer than the other (L2) was due to the fact that this language didn't receive any treatment during the 20 months of therapy provided to M.C. prior to this study and also to the emotional value that it has always had for the participant. Previous intervention focused exclusively on Italian (L2), at the end of which M.C. demonstrated a parallel recovery of either language known prior to the brain damages that he had suffered in 2015 and 2017. Nevertheless, this recovery regarded only auditory comprehension of the spoken output. It is not sure whether the untreated language (Sardinian) benefited from the treated one (Italian) during the previous treatment; what is sure is that both languages premorbidly spoken appeared to be impaired to the same extent when the current study commenced. Therefore, it seemed reasonable to provide treatment to both of them, although in two different, consecutive blocks. Despite this, M.C. was always encouraged to use either language he wanted to during the therapy sessions; thus, this apparent separation between Sardinian and Italian treatment was, actually, never strictly applied. Sure enough, it was designed a treatment plan that could facilitate M.C. oral communication in either language during his daily life, since his family and most of the people that he frequently meets speak both languages that he knew before the strokes.

Consequently, this plan was purposely focused on his social background and language use routines prior to the CVA, namely the daily use of both Sardinian and Italian. Nevertheless, in this therapy planning the weight of the two languages in M.C.'s life was also considered, not only in terms of their use, but also in terms of their emotional value. The language to which M.C. is more emotionally tied has always been, undoubtedly, Sardinian. For this reason, although two treatment blocks were provided, the first one focused on Sardinian and lasted longer (4 months) than the one provided in Italian (2 months). For similar reasons, every session of each treatment was conducted bilingually, using translation and language switching in order to restore as much as possible M.C.'s pre-morbid bilingual mode of communication. This is why M.C.'s daughter participated as a bilingual co-worker, not only in Sardinian, but also in Italian treatment.

Consistent with his pre-stroke language dominance pattern, at the end of this study, M.C. started to use Sardinian more than Italian, even if the latter is still present in his oral production. Indeed, when he experiences difficulty in finding a word in Sardinian, which is the language that he uses most of the times to speak, he relies on Italian more than he did during the preliminary phases of the therapy, when he used to frequently give up, resulting in a bigger incidence of communication breakdowns. This difference between initial and late phases of treatment confirms that M.C. has somehow mastered the voluntary language switching strategy that was promoted during the therapy sessions, and achieved an easier access to his mental lexicon.

On one hand, some could argue that the one observed in M.C. might be a non-satisfying recovery, since his expressive abilities recovered only one of the languages previously spoken. On the other hand, in the light of the clinical picture observed prior to this study, namely a severely compromised speech output in both Italian and Sardinian, the results obtained at the end of this intervention might be considered satisfying to a certain extent, since they allowed the participant to restore, even if partially, his ability to communicate verbally.

Limitations

One limitation of the present work was the restricted availability of studies focused on bilingual aphasia therapy that could be reviewed before starting the assessment and treatment protocol, in order to receive useful insights. The topic of acquired language and

communication disorders in bilingual population has interested neurosciences for a long time, but only recently the attention has been directed to developing the most efficient way to promote language recovery, including the issue of which language is better to treat and why. Research on bilingual aphasia has certainly attracted increasing attention in the field of speech and communication sciences; but, on the other hand, the studies on this topic are not copious and many of the questions raised, still need a comprehensive answer.

This study suffers from another, big limitation. Indeed, during the 20 months of treatment provided prior to this work and following the first stroke (occurred in September 2015), the participant was assessed and treated only in Italian. Assessment and treatment of both languages known by the patient, mediated by his daughter as a bilingual co-worker, started only some months after the second stroke happened, precisely in October 2017, and ceased in April 2018, when the patient was considered to have reached his maximal recovery in both languages. What still remains uncertain is whether a therapy provided to both languages immediately after the first cerebrovascular accident would have determined a parallel recovery of M.C.'s expressive abilities in both Italian and Sardinian, and not only in the latter, as observed at the end of this study, or it would have at least determined a better recovery than the one here described.

This is the reason for which one of the questions of this research, namely if treatment conducted in both languages might increase the probability of recovery, is still in part unanswered.

Strengths

This work may contribute to guide clinical approach toward a systematic assessment and treatment of bilingual aphasia, by providing useful insights into the steps which should be taken when assessing all the languages known by a bilingual aphasic patient. Indeed, this is a basic prerequisite for the following diagnosis and treatment plan, both aspects that deeply affect speech and language therapy outcomes. Furthermore, it may provide the reader with food for thought on an issue that is still in part unanswered, namely whether the therapy should be offered in both languages spoken by the bilingual aphasic client, or restricted to one language.

Future research

The state of bilingual aphasia needs to be better analysed under some aspects. In order to help both clinicians and speech-language pathologists, as well as the bilingual brain-damaged population, it would be useful to determine how to treat all languages known and how to identify which aspects of these languages are most vulnerable to therapy. This might be a way to ease the probability of recovery. A multilingual aphasic, who used to speak more than one language in everyday life prior to a brain damage, would be deeply affected by the impossibility of doing it again. Consequently, a recovery of only one of the languages spoken, could represent for some individuals an unsatisfactory recovery. For this reason, an early and appropriate intervention in each of the languages known has a great importance, in terms of improving the quality of communication and life. It is, then, clear the importance of designing aphasia therapy approaches accordingly. In this regard, an increasing, but still small number of studies show better outcomes when speech and language therapy is mediated by bilingual co-workers, in case no bilingual speech-language pathologists are available. Thus, it would be worth it to know more about the use of bilingual co-workers during the therapy and in which way they could contribute to therapy assessment, planning and outcomes. Moreover, there is still a need to better understand if and how to provide bilingual training to speech-language pathologists, in order to make them able to properly service the bilingual aphasic population.

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Annexes

Consenso informato

Come partecipante allo studio, o come tutore di un partecipante, mi è stato spiegato e mi è chiaro lo svolgimento e lo scopo connessi a questo studio, così come per quanto riguarda le aspettative di chi vi avrà partecipato. Per eventuali dubbi e domande potrò rivolgermi in qualsiasi momento al personale interessato che provvederà a rispondere nel modo più adeguato.

1. Parteciperò al seguente programma di ricerca che prevede:

- intervista generale sulla salute (anamnesi)
- acquisizione immagini T.C. o R.M.
- valutazione neurolinguistica (B.A.T., questionario LEAP-Q, questionario CETI)
- trattamento riabilitativo delle funzioni linguistico-comunicative

2. Sono d'accordo che i miei dati siano mantenuti in forma anonimizzata e separata, tra dati personali e medici, e che siano impiegati a scopo di ricerca in accordo con le leggi vigenti (legge sulla TUTELA DEI DATI PERSONALI, Decreto legislativo 30 giugno 2003, n. 196).

3. Sono d'accordo che i dati ottenuti dalla valutazione neurolinguistica vengano utilizzati per la ricerca e per la stesura della tesi di laurea magistrale della dott.ssa Angela Maria Fenu. Mi è conosciuto che questo studio è condotto a scopo di ricerca e che non sarò messo a conoscenza dei suoi risultati.

4. Sono d'accordo che i dati siano utilizzati dall'Istituto di Riabilitazione Santa Maria Bambina, Oristano, dove tale studio avrà luogo, ed eventualmente trasmessi in forma codificata ad altre istituzioni di ricerca.

5. Sono d'accordo che i miei dati personali siano preservati unicamente nell'Istituto di Riabilitazione Santa Maria Bambina, Oristano, e che verrò ricontattato eventualmente per domande chiarificatrici o invitato a partecipare a studi successivi.

6. Ho preso visione e sono a conoscenza delle informazioni riguardanti questo studio, sono preparato a sostenerlo con la mia partecipazione. Concedo a chi lavora in questo studio di trattare i dati e a procedere con l'intervista generale sulla salute, la valutazione neurolinguistica ed il successivo trattamento riabilitativo delle funzioni linguistico-comunicative.

7. Mi dichiaro d'accordo con tutti i punti sopraindicati.

☐Si ☐No

Non sono d'accordo (esprima qui il suo dissenso in merito al punto specifico o ai punti con i quali non concorda)

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Sono a conoscenza del fatto che la presente ricerca non ha scopo diagnostico e che non riceverò alcuna informazione specifica sui risultati di questo progetto.

Posso revocare in ogni momento il mio consenso, senza alcun bisogno di specificare la motivazione, comunicandolo per iscritto o per telefono all'indirizzo riportato, e confermando la mia intenzione per iscritto.

La Sua disponibilità a partecipare a questo studio è un importante contributo per il progresso della scienza medica. Per questo motivo Le siamo riconoscenti e La ringraziamo calorosamente.

Nome: _____ Data di nascita: _____

(Partecipante allo studio)

Firma: _____ Firma: _____

(Partecipante allo studio o eventuali tutori)

Data: _____

Il sottoscritto certifica di aver eseguito un'informazione al paziente dettagliata e completa sul tipo di studio che sarà condotto.

Nome: _____ Firma: _____

(Personale specializzato) (Personale specializzato)

Data: _____