The First Step of Implementation of a Software to Facilitate Italian Children in Learning English

Giuseppe Città, Lucia Collerone

University of Messina, Italy

0512

The Asian Conference on Education 2013

Official Conference Proceedings 2013

iafor
The International Academic Forum
www.iafor.org

Introduction

This work presents the theoretical basis and first steps for the realization of an educational software to learn English in the first classes of the Italian Primary School: MOLKI (More Language for Kids).

This software was created starting from the way in which the high-frequency words are usually uttered, perceived, used and acquired by children on the basis of the input they receive. The choices to implement these information in an educational technological tool arises from the necessity to create functional teaching tools to support inclusive didactic choices and to give children a strong motivation for using English in gaming context, even outside the school time as to enlarge the time of L2 exposure text.

The scientific model used by the Italian research group named "Brain, Cognition & Education" is "Educational Neuroscience" a new field of interdisciplinary research that correlates the neurobiology and the researches on brain functioning, to educational sciences.

The main steps for the realization of the final work of the research project presented here are:

- the study of bilingualism trough the different information given by the researches in Cognitive Science as regard to the neurobiology of bilingualism,
- the importance of the linguistic input.
- the methodological and didactical choices made up on these scientific information
- the first steps for the creation of MOLKI.

1. BIOLINGUISTIC STUDIES

1.1 The acquisition of L2 in the brain

This part of the article is a review of the recent studies on the most important neurobiological and neurocognitive mechanisms at the basis of the acquisition of a L2.

Studying the bilingual brain, from the neurobiological point of view, means to concentrate the attention on the cerebral structures that underline the L2 learning, to understand how these structures are functionally used and which are the changes that happen in the structures that traditionally are considered at the basis of the linguistic process and finally, what are the possible interferences in the use of the two languages.

Other factors that can or can not influence a "native like" use of L2 are:

- the constraints to which the cerebral structure is submitted and the "critical

period ” for learning a L2;
- the correlations with the age of acquisition of L2, the “proficiency” and the modalities of exposition to L2;
- individual factors and the impact of context in learning a L2.

In general, the idea at the basis of the researches is that bilingualism needs an adaptation of cerebral structures that are used traditionally for language processing (Zou *et al*. 2012), and that speak a second or more languages is possible thanks to the neural plasticity and to a functionally different use of the neural networks, activated in linking the different brain areas, that can be used for different functions, without qualitative, but only quantitative variations of the brain matter (Parker Jones 2011).

Abutalebi e Green (2007) studied the mechanism of bilingual language production and specified a model that integrates distinct neural systems responsible of different aspects of the cognitive control involved in the production of bilingual language. The neural systems involved in the production of bilingual language includes the prefrontal cortex (updating of language, inhibition of language not in use, error correction), the anterior cingulated cortex (attention, monitoring of conflict, error erasing) the basal ganglia (selection of language) and the inferior-parietal lobule (maintaining of representations and working memory).

The representation of the two languages is mediated by a structure of control (including the anterior cingulated cortex, the basal ganglia, the inferior parietal lobule and predominantly, the prefrontal cortex) that is able to maintain the two linguistic systems separated, avoiding the interferences (Gollan *et al*. 2011).

The work of this network depends on the proficiency in L2 (Leonard *et al*. 2011), that is accompanied by a shifting from controlled processing to automatic ones and by a reduction of the prefrontal activity; as the proficiency increase, the neuronal difference between native speaker and bilingual decreases.

Many neuroimaging studies confirmed that when the proficiency in L2 is like in L1, neuronal common activations in similar cerebral areas are registered, that are even used by monolingual while doing the same tasks, for example in producing single words (Hernandez *et al*. 2007) or in retrieval tasks (Stein *et al*., 2009).

If the proficiency is low some non usual areas, just like the posterior bilateral visual regions, are recruited for word processing, both in writing and in oral form (Leonard *et al*. 2011). Even exposure to L2 can have great importance in influencing a greater or lesser dependence on the lexical-semantic system in bilinguals. Perani *et al*. (2003) have shown that those who have greater exposure to L2, requires less activation of the left prefrontal cortex, moreover, he indicates that there is a possibility of reversibility of the system of language learning in the early years of children's lives, within 3 and 8 years, for example in the case of adoption, when the L1 is forgotten and replaced with L2.

Puberty seems to be considerable as the time limit for the acquisition of another language in a "native-like" way (Lennenberg, 1967), but a certain plasticity continues even after this time limit and allows to learn another language, causing changes in the brain even after short periods (5 months) of intensive training for the general use of the L2 (Stein *et al*. 2010;) and just 5 days of training for the acquisition of new words

in L2 (Dobel *et al*. 2010).

Summarizing we can say that the competence in L2 and exposure may be critical for the lexical-semantic processing, and the age of acquisition has not much influence on it. Instead, in the grammatical domain the neural substrate seems to be more dependent on the effects of age of acquisition, rather than on competence. While the acquisition of competence relating to the cognitive aspects of language, such as syntax and vocabulary, seems to be possible for those who learn a L2 in adulthood, when the L2 is learned after the first years of a child's life, the control of the rules of pronunciation can not reach the level of competence of the native speakers.
The pronunciation is the only part of "natural" language with neuromuscular complex needs and proper pronunciation depends largely on sensory feedback, how and where the articulator muscles move, with specific timing and sequences (Scovel, 2000). Golestani *et al*. (2007) have shown that the ability to produce and articulate sounds of a foreign language can be correlated to the activation of different structures in the prefrontal cortex, in the left insula, in the left temporal cortex and in the bilateral parietal cortices.

Some studies proved that in the processes, such as the articulation and the post-articulatory monitoring, there was a larger activation of brain areas for bilinguals that for monolinguals (Parker Jones *et al*. 2011), greater activation that could directly reflect the lack of familiarity with the motor commands needed to produce the target sound.

In the case that the L2 sound does not exist in the native language or is very difficult to discriminate and reproduce, there is the involvement of the areas of the motor representation (premotor cortex), areas of the oro-sensory, articulatory and auditory cues mapping that allow the connection of the movements of mouth to the emission of sounds (Port, 2010).

There are strong evidences that the motor system generates internal representations of speech sounds (Wilson and Iacoboni, 2006), and in a native speaker, these internal representations, that the motor system makes of the sounds of language, correspond to the auditory input received.

The oral movements necessary for producing the sounds of the native language are very well learned and automatic, because they integrate the pre-controls motors and the feedback of auditory and somato-sensory information. Instead, in a foreign language, auditory and somato-sensory inputs do not match the internal representations, and there is the need to do a mapping of new insights into their internal representations, in order to be able to produce the sounds of the foreign language.

At the beginning of learning a L2, the sounds of the new language are processed as auditory stimuli similar to non-words, with a greater involvement of the right hemisphere (Sugiural *et al*. 2011).
Finally, studies on the neurocognitive motor representations of language sounds, the language related to the action (Wilson and Iacoboni, 2006) and the co-speech gestures (Hagoort and van Berkum, 2007) have shown a correlation in the brain that includes language, action and gesture.

The brain is not only able to process the flow of a lot of information, but it does it in a qualitatively similar way even if they have different perceptual features and involve different brain areas. The processing of unimodal perceptual data is acted in a way that could be called a-modal, in brain hubs that have the precisely task of integrating information.

For example, in the case of language understanding, the brain uses many kinds of information, in a qualitatively similar manner, to achieve understanding. The information used are those that come precisely from the knowledge of words, co-language gestures, from images, from information provided by the characteristics of the voice or from previous speeches.

1.2 Age of acquisition (AA) and "critical period"

AA is referred to the age at which a concept or skill is acquired, that is called the "critical period" or "sensitive period" of learning. It defines the time constraints that affect the acquisition of a skilled competence in the foreign language. There are many studies that attempted to outline the best time to learn a L2 and gave different indications which can be summarized as follows: before the age of 5 the exposition to bilingualism allows the development of both languages and their mastery, and there is an overlap of the language cerebral areas, without any supplementary cognitive efforts to process the two languages (Petitto and Dunbar 2004), with a lengthening of the period of stabilization of the lateralization of language, which lasts up to 6 years and, therefore, there is a use of both hemispheres in processing the two languages (Peng *et al*. 2011).

Children, who at birth are exposed exclusively to L1 and after learn a L2 between the age of 2 to 9, can learn the morpho-syntax bases of the new language, from the first year of exposure, but only if they are subjected to an extensive and systematic exposure, in different environmental and communicative contexts.

In any case the complete mastery of L2 is not acquired if learners are exposed only to a teaching activity in a school context (Kovelman *et al*. 2008). Children and adults differ, both qualitatively and quantitatively, in their ability to acquire a new language. Bley-Vroman (1990) affirmed that there is a fundamental difference between the acquisition of the first and the second language in children, in fact L1 is driven by innate language-specific acquisition procedures and, conversely, in adult learning is driven by mechanisms of general domain learning.

Another possibility, which justifies the difference between children and adults is that they differ profoundly in their cognitive abilities and in the linguistic input. Children have lower cognitive abilities, such as memory and in the speed processing, which could help children to learn the new language, avoiding the hyper regularization of inconsistent input (Hudson and Newport 2005). Another possibility is that learning a second language is more difficult in relation to the interference due to the first language, as evidenced by several recent studies and research as well (for a summary of studies see Bardovi-Härlig and Stringer 2010).

During the 32th Annual Meeting of the Cognitive Science Society of Portland in 2010, Amy Perfors and David Dunbar identified in the ability to distinguish phonological sounds, the basic skills that would activate cascade effects on language

skills and would condition the acquisition or the functioning of other aspects of higher level language, with which the basic function has a bond of interdependence, especially in the acquisition of L2 at a later age to 9 years. The researchers conclude that a phonological training activity improves learning ability of words, thus proving their contention that puts the basis of learning difficulties of a competent L2, over the age of 5 years, in the inappropriate level of phonological competence in L2 which has a domino effect on all other abilities.

2. THE ROLE OF INPUT

In this section we will examine, in particular, a trait that has a strong influence in linguistic ontogeny. We will focus first on the nature of linguistic input addressed to the child by the parents in a family setting, and then on the nature of linguistic input by the teacher who, in a new communicative context (school), plays a similar role that parents play in a familiar context.

2.1 The role of Child Directed Speech

The set of individual linguistic input is also referred with the expression 'Child Directed Speech' (CDS) and is the language environment within which the child lives and from which, both at the production level and at comprehension level, the organization of linguistic knowledge starts. It is a key factor that determines the age of acquisition, the rhythm of growth, the size of productive vocabulary - as regards the phase of the explosion of vocabulary - and the formation of abstract categories of language - as regards the first period of schooling (Huttenlocher 1998, Roy *et al*. 2009, Roy 2009). School is, in fact, the first real organized social group with a degree of stability in which the children live, apart from their family group.

In order to make the argument more clear we will proceed by dividing it into two sequences, the first of which will have as its core the role of parents' linguistic input at four years of age, while the second will focus on the central role that teacher's linguistic input plays, during the first schooling period, in the learning of particular language skills. This is because, according to the stage of language development and according to the social actors involved, we can draw from the CDS different elements. Different aspects of syntax, in fact, may exhibit a sensitivity to different forms of linguistic input in different stages of development. Consequently, skills which, at an early stage, are less related to linguistic input, could be considered as more closely linked to it in more mature stages.

Parental CDS

For example, during explosion of vocabulary, the frequency with which elements such as verbs occur in the parental speech seems to be a key factor in the linguistic input: the child tends to use more verbs that occur most frequently in maternal speech (Naigles-Hoff 2006). In a more mature phase (after three years of age) the complexity of utterances takes the role of main feature of influence. At the age of four, the frequency of use of specific terms in the speech that the child perceives is no longer a primary predictor of the internal organization of child's expressions. It (this internal organization) receives a direct influence from the way in which expressions are structured in the input. In other words, the ability of the child to master complex expressions will be directly proportional to the number of utterances of the CDS formed by sentences logically stratified.

We can summarize as follows:

- up to three years of age, in the stream of the CDS, the frequency of use of words in specific contexts is a component of primary influence and provides results as (a) the increase of the amount of words that are part of the child's productive vocabulary; (b) the acquisition of elementary and telegraphic compositions of words used by the child in restricted contexts of use in which the verb is in a prominent position;

- up to four years of age, in the flow of CDS, conversational complexity - the way in which the different sentences within the discourse are related to each other - is the primary factor of influence and returns, as the most evident result acquired by the child, the skill to bind the sentences to each other in a more or less stratified way. For example, the analysis of the input returns that the number of subordinate clauses present in the child's utterances is directly proportional to the number of subordinate clauses belonging to the CDS (Huttenlocher *et a*l. 2002).

The results of several experiments (Huttenlocher *et al*. 2002) show, in fact, a precise relationship between parental speech and child utterances on some aspects of syntax: for example, there is a proportional correlation between the number of noun phrases used by the child and the number of noun phrases in the CDS.

The teacher's CDS

However, to complete the framework we are drawing, we must now consider how schooling (especially in relation to early years) influences, at the level of linguistic input, the development of the child's abstract language skills. We can, in fact, draw interesting indications on the quality of the development of various language elements: vocabulary, morphology, syntax. At this stage (4-6 years), in fact, the school CDS plays a central role, joining the parental CDS, with its specific traits, in communicative context of each child.

The main feature that distinguishes school inputs and parental inputs is to be found in the fact that syntactic skill of the child, at the beginning of schooling, it is not related to the syntax of teacher's linguistic input. They are separate, unrelated, unlike what happens, as mentioned above, for the relationship between parental CDS and child's

speech comprehension/production. This mutual lack of initial report allows us to examine the structure of the teacher input not as a factor in proportional relationship with the expressiveness of the child but as a decisive and powerful resource of development in the acquisition process. Some studies (Huttenlocher *et al*. 2002: 367), in fact, have shown that the teacher's speech is a critical factor in the development of language comprehension. There is a relationship of direct influence exerted by the composition (structure) of the teacher's utterances on the development of syntactic skills that the child shows from his first year of school. These skills are related to understanding and later to the production of multi-propositional expressions within which the sentences are linked to each other on the basis of different syntactic logical relations: phrases, coordination, subordination, use of relative clauses as well as quantitative increase of lexicon especially in relation to words whose use are closely tied to specific contexts. Further confirmation of the direct influence of the teacher's CDS on language and cognitive development comes from the fact that it is very sensitive to internal changes of the same input. Several experimental data (Bowers and Vasilyeva 2011, Huttenlocher *et al*. 2002) show that substantial changes in the composition of the linguistic inputs influence in different ways the language development of the child. This is most evident especially in reference to the increase of vocabulary during the early school years. Around 4-5 years old, in connection with the acquisition of specific words (words not in common use, linked to specific contexts of use and not frequently recurring) children whose teacher speaks to them through logically structured and rich expressions are lexically more advantaged. Essentially, although the total number of words of the teacher, and not only the logical-syntactic organization in which these words occur, is a factor of direct influence of lexical growth in this particular phase of the acquisition process (Bowers and Vasilyeva 2011).

3. DEVELOPING APPROPRIATE TEACHING METHODS IN THE LEARNING OF A SECOND LANGUAGE: THE CONTRIBUTION OF LINGUISTIC CORPORA IN THE REALIZATION OF A TEACHING-LEARNING SOFTWARE.

Among the contributions provided by Cognitive Sciences in the study of language learning and of L2 learning, the contribution from the computational analysis of linguistic data collected in databases (corpora), in terms of research methodology, is very important. The realization of a derived linguistic corpus, on the model of the corpora that are part of the CHILDES database (MacWhinney 2011), therefore, could play a key role in the development of efficient educational strategies involving the use of appropriate educational tools. According to the perspective that we are arguing, in fact, having a large set of linguistic data facilitates the understanding of a complex phenomenon which is the influence of the input (CDS) in structuring linguistic and cognitive system, and also allows, on the basis of empirical evidence from concrete linguistic data, the creation of appropriate methods of teaching-learning. In the specific case of second language learning the work that we propose to do is the realization of a software with a particular database: MOLKI (More Language for Kids). An educational software equipped with a linguistic derived corpus as database, made from different subjects in a particular age, generated by spontaneous conversation and morphologically annotated.

Having data from several subjects depends on the need to create a mutual control

function that allows us to limit the individual particularities and to conduct a detailed study of common linguistic characteristics that emerge during the process of ontogenesis.

3.1 The first steps of implementation of MOLKI

From these theoretical assumptions, we have developed the project to create an educational software that makes easier learning a second language in the early age of Italian primary schools. The realization of an educational software that that works starting from cognitive and linguistic processes involved in a L2 learning.

This project has taken its start from some linguistic corpora that collect 3 years old native English-speaking children expressions.

The main aim that produced the choice of such corpora is to put an Italian child in direct connection with an English-speaking child's input during his first steps of language production.

The aim we are pursuing is set up a direct relationship between the Italian children and the contexts and co-texts of English language through linguistic input that native English-speaking children receive.

Moreover, we are pursuing this aim by adapting it to the stages of language development inside the mother tongue of Italian children.

This means that, in constructing a derived corpus that will be the software linguistic database, in addition to considerations concerning cerebral processes involved in learning a language, we will take into account language skills of the child, who will interact with MOLKI.

Conclusion

The next two steps of our project will be (a) the development of the architecture of software MOLKI and (b) the interactive tasks with which it will interface with the child.

The ultimate goal will then be represented by the classroom level where both the theoretical perspective and MOLKI will be tested.

References

Abutalebi, J. and Green, D. (2007). 'Bilingual language production: The neurocognition of language representation and control'. J*ournal of Neurolinguistics* 20, 3: 242–275.

Bardovi-Harlig, K. and Stringer D. (2010). 'Variables In Second Language attrition. Advancing The State Of The Art'. *Studies In Second Language Acquisition* 32: 1–45.

Bley-Vroman, R. (1990). The logical problem of foreign language learning. *Linguistic Analysis*, 20: 3–49.

Bowers, E.P. Vasilyeva, M. (2011). 'The relation between teacher input and lexical growth of preeschooler'. *Applied Psycholinguistic*, 32: 221-241.

Dobel, C. Junghöfer, M. Breitenstein, C. Klauke, B. Knecht, S. Pantev, C. and Zwitserloo, P. (2010). 'New Names for Known Things: On the Association of Novel Word Forms with Existing Semantic Information'. *Journal of Cognitive Neuroscience*, 22, 6: 1251–126.

Gollan, T.H. Sandoval, T. and Salmon, D.P. (2011). 'Cross-Language Intrusion Errors in Aging Bilinguals Reveal the Link Between Executive Control and Language Selection'. *Psychological Science*, vol. 22 no. 9: 1155-1164.

Hagoort, P. and van Berkum, J.J. (2007). 'Beyond the sentence given'. *Philos Trans R Soc Lond B Biol Science*, 362, 1481: 801–811.

Hernandez, A. and Li, P. (2007). Age of Acquisition: Its Neural and Computational Mechanisms. *Psychological Bulletin*, 133, 4: 638–650.

Hudson, K. C. and Newport, E. (2005). 'Regularizing unpredictable variation: The roles of adult and child learners in language formation and change'. *Language Learning and Development*, 1, 2: 151–195.

Huttenlocher, J. Vasilyeva, M. Cymerman, E. Levine, S. (2002). 'Language input and child syntax'. *Cognitive Psychology*, 45: 337-374.

Huttenlocher, J. (1998). 'Language Input and Language Growth'. *Preventive Medicine* 27: 195- 199.

Kovelman, I. Baker, S.A. Petitto, L.A. (2009). 'Age of first bilingual language exposure as a new window into bilingual reading development'. *Biling (Camb Engl)* 1, 11, 2: 203–223.

Lenneberg, E. H. (1967). *Biological foundations of language*. New York: Wiley.

Leonard, M.K. Torres, C. Travis, K.E. Brown, T.T. Hagler, D.J. Jr (2011). 'Language Proficiency Modulates the Recruitment of Non-Classical Language Areas in Bilinguals'. *PLoS ONE*, 6, 3: e18240.

Naigles, L.R. and Hoff, E. (2006). 'Verbs at the very beginning: parallels between comprehension and input'. In: Hirsh-Pasek, K. Golinkoff, R.(eds.). *Action meets word: How children learn verbs*. Oxford: University Press.

Parker Jones, O. Green, D.W. Grogan, A. Pliatsikas, C. Filippopolitis, K. Ali, N. Lee, H.L. Ramsden, S. Gazarian, K. Prejawa, S. Seghier, M.L. Price, C.J. (2011). 'Where, When and Why Brain Activation Differs for Bilinguals and Monolinguals during Picture Naming and Reading Aloud'. *Cereb Cortex*. Jun 24.

Pattern, K.E and Campbell, S.R. (2011). 'Introduction: Educational Neuroscience'. *Educational Philosophy and Theory,* 43 (1).

Peng, G. Wang, S.Y. (2011). 'Hemisphere lateralization is influenced by bilingual status and composition of words'. *Neuropsychologia*, 49, 7: 1981-1986.

Perani, D. and Abutalebi, J. (2005). 'The neural basis of first and second language processing'. *Current Opinion in Neurobiology*, 15, 2: 202–206.

Perfors, A. and Dunbar, A. (2010). Phonetic training makes word learning easier'.

Cognition in flux: Proceedings of the 32nd Annual Meeting of the Cognitive Science Society Portland, Oregon, August 11-14, / S. Ohlsson and R. Catrambone (eds.): 1613-1618.

Petitto, L-A. and Dunbar, K. (2004). 'New findings from Educational Neuroscience on Bilingual Brains, Scientific Brains, and the Educated Mind'. *Conference on Building Usable Knowledge in Mind, Brain, & Education Harvard Graduate School of Education*, Oct. 6- 8.

Port, R.F. (2010). 'Rich memory and distributed phonology'. *Language Sciences*, 32: 43–55.

Scovel, T. (2000). 'A critical review of critical period researches'. *Annual Review of Applied Linguistics*, 20: 213-223.

Roy, D. (2009). 'New Horizons in the Study of Child Language Acquisition'. *Keynote at Interspeech 2009*, Brighton: UK.

Roy, D. Roy, C.B. Frank, M.C. (2009). 'Exploring Word Learning in a High-Density Longitudinal Corpus'. *Proceedings of the 31st Annual Cognitive Science Conference*. Amsterdam: Netherlands.

Stein, M. Federspiel, A. Koenig, T.Wirth, M. Lehmann, C. Wiest, R. Strik, W. Brandeis, D. Dierks, T. (2009). 'Reduced frontal activation with increasing 2nd language proficiency'. *Neuropsychologia*, 47, 13: 2712-20.

Sugiural, L. S. Matsuba-Kurita, H. Ippeita, D. I. Hagiwara, H. (2011). 'Sound to Language: Different Cortical Processing for First and Second Languages in Elementary School Children as Revealed by a Large-Scale Study Using fNIRS'. *Cereb. Cortex 21* (10): 2374- 2393.

Wilson, S.M. Iacoboni, M. (2006). 'Neural responses to non-native phonemes varying in producibility: Evidence for the sensorimotor nature of speech perception'. *NeuroImage*, 33, 1: 316-325.

Zou, L. Abutalebi, J. Zinszer, B. Yan, X. Shu, H. Peng, D. Ding, G. (2012). 'Second language experience modulates functional brain network for the native language production in bimodal bilinguals'. *NeuroImage*, 62, 3: 1367-1375.

iafor