TOWARD A TRANSLATION ABILITY TESTING:
MERGING RESEARCH ON BILINGUALISM AND L2 TEACHING WITH TRANSLATION THEORY

LAURA SALMON, MANUELA MARIANI, ALESSANDRO AGNETTA[1]

Abstract

I dati, in parte controintuitivi delle ricerche sul bilinguismo e sulle disfunzioni della traduzione sono di fondamentale rilevanza glottodidattica, ma necessitano di una progressiva integrazione con i dati della traduttologia. Sulla base di una proposta teorica sui processi traduttivi umani (TTP, cfr. Salmon 2006), coerentemente a un modello multidisciplinare del funzionamento (normale) del "cervello interlinguistico", vengono evidenziate rilevanti connessioni teoriche tra le discipline coinvolte (neuro-/psicolinguistica, glottodidattica, traduttologia) con le possibili applicazioni anche in ambito sperimentale. Secondo la TTP, esistono a livello innato A) una facoltà per la ricodificazione interlinguistica (Translation Device) e B) una predisposizione spontanea alla ricodifica funzionale. Viceversa, la diffusione della traduzione strutturale è da considerarsi l'esito non di una naturale imperizia dei discenti, ma della innaturale, diffusa prassi scolastica del "calco" interlinguistico. Dopo una sintesi critica delle più recenti teorie neurolinguistiche e traduttologiche, vengono presentati tipologia e risultati di un osservatorio di ricerca, atto a 1) indagare la sperimentabilità dei modelli traduttologici; 2) testare i postulati della TTP con bambini bilingui ancora esenti dagli effetti collaterali dell'esercizio forzato al "traduttese".

Parole chiave: *cervello interlinguistico, traduzione, lingue*

[1] L.Salmon – University of Genoa, Dipartimento di Scienze della Comunicazione Linguistica e Culturale; M. Mariani – University of Genoa, SSIS-Liguria; A. Agnetta - University of Palermo. Even if the authors worked out the paper and the preliminary school tests all together, part 1 was developed by M. Mariani, part 2 by L. Salmon, and part 3 by A. Agnetta.

1. The state of art in the neurofunctional study of bilingual and polyglot linguistic competence

1.1. Bilingualism: an up-to-date definition

According to traditional studies, bilingualism is mostly classified as "early coordinated" or "late subordinate", depending on the age of L_2 acquisition (cf. for example Fabbro 1996, 119-120). The definition of "early coordinate" bilingualism means that both languages have been acquired before puberty, even though L_2 is often acquired in an extra-familiar environment (frequently after the immigration into a new country). In the "subordinate" bilingualism, the two languages are rather in a hierarchical relation (one is always dominant upon the other).

Nevertheless, such a strict distinction is still a by-product of a monolithic, abstract idea of what a "perfect" linguistic competence should be. Language experts (scientists, L_2 teachers, speech therapist etc.) are well aware that languages are acquired in different contexts and for different purposes, and that the level of proficiency of a bi-/multilingual person in each language is functional to its usage. As a consequence, a bilingual has no need to reach the same "perfect" level of competence in each language: "A bilingual is not two monolinguals in one person!" (Grosjean 1989).

A more operative definition of bilingualism could then pertain to a person who uses two or more languages or even dialects in everyday life (Grosjean 1994; Fabbro 2001a). As a matter of fact, this perspective has been shown to be particularly useful in testing and studying linguistic recovery in bilingual and polyglot aphasia. The BAT, *Bilingual Aphasia Test* (Paradis/Libben 1987; Paradis 2001a, 2001b), provides with objective criteria the assessment of linguistic disorder in bilingual aphasics, in order to detect and classify patient's linguistic perfomances and recovery in both languages[2].

1.2. Language processing: new perspectives of functional cerebral mapping

Recent neuro-functional brain-imaging research have evidenced the need to provide the functional brain map with new, more complex models. The one-to-one relation between brain areas and cognitive functions, resulting from the traditional neo-cortical investigation, is now successfully integrated with the neural networks system. This model enlightens the role of some subcortical structures (basal ganglia, putamen, thalamus) in the corticocortical connections and in the neuro-functional processing (Alexander/Crutcher 1990; Crosson 1992; Dubois *et al.* 1995; Lebrun 1997; Destrebecqz *et al.* 2005).

PET- and fRMI studies on the Parkinson syndrome, which affects specifically the basal ganglia, provided evidence of the relevance of the striatum (basal ganglia and putamen) in some procedural aspects of the language processing (cf. Kent *et al.* 2000, on the concomitance of disarthria and gestual disorders in the Parkinson syndrome; cf.

---

[2] Part A accounts for the pre-morbid patient's linguistic history (50 items). Part B in a systematic, comparative way values linguistic disorder in each language (472 items for each language). Finally part C tests patient's residual translation abilities from one language into the other and *vice versa*, and notes and classifies interference (58 items each). BAT is today available in 65 languages for part B, and in 160 language pairs for part C. Dialect, as shows the Friulan/Italian version (Paradis/Fabbro 1993) is considered as any other language.

also Pramstaller/Marsden 1996; Pickett *et al.* 1998), such as: integrating motor and cognitive sequences (Marsden 1984; Lashley 1951; Graybiel 1995, 1998); sequencing language, i.e. coordinating and selecting linguistic items before verbal production (Partiot *et al.* 1995; Guillery 1995; Graybiel 1998; Kropotov *et al.* 1999; Lieberman 2000, 2001; St. Clair *et al.* 2005)[3]; performing specific syntactic tasks as noun/verb agreement (Kotz *et al.* 2003). Moreover, clinical studies on parkinsonian subjects (Pickett *et al.* 1998) revealed not only active (in the syntactic production), but also passive problems (in the syntactic comprehension).

In this respect, the notion of "subcortical cognition" (Wallesch/Papagno 1988; Crosson 1992; Aglioti 1997) is a key-concept in contemporary neuropsychology and neurolinguistics. As observed by Perlman Lorch (2003), the Neural Networks Model somehow recovers the more holistic and less localized view of the linguistic brain representation, already claimed by some 19th century authors.[4]

Because of their multiple connections with the neocortex, basal ganglia are an important neural knot linked with the frontal lobes. The so called "frontal loop" (Alexander/Crutcher 1990) is yet a crucial element in the neurolinguistic study of the code-switching mechanism: the frontal lobes are thought to control the production of new- and the inhibition of previous actions (Ridderinkhof *et al.* 2004), while the striatum should hold the new programs till the action is achieved (Partiot *et al.* 1995; Dubois *et al.* 1995; Abutalebi *et al.* 2000; Exner *et al.* 2002; Aldridge/Kent 1998, 2003). Clinical evidence is given that lesions or tumoral damages in the frontal lobes may cause pathological switching (Fabbro *et al.* 2000). FMRI studies on switching tasks confirm the role of the prefrontal cortex in switching performances (Hernandez *et al.* 2000, Hernandez *et al.* 2001). Studies on patients with frontal lobes lesions have however revealed other typical disorders, such as a reduction in general anxiety and verbal disinhibition, with an increasing tendency to a scurrilous speech. A bilingual patient with a tumor in the left frontal lobe, presented in a case-study by Fabbro *et al.* (2000), showed all these symptoms together with pathological code-switching, but without any aphasic symptom. These results support the hypothesis that the system responsible for the linguistic switching is not dependent upon the language system, but needs to be considered as a part of a larger executive system, deputed to choose between divergent behaviors.

After a long-time searching for a location of a neuro-anatomical switching mechanism (Pötzl 1930; Leischner 1948), the ability of code-switching is now considered as depending upon a more general system, responsible for the control of antagonist tasks, such as, for example, standing up/sitting down, talking/keep silence, speaking L1/L2, speaking a standard/dialectal variety of a language (Fabbro *et al.* 2000). In Green's Inhibitory and Control Model (Green 1986, 2004)[5], the "inhibition device" allows the system to select and send information to the working memory, to

---

[3] The neural subthalamic activity in tasks of sentence production and syllabic repetition has been recorded by Watson/Montgomery (2006). Evidence has been given that, when dealing with sentence production, the neural activity was more organized than with syllabic repetition.

[4] Especially by the British neuro-physiologist J.H. Jackson, who criticized the neo-cortically oriented Broca's and Wernicke's associationist theory, which became so popular to permeate all the 20th century research (cf. Jackson 1874/1958).

[5] Cf. also Zatorre 1989, Dempster 1992, Fabbro 1999, Fabbro *et al.* 2000.

control and merge the contents of the working memory with the task, and finally to inhibit all the possible competitive answers.

This device affords a multilingual brain to control the competition among antagonist schemas and tasks, in order to talk in only one language, or to translate from one language into another (Activation Threshold Hypothesis: Paradis 1993, 2004). The switching mechanism is essentially a "monitor system" (Albert/Obler 1978; Abutalebi *et al.* 2000), which assigns priorities such as "if one were in France, the tendency would be to interpret incoming data as if they were in French" (Perecman 1984, 213). The introduction of a L2 implies a reset of the priorities: "The bilingual condition may increase the efficiency of inhibitory mechanisms" (Kefi *et al.* 2004).

Some typical bilingual language disorders can then be explained as 'alternate antagonism', for instance, the temporary loss of the ability of switching with access to only one language. This syndrome often occurs with paradoxical translation: the patient is able to translate only into the language that she at that moment cannot spontaneously speak (but not *vice versa*). These symptoms could be due to a lesion of the Inhibitory and Control (IC) specifier, which may cause either a pathological code-mixing, or difficulties in the *switching* performance (Abutalebi *et al.* 2000).

1.3. Leaving the hypothesis of a neuro-functional specificity of linguistic competence in bilingualism

To discuss the hypothesis of a specific anatomical location of a switching mechanism means to deny the idea that each language is stored in a differed brain site. Green's IC model helps emancipating from the hypothesis of a specific "cip" for bilingualism. Against the traditional claim of a neuro-functional specificity of bilingual competence, i.e. of an inter-hemispheric lateralization of L_1 (left) and $L_{2/}L_n$ (right) processing, evidence is now given that languages are represented in the same areas in *early* bilinguals (Hernandez *et al.* 2000; Hernandez *et al.* 2001; Paradis 2000; Fabbro 2001b; Perani/Abutalebi 2005; Reiterer *et al.* 2005). But it is the level of proficiency, rather than the age of acquisition, the key-feature in mapping the neural systems involved in L_2 learning. The inter-hemispheric lateralization is thus relative to L_2 proficiency (Kim *et al.* 1997; Perani *et al.* 1998; Klein 2003; Green 2004; Mechelli *et al.* 2004): the higher the competence, the more the neural systems for L_1 and L_2 processing tend to overlap, and the L_2 working profiles are similar to those of native speakers (cf. Green's "Convergence Hypothesis" 2004 and Paradis 2004)[6].

Consequently, the question is not when, but how L_2 competence has been formed: a topic of contemporary language acquisition theories[7] is the problem of the functional split between procedural (implicit) and declarative (explicit) memory and the role it plays in lexicon and rules learning.

---

[6] "When a L_2 is learned formally and mainly used at school, it apparently tends to be more widely represented in the cerebral cortex than the first language (L_1), whereas if it is acquired informally, as usually happens with the L_1, it is more likely to involve subcortical structures (basal ganglia and cerebellum)" (Fabbro 2001b).

[7] Cf. for example the Dual-Mechanism Model and the innatist theories (Chomsky 1995; Pinker 1994); the connectionist framework of the Single-Mechanism Model (Bates/MacWhinney 1989; MacDonald *et al.* 1994); the Declarative/Procedural Model (Ullman *et al.* 1997; Ullman 2001; Ullman/Pierpoint 2005); the Shallow Structure Hypothesis (Clahsen/Felser 2006), the MUC (Memory Unification Control)-Model Theory (Hagoort 2006). See also Paradis (1994, 1997, 2004).

Leading studies on specific pathologies of bilingual aphasia showed the role of the subcortical structures in procedural acquisition processes[8], compared to the metalinguistic learning (cf. Fabbro/Paradis 1995, Fabbro *et al.* 1997). Bilingual subjects with Parkinson syndrome show a greater deterioration at the morpho-syntactic level in L_1, rather than in the L_2 (Zanini *et al.* 2004). This fact provides evidence that procedural memory is involved more in L_1- than in L_2 grammar brain representation. Hence, in the paradoxical phenomena of differential recovery of bilingual patients' languages, a reduction in the implicit competence may explain the better recovery of L_2 (Aglioti/Fabbro 1993; Fabbro/Paradis 1995). The disease damages the competence in both languages, but patients can resort to the wider explicit memory by which L_2 was stocked (Paradis 1994).

On the contrary, the loss of L_2 against a better preserving of L_1 is typical of amnestic and Alzheimer patients (Obler 1999). Alzheimer is indeed known to be a degenerative disease of the neo-cortex marked by the loss of the declarative memory. According to a study on a group of Japanese-Portuguese bilingual subjects with a diagnosed Alzheimer (Meguro *et al.* 2003), the main difficulties were found with the Japanese *kanji* (ideographic signs) and the Portuguese's irregular words, not with the *kana* and the (morphologically) regular Portuguese words. That was because *kanji* and irregular Portuguese words do not have a one-to-one relation between grapheme and phoneme. For these patients the features related to the declarative memory were selectively or considerably more damaged than those resulting from rules more procedurally (automatically) assimilated (cf. also Sasanuma 1975).

Moreover, studies on bilingual aphasia (Fabbro/Paradis 1995; Fabbro 1999) and neuroimaging studies (Dehaene *et al.* 1997; Weber-Fox *et al.* 1996) confirm that the declarative learning of a L_2 grammar and the lexico-semantic level of both L_1 e L_2 are mainly supported by the temporal neocortex and the parieto-temporal areas. All these data stress the importance of both implicit acquisition and explicit learning in every language fixing process.

1.4. Translation disorders in 'bilingual' and 'polyglot' aphasia

Since at least the 19th century, bilingual and polyglot aphasia's clinical studies have provided a rich literature[9] on certain pathological translation disorders, summarized in the following list:

- *impossibility to translate*: both from L_1 into L_2, and from L_2 into L_1;

- *spontaneous/incoercible translation*: impulse to translate everything the patient or her interlocutors say;

---

[8] Basal ganglia are known to be related to implicit memory learning (forming specific stimulus-reply connections, but also more complex processes such as visuo-motory abilities or rules/categories learning). In any case, studies on the implicit learning of motory sequences (cf. for example Exner *et al.* 2002) assert that implicit learning is more likely to be the effect of the cooperation of a network of cortical and subcortical structures, where basal ganglia would only be responsible for the adaptation to the necessary requisites of a task, while the learning of specific associations of stimuli would be rather due to the premotory frontal cortex areas and to the cerebellum (see above).

[9] Cf. for example Pitres (1895/1983), Silverberg/Gordon (1979), Paradis *et al.* (1982), Perecman (1984), Paradis (1989), Paradis *et al.* (1989), Hamers/Blanc (1989), Nilipour/Ashayeri (1989), Fabbro *et al.* (2000), Paradis (2004).

- *translation without comprehension*: the patient does not understand what she is asked to translate, though she correctly performs it;

- *paradoxical translation*: the patient is able to translate only into the language that she cannot speak spontaneously at that moment (not *vice versa*)[10].

Such disorders seem to support the hypothesis that different bilingual abilities are processed by a network of neuro-functional components. The damage of one of them may not necessarily involve the damage of all the system[11]. Moreover, recent data from neuro-imaging research on translation and switching processes[12] seem to confirm even at the cerebral representation level (cortical and subcortical) the differences between switching and translation processes.

The pathological processes involving translation disorders allow to assume the existence and the importance of automatic mechanisms in the translation procedures. The forming and rising of these automatisms seem to depend not only on one's bilingual competence, but mainly on the switching practice.

2. Merging the fields

2.1. Interdisciplinary gaps

As shown in the previous part 1. of the paper, the questions related to bilingualism and switching should be investigated referring to the phenomenon of inter-linguistic translation. Nevertheless, if most of the main studies on bilingualism pay attention to translation disorders, they often treat translation with no mention to it's disciplinary and multidisciplinary complexity, i.e. avoiding to take into account the scientific contributions by the field of Translatology.[13] In other words, they lack to consider the connection to a complex theoretical model of *general* human translation processes (which should include standard translation activities). Moreover, the research on bilingualism often disregards the pragmatic level of natural language communication. This fact is also due a) to the difficulty in thinking out experimental frameworks for testing pragmatic proficiency (not disorders) and b) to the theoretical complexity of pragmatics itself.[14]

---

[10] See above.

[11] As a pioneering idea Paradis (1984) assumed the translation process to be the result of a series of neuro-functional *components* independent one from each another: one component to translate from language A into language B, one component to translate from language B into language A, one component responsible for the comprehension of languages A and B (passive ability), and finally one component for the expression in languages A and B (active ability).

[12] Translation and switching tasks monitored by PET (Price *et al.* 1999) in a group of German (L_1)-English (L_2) bilinguals have shown to activate al least partially different areas. The translation tasks activated the anterior cingulate and the basal ganglia, and areas related to articulation (insula, cerebellum, SMA). The switching tasks activated Broca's area and supramarginal gyri (in the phonological recoding). Similar results have been found by Lehtonen *et al.* (2005).

[13] The birth of this science can be associated to the invention of the first "translation machine" by the Russian engineer Petr Trojanskij in the first Thirties of the 20th Century (Cf. Salmon 2003b, 99-122).

[14] But it is namely pragmatics the very level at which humans are normally able to better understand each other and no one of the single language capabilities (as phonology, morphology, syntax or lexicon) can alone guarantee a standard linguistic communication.

An analogue kind of epistemological gaps, on the other side, can be revealed in main studies investigating Second Language Learning[15], where translation is frequently mentioned apart from a consistent theoretical guideline, including a key-definition of which processes are considered to be "translation": L2 research, also when it excellently analyses the role of neurolinguistics in L2 teaching (cf. for instance Danesi 1988, Cardona 2001, Fabbro 2004), tend to ignore the potential role of a scientifically founded translation training in reinforcing memory strategies and capabilities.

Finally, even if it is unquestionable that translation processes cannot be studied without a strict connection to the research on bilingualism and switching, in the very field of Translatology poor references are normally given by scholars to clearly inform the addressees of terms, definitions and neuro-research results, which could on it's turn directly involve a "revolution" in L2 teaching (cf. Salmon 2003a; 2003b, 232-243, 2004). The origin of the epistemological problems of Translation Studies is thus, on the one hand, the incredible breadth of scientific branches and topics involved, and on the other, the "dissection" between humanities and science in approaching the "main object" (translation).

In this paper is claimed that only a deeper understanding of both standard and pathological translation processes can a) help the overall understanding of human bilingual mental activity and consequently 2) play a basic role in L2 Teaching/Learning.

Despite the astonishing amount of data involved in translation processes research, this field can actually be useful at the epistemological, theoretical and experimental level to all the linguistic research. Early or late, no linguistic theory will be considered complete and really applicable to an intelligent system (of any kind) if not supported by the consistence with a Translation Theory. Especially a solid theory of L2 teaching has to be based on a model of how the mind processes the bilingual data when kept separate, switched or converted, i.e. of how a standard mind "links" the units of a L1 to the units of a L2 and consequently of why a given damage can cause certain dysfunctions. Only with this "merging operation" translation training could become a pedagogical key-method to reinforce both the proficiency of the known languages and the performance of inter-linguistic switching (increasing speed in the passage from one to another language without mixing the codes).

2.2. A Theoretical Proposal of Human Translation Processes (TTP)

The TTP (cf. Salmon 2006) is a theoretical model on how the main translation processes probably occur in a standard bilingual mind. The model supplies a definition of the bilingualism needed for a effective translation and consistent to the definition of translation itself.

Translation is defined in a strict functional way in a framework of a stimulus-response mechanism, where the text is intended as a trigger of a psycho-cognitive reaction. To translate means thus to recode a text T into a text T1 so, that T1 *functions*

---

[15] The term "learning" is here used in a broad sense to intend all the scientific works on L2 teaching, not developing the well known opposition learning/acquisition, which will be considered further in connection with the implicit/explicit kind of L2 data-processing by students.

for most of the target addressees *more or less* as T functioned for most of the source audience.[16] Consequently bilingualism in translation is the ability of the translator to "do" with language A the same she can do with language B (having the same problems of subjective perception/interpretation). Hence, as claimed by theories on different topics, it is not the structure, but the function which actually determines the equivalence in replicating information (cf. Aunger 2002, 136-158).

According to the TTP, functional (f-) equivalence is the aim of the translation process: the translator's mind splits source text in a set of *minimal units*, translatable only as a formulaic whole (i.e. at "their lowest level of composition": Wray 2002, 4). To recode a unit into the target language means to find (on the basis of a consistent project) the unit a native would have used to express the same output in the same context (*what's your name?↔come ti chiami?↔kak tebja zovut?↔wie heisst Du?* etc.). A one-to-one f-equivalent is easily available to a proficient bilingual for the overwhelming majority of units. The translator can implicitly evaluate the grade of equivalence between L1/L2 units thanks to a mental mechanism (the so called "internal ear") which checks in the mental corpora the "candidate" units, comparing them with the contextual *wh- factors*. The leading parameter, allowing the internal ear "stop computing" (giving the "ok" when the found target unit "sounds good") is the *functional markedness*, a concept deeply different from the common linguistic definition (based on infrequent occurrences). f-markedness is indeed a syncretic macro-parameter joining all the linguistic factors co-acting in an utterance (lexicon, morpho-syntax, phonetics, prosody, intonation, formulaicity etc.).

Synthetically, a L1 translation unit triggers in the translator's mind the implicit or semi-explicit pre-activation of a set of L2 units, "candidates" for f-equivalence. These candidates are not *synonyms*, but *quasi-synonyms*: they express "the same ± something else" (X+Y). The X is the "meaning", intended as the network of perceptive, psycho-emotional, cognitive data stored in someone's memory in connection to a linguistic unit, able to retrieve all the network when triggered by a perceptive input. The additional Y concerns the vertical (hierarchical) and horizontal (affective) relationship between the sender and the recipient at that moment.[17] The Y is often acting at the subliminal (or implicit, or unconscious) level: a speaker can become aware of Y only if especially reflecting on it (psycho-analysis is the best known way to convert implicit in explicit data in somebody's mind).

The combinatorial computational ability of the linguistic device can in few millisecond establish implicitly the X and the Y, and react to the selected heuristic inference. In translating, after implicitly evaluating the f-markedness of the source unit (input), the Translation Device checks each of the L2 candidates in order to select an output (the target unit): the translator's internal ear chooses one and only one f-equivalent.[18] In the decision making process all the linguistic levels (from syntax to

---

[16] The "more o less" refers to the unavoidable subjective gap in the response to a message by speakers of also the same native language.

[17] Whatever a human can say is always unavoidably set on a Cartesian plan where verticality and horizontality are synchronically represented.

[18] For instance, It. *qual è il tuo nome?* is an equivalent, but not the f-equivalent of Eng. *what's your name?*: it is less expected and, along with X ("asking for your name"), it contains an evident Y ("asking you *in a special way*").

intonation) and the extra-linguistic data are implicitly considered and compared.[19] Consequently what is f-marked (not expectable in that context by that sender), or unmarked (expectable) emerges in communicants' mind heuristically during the communication process.[20] The ability to evaluate f-markedness by intuition is typical of all human communication and requires to process simultaneously (in milliseconds) all the data (linguistic and extra-linguistic) related to a unique situational context.

The proficiency of the internal ear strictly depends upon the richness of the data base stored in memory and on the training in recalling inter-linguistic correspondences, i.e. in switching from one to the other linguistic code. Translation is indeed one of the abilities a bilingual mind *if especially trained* can perform. But if it is trained to act at the level of structure, not function, the result will be the "translationese" (the odd unnatural pseudo-language which characterizes pseudo-translations). In L2 classes pseudo-translations often become the main goal of L2 teachers and they cause a real damage to the Translation Device of the potential translators.

In summary, bilingualism is one of the necessary, but not sufficient conditions in an efficient translation process. This fact is already universally accepted by the scholars, but it generates an intuitive, false corollary, which prevails not only in the common sense, but also among translation teachers: a subject has *first* to become a proficient bilingual and *then* to be "taught" how to translate. Empirical data, suggests on the contrary a counterintuitive fact: a training in functional translation reinforces bilingualism also when it is at the very first steps of its formation in the students' mind. In other words, translating a student become a better bilingual.[21] Of course, this statement can be claimed just if translation is intended not at the narrow, structural level, but at the higher level of its pragmatic complexity, i.e. as the whole set of processes occurring in somebody's brain when an L1 input is worked up into a L2 output so, that the input and the output can be reasonably thought as f-equivalent.

If a L2 student links in a memory network (by a Hebbian reinforce) each L2 unit with the f-equivalent L1 unit, in the implicit translation process the link will be more automatically available with less computational effort. The students indeed are formed in L2 by way of the linkage of L1 units with L2 f-synonyms. As L2 data-base grows up in the mental hypertext of the student (an hyper L1/L2 neuro-network), all new L2 linguistic units, thanks to the link to L1 correspondent units, are automatically linked also to all the encyclopaedic tools already aroused by L1 inputs. In L2 teaching, this fact means that the more the so called "communicative" methods are reinforced through the L1/L2 translation, the more they are effective.

2.3. More on the crucial concept of f-equivalence

---

[19] When somebody utters "I'm tired", she triggers an X, but the intonation in namely that context can (or not) add an Y even more important or even in clear contradiction with the X ("You know I'm not tired, I'm just angry with you", or "why do you ask me, you perfectly now it!" or "It's a pity that I'm tired, sorry for that!" etc.).

[20] Better to be reminded, only part of the communicated information is processed at the conscious level by both the sender and the recipient. Most of the everyday communication process occurs at a subliminal (implicit) level. This fact can involve also unconscious language switching and interference (cf. Amati Mehler *et al.* 2003).

[21] Figuratively: the ability to swim is a necessary, not sufficient condition to play water polo, but in playing water polo the swimming ability gets reinforced.

The concept of f-equivalence is the main merging point of the theoretical model: bilingualism and L2 proficiency are necessarily involved on evaluating whether a subject is able "to do" with L2 *the same* she is able to do with her L1. The concept of *sameness* is hence a crucial parameter not in defining the asymmetries among different languages' performance, but also in testing translation as an educational tool. Translation is indeed an optimal "gymnasium" to give students a deeper feeling of how their linguistic mind works: they can test the context-related use of words and the language *formulaicity* (cf. Wray 2002). Also doing a very simple kind of training, they can test themselves, as early bilingual children do, both in automatically uttering f-equivalences and in arguing explicitly what is working well or not.

Asking an Italian student to translate Ital. *casa* into English, she usually answers *house* (in Italy everybody can check this claim empirically in an English classroom). A proficient bilingual should answer: "it dipends", the only possible answer for an isolated lexeme. The concept of f-equivalence is not applicable when a context is not available. Nobody can value whether the binomial *casa*/*house* is actually "right or wrong": it depends upon the unit (very seldom an isolated lexeme can be a unit). Thus, no equivalence of any kind between *house* and *casa* is ascertainable till L1/L2 words are compared in context-related utterances.[22] This statement is true for all the lexical items of each natural language when isolated from their living (pragmatic) context. Only having in input a "living context" (enough data to process words), the f-equivalence of a lexical L1/L2 binomial can be tested.

A trivial case like the *casa*/*house* example can already provide an important educational information: each time our students are provoked to perform a word-to-word translation (better to say a "pseudo-translation"), their brain is forced to a decision making process lacking the needed data for a regular problem solving operation. Consequently the functioning of the Translation device is inhibited.

It is known that even early bilinguals can radically lack the ability to process inter-linguistic f-equivalence. Mostly it is just because they are not trained to use translation in everyday life (or because they are in that standard teenage phase when they reject the language not used in the country they live). But there is a possibility, empirically suggested in observing pre-scholar bilinguals, that namely a distort language teaching can cause or stimulate a inhibition of the natural predisposition of early bilinguals to f-equivalent translation.

In other words: if well trained in everyday-translation, humans do probably translate spontaneously better, than after years of L2 courses at school, where they are taught to use the non-existent language of structural calque (translationese). Whether this is true or not, this question can be answered to only if further research on language

---

[22] *House* can just in some cases be equivalent to *casa* (and properly translated by that lexeme). In the Ital. "Non ho soldi perché ho comprato una *casa*" (I've no money, because I bought a *X*", *casa* almost certainly means *flat*, not *house*! And "vedrai una grande *casa* rossa a molti piani" will be in English "you'll see a many-storied red *building*". Till the translator cannot heard/read the context, she cannot decide what *casa* will be in English (and she also can decide to differently translate for an American or a British audience). This fact gives a first explanation, why bilingual dictionaries are very distant in their form, concept and usefulness from the real, immeasurable mental dictionary a bilingual human deals with.

(origin, teaching, acquisition, translation etc.) will suspend any "off limits", i.e. all the data on linguistic brain activities will be considered useful for theory and testing.

3. Looking for empirical evidence

3.1. Testing the model

In translation research the problem of empirical testing is actually hard and the reason is first of all of an epistemological kind. In the experiments on bilingualism the aim to find "general laws" is *a priori* endangered by the differences in the level and typology of bilingualism of tested subjects. In testing translation competence more troubles emerge: suppose a classical experiment on back-translation (L1→L2→L1) is held with humans, in order to check whether or not a L2 text converted from a L1 text can be re-converted into exactly the starting L1 source-text. Yet, if the L2→L1 translator is the same person who performed L1→L2 passage, she can clearly be influenced by the previous translation process (remembering the source-text), but if the translator is not the same, the difference in translation proficiency between the two actors can deeply invalidate a generalised statement. In this case, also the fyzzy "more or less" component should be measured by difficult to be found "fixed parameters". The use of neuro-imaging is also difficult in such a complex kind of operation (translation processes) because it involves a lot of brain areas. It is also possible that *surface* inter-language asymmetries can invalidate the task of finding similarities in human translation *deep* processes: it is well known how a translator from German tends to infer a (final) verb before having heard/read it (the so called "anticipation"), while with two typologically very similar languages less or no structural re-coding is needed. Finally, to organize a control group is extremely difficult, because the same experimental condition can be guaranteed only in non-spontaneous communication. It is clear that by now the main problem in testing is a meta-problem: how to test the way a testing method can be scientifically available?

3.2. The workshop

At this first purpose two workshops were organized in order to observe bilingual abilities in 6-8 aged primary school children. Our assumption was that translation ability does not arise from rules-knowledge, but from a procedural competence involving the knowledge of the relation among language/context/usage situation. So the workshops were intended to stress the pragmatics of bilingualism (i.e. subjects' linguistic behaviour in real situations). The children age was hence selected to be sure the subjects of the experiment were not influenced by explicit meta-linguistic school knowledge.

The main problem was how to measure bilingualism with reference to the degree of subjects' knowledge of f-equivalents in their two languages. The hypothesis was: the more automatic the translation mechanism, the higher the f-equivalence.

For that reason, kids have never been asked to explicitly apply to grammatical rules. On the contrary, their spontaneous translation behaviour has been observed, only asking them to play in stimulus/response tasks. Such spontaneity is thought to decrease with scholastic formal linguistic education. To test this assumption, a workshop with a control group (students of school level) will be organized. New data

will be then compared, in order to stress meaningful differences in translation behaviour of each age group.

3.2.1. The Workshop at the German School

The first survey was carried out in the German School of Genoa. The study was conducted in a first level class with a group of twelve children. Most of them were German/Italian bilingual, but some of the Italian monolingual children, who study German only at school, were also present. The wealthy socio-cultural background of the families of these children must also be taken into consideration in our study. The workshop included a 45-minute play session (previously subjected to parental approval) in the presence of the students' teacher and within the classroom setting.

The native German children were asked to relay to their schoolmates what was previously said to them in their L1 (according to a set of tasks and games properly prearranged). The original idea was to read and translate fairytales and children stories, but afterward this option of well structured tasks was abandoned in order to enhance spontaneity. The choice of the material was oriented toward the use of everyday language in well known, informal circumstances so that the linguistic expressions might be easily retrieved. The class teacher was the only one who spoke German and the students had to make us understand in Italian what she had said. We were presented as persons who wished to learn German, with a knowledge of only a few German words and utterances. The fact children regarded us as deficient in the linguistic German competence gave them an important cooperative role.

After a short introduction, the children were provided with the reading of the following rhyme:

a)   *Ich   bau,   ich   bau*
Ich   bau   mir   ein   Haus.
Bau   mir   ein   großes   Haus
Schaue   zum   Fenster   hinaus
Ich   bau   ich   bau
Ich bau mir ein Haus.

Children were asked, in turn, to translate it. An interesting point was to note that one of the German/Italian bilingual children tried to maintain the same rhythmic and musical intonation of the source text:

b)   *Io costruisco, io costruisco,*   (I   build,   I   build,)
io mi *costruisco una casa*   (*I build a house* for me)

This child was able to evaluate the difference between *Ich bau* and *Ich bau* *mir*, and consequently the necessity of pointing it out in his translation. The constant repetition of the I-subject, perceived as redundant for an Italian native speaker, seems to have been essential for the German child, in order to make the distinction from the object pronoun which was to come. Conversely, in front of the sentence:

c)   *Schaue zum Fenster hinaus*

he perceived the adverb *hinaus* as redundant and so not necessary in his translation process. The translation was:

>   c') *Guardo dalla finestra*　　*(I look* from *the window)*

An Italian child, trying to analyse the phrase in order to translate it with a calque, maintained the adverb (*hinaus*) and corrected his German-speaking classmate:

>   c'') *Guardo* <u>fuori</u> *dalla finestra.*　　*(I look* out of *the window)*

The next task was to recite, mime or translate the following text:

d)　　*Hausspruch*	*In meinem Haus,*
	da lache ich,
In meinem Haus,	*da weine ich,*
da wohne ich,	*da träume ich.*
da schlafe ich,	
da esse ich.	*Und wenn ich will,*
	dann schließe ich
Und wenn du willst,	*die Tür*
dann öffne ich	*und bin allein.*
die Tür	
und lass dich ein.	(Gina Ruck-Pauquèt)

It is worth mentioning that the translation of the first two lines were performed by a German kid as:

In meinem Haus,	*Nella mia casa,*　　*(In my house)*
da wohne ich,	*io abito*
	(I live)

In this case, the German deictic "*da*" was omitted, as a functional translation requires.

In the next phase of our experience, some of the children were interviewed and asked to translate some sentences into German. The first case was in discussing food and lexemes like *colazione* (*breakfast*), *pranzo* (*lunch*) and *merenda* (*snack*) in German. Most of the children were not able to translate the word *merenda* with the German word *Zwischenmahlzeit*, using *Frühstück*, "*breakfast*", instead. The probable reason is that *Zwischenmahlzeit* is not commonly used in German and the word was

hardly used within the familiar context (it is even more possible the use of It. "merenda" by a German mother living in Genoa among Italians). Another explanation is that what is eaten/drunk as *Frühstück* matches also with what is eaten as school-snack during the morning break (*merenda*). The next question was consequential:

If *Frühstück* is *merenda*, then at what time you'll have *Mittagessen*?

e) *Mittag* is one o'clock - said one of the children.

Once again the bilingual child implicitly and spontaneously chose to privilege the pragmatic communication rather than the literal (Mittag is 12 pm).

When the bell rang, one of the children was asked how she would say, "adesso è suonata la campanella" (the bell rang now) in German. She replied:

f) *Die Glocke klingelte*

and interestingly enough, her Italian classmate, noting that the translation was not precise enough, because it was lacking the adverb "now", commented:

f') "*Ma se vuoi dire* adesso *devi dire* jetzt"

(But if you want to say '*now*' you have to say '*jetzt*')

For the children, who did not have the same experience of the pragmatic German context as the native speaker, a literal and more "grammatically correct" translation revealed a higher explicit competence.

The third case was perhaps the most interesting. Two 6 years old kids were asked to translate into Italian the idiom:

g) "*Du bist an der Reihe*"

(It's your turn)

Both children had Italian fathers, one had a German, the other a Swiss mother. They did not perform the task in the same way. The child whose mother was Swiss provided a word‑to‑word translation (which makes in Italian no sense):

g') "*Sei sulla riga*"

(*You are on the line)

On the contrary, the second child translated it functionally as:

g'') "*ma no! vuol dire 'tocca a te!*"

(No! It means 'it's your turn'!)

Their teacher informed us that the given idiom is commonly used in Germany, but not in Switzerland. Consequently the calque appears to be used by the first child as the only possible solution for an unknown formulaic input, which probably was not completely understood.

3.2.2. *The Workshop at the 'Daneo' Primary School*

The second study was held at the Daneo Primary School, where we met with other bilingual children in third- and first grade. The multilingual reality of this school is outstanding: English, German, Russian, Albanian, Arabic, and Spanish speaking children are in the same class, where English and French are regularly taught as foreign languages since first-grade.

The experience with the third-grade took place during the students' English class. The entire hour was English-oriented, the teacher reading the children passages from *The Wizard of Oz*. During the reading, the teacher asked the children to translate a sentence just read from the tale in their L1, as for example:

h)   "*Can you please give me a heart?*"

Interestingly enough, not all the children could perform the task. Compared to a Spanish girl, who translated functionally:

h')   "*¿Por favor, me puedes dar un corazon?*"

an Albanian boy was not able to perform the task initially, so that his classmates asked him:

i)   "*Non sai la tua lingua?*"   (Don't you know your own language?)

At the beginning, we thought it could be due to a sort of shyness, also possible, of course (this boy was said by his teachers to be very good at language study). But the difficulty of this Albanian child could be compared to an analogous resistance to translate into his L1 of a first-grader Russian child.

The organization of the workshop with the first-graders was different. The children were asked by their teachers to wander around the classroom with their eyes closed following the music which was provided, and then to express their thoughts and feelings, in their mother tongue and in Italian. The Russian boy had no problem to tell spontaneously in Russian his thoughts and feelings, but when explicitly asked to translate something from Italian into Russian, he was unable to do it. He gave us the following explanation:

l)   "*Prendo l'areo*, *volo sulle montagne*, *attraverso il mare*, *parlo russo*"

(I'll take the plane, fly over the mountains, go over the sea, I'll speak Russian)

He speaks Italian in Italy, but Russian only in his native land.

3.3.   *Results and conclusions*

The empirical data of the study suggest:

-       children translation ability is not consistent with bilingual proficiency;

-       a functional translation is based on the knowledge of the pragmatic equivalence of two 'language units' (cf. examples *g*, *g'*, *g''*);

-       translation and switching are different mechanisms: in untrained subjects the switching ability can often occur without the translation ability (cf. examples *i*, *l*);

References

Abutalebi J., Miozzo A., Cappa S. F., 2000, "Do Subcortical Structures Control 'Language Selection' in Polyglots? Evidence from Pathological Language Mixing", *Neurocase* 6, pp. 51-56.

Aglioti S., 1997, "The Role of the Thalamus and Basal Ganglia in Human Cognition", *J. Neurolinguistics* 10, pp. 255-265.

Aglioti S., Fabbro F., 1993, "Paradoxical selective recovery in a bilingual following subcortical lesions", *Neuroreport* 4, pp. 1359-1362.

Albert M.L., Obler L.K., 1978, *The Bilingual Brain*, New York, Academic Press.

Aldridge J.W., Kent C.B., 2003, "Basal Ganglia Neural Coding of Natural Action Sequences", in Graybiel A.M., Delong M.R., Kitai S.T. (eds.), *The Basal Ganglia VI*, Series: Advances in Behavioural Biology, 54, art 29.

–, 1998, "Coding of Serial Order by Neostriatal Neurons: A 'Natural Action' Approach to Movement", *The Journal of Neuroscience*, 18, pp. 2777-2787.

Alexander G.E., Crutcher M.D., 1990, "Functional Architecture of Basal Ganglia Circuits: Neural Substrates of Parallel Processing", *Trends in Neuroscience* 63, pp. 266-27.

Amati Mehler J., Argentieri S., Canestri J., 2003, *La Babele dell'inconscio*, Milano, Raffaello

Cortina.

Aunger R., 2002, *The Electric Meme. A New Theory of how we Think*, New York, The

Free Press.

Bates E., MacWhinney B., 1989, "Functionalism and the Competition Model", in B. MacWhinney, E. Bates (eds.), *The Crosslinguistic Study of Sentence Processing*, Cambridge, Cambridge University Press, pp. 3-73.

Cardona M., 2001, *Il ruolo della memoria nell'apprendimento delle lingue.Una prospettiva glottodidattica,* Torino, UTET.

Chomsky N., 1995, *The Minimalist Program*, Cambridge MA, MIT Press.

Clahsen H., Felser C., 2006, "Grammatical Processing in Language Learners", *Applied Psycholinguistics* 27, pp. 3-42.

Crosson B., 1992, *Subcortical Functions in Language and Memory*, New York, The Guilfors Press.

Danesi M., 1998, *Il cervello in aula: neurolinguistica e didattica delle lingue*, Perugia, Guerra

–, 1988, *Neurolinguistica e glottodidattica*, Padova, Liviana Editrice.

Dehaene S., Dupoux E., Mehler J. 1997, "Anatomical variability in the cortical representation of first and second language", *Neuroreport* 8, pp. 3809-3815

Dempster F.N., 1992, "The Rise and Fall of the Inhibitory Mechanism: Toward a Unified Theory of Cognitive Development and Aging", *Developmental Review* 12, pp. 45-75.

Destrebecqz A., Peigneux P., Laureys S., Degueldre C., Del Fiore G., Aert J., Luxen A., Van der Linden M., Cleeremans A., Marquet P., 2005, "The Neural Correlates of Implicit and Explicit Sequence Learning: Interacting Networks Revealed by the Process Dissociation Procedure", *Learning&Memory* 12, pp. 480-490.

Dubois B., Defontaines B., Deweer B., Malapani C., Pillon B., 1995, "Cognitive and Behavioural Changes in Patients with Focal Lesions of the Basal Ganglia", in W.J. Weiner, A.E. Lang (eds.), *Advances in Neurology*, New York: Raven Press, vol. 65, pp..

Exner C., Koschack J., Irle E., 2002, "The Differential Role of Premotor Frontal Cortex and Basal Ganglia in Motor Sequence Learning: Evidence From Focal Basal Ganglia", *Learning&Memory* 9, pp. 376- 386.

Fabbro F., 1996, *Il cervello bilingue. Neurolinguistica e poliglossia*, Roma, Casa Editrice Astrolabio.

Fabbro F., 2004, *Neuropedagogia delle lingue. Come insegnare le lingue ai bambini*, Roma,

Astrolabio.

–, 2001a, "The Bilingual Brain: Bilingual Aphasia", *Brain and Language* 79,

pp. 201-210.

–, 2001b, "The bilingual brain: cerebral representation of language", *Brain&Language* 79, pp. 211-222.

–, 1999, *The neurolinguistics of bilingualism*, Hove, Psychology Press.

Fabbro F., Paradis M., 1995, "Differential Impairments in Four Multilingual Patients with Subcortical Lesions", in M. Paradis (ed.), *Aspects of Bilingual Aphasia*, Oxfrod, Pergamon Press, pp. 139-176.

Fabbro F., Peru A., Skrap M., 1997, "Language Disorders in Bilingual Patients after Thalamic Lesions", *J. Neurolinguistics* 10, pp. 347-367.

Fabbro F., Skrap M., Aglioti S., 2000, "Pathological Switching between Languages Following Frontal Lesions in a Bilingual Patient", *Journal of Neurology, Neurosurgery, and Psychiatry* 68, pp. 650-652.

Graybiel A.M., 1998, "The Basal Ganglia and Chunking of Action Repertoires", *Neurobiology of Learning and Memory* 70, pp. 119-136.

–,1995, "Building Action Repertoires: Memory and Learning Functions of the Basal Ganglia", *Current Opinion in Neurobiology* 5, pp. 733-741.

Green D. W., 2004, "The neurocognition of recovery patterns in aphasic bilinguals", in J. F. Kroll, A. M. B. de Groot (eds.), *Handbook of Bilingualism*: *Psycholinguistic Perspectives* (in press).

–, 1986, "Control, activation, and resource: A framework and a model for the control of speech in bilinguals", *Brain&Language* 27, pp. 210-223.

Grosjean F., 1994, "Individual bilingualism", in R. E. Asher (ed.)., *The Enciclopaedia of Language and Linguistics*, Oxford, UK: Pergamon Press, pp. 1656-1660.

–, 1989, "Neurolinguists, beware! The bilingual is not two monolinguals in one person", *Brain&Language* 36, pp. 3-15.

Guillery R.W., 1995, "Anatomical Evidence Concerning the Role of the Thalamus in Corticocortical Communication" *J. Anatomy* 187, pp. 583-592.

Hagoort P., 2006, "The Memory, Unification, and Control Framework for Language", *5th Forum of European Neurosciences*, Vienna 8-12 july 2006, *FENS Forum Abstract*, vol. 3.

Hamers J.F., Blanc M.H.A., 1989, *Bilinguality and Bilingualism*, Cambridge, Cambridge University Press.

Hernandez A.E., Martinez A., Kohnert K., 2000, "In search of the language switch: An fMRI study of picture naming in Spanish-English bilinguals", *Brain&Language* 73, pp. 421-431.

Hernandez A.E., Dapretto M., Mazziotta J., Bookheimer S., 2001, "Language Switching and Language Representation in Spanish-English Bilinguals: an fMRI Study", *Neuroimage* 14, pp. 510-520.

Jackson J.H., 1874/1958, "On the nature of the duality of the brain", in J. Taylor (ed.), *Selected writings of John Hunghlings Jackson*, New York, Basic Books, pp. 129-145.

Kefi M.Z., Phillipe A., Karine P., Havet-Thomassin V., Ghislaine A., Arnaud R., Le Gall D., 2004, "Bilingualism and Adult Differences in Inhibitory Mechanism: Evidence from a Bilingual Stroop Task", *Brain&Cognition* 54, pp. 254-256.

Kent R., Kent J., Weismer G., Duffy J., 2000, "What Dysarthrias Can Tell Us About the Neural Control of Speech", *Journal of Phonetics* 28, pp. 273-302.

Kim K.H.S., Relkin N.R., Lee K.-M., Hirsch J., 1997, "Distinct cortical areas associated with native and second languages", *Nature* 388, pp. 171-174.

Klein D., 2003, "A positron emission tomography study of presurgical language mapping in a bilingual patient with a left posterior temporal cavernous angioma", *Journal of Neurolinguistics* 16, pp. 417-427.

Kotz S.A., Frisch S., Cramon D.Y.V., Friederici A.D., 2003, "Syntactic Language Processing: ERP Lesion Data on the Role of the Basal Ganglia", *Journal of the International Neuropsychological Society* 9, pp. 1053-1060.

Kropotov J.D., Etlinger S.C., 1999, "Selection of Actions in the Basal Ganglia-Thalamocortical Circuits: Review and model", *International Journal of Psychophysiology* 31, pp. 197-217.

Lashley K.S., 1951, "The Problem of Serial Order in Behavior", in L.A. Jeffres (ed.), *Cerebral Mechanisms in Behavior*, New York, Wiley, pp. 112-146.

Lebrun Y., 1997, "Subcortical Structures and Non-volitional Verbal Behaviour", *J. Neurolinguistics* 10, pp. 313-323.

Lehtonen M.H., Laine M., Niemi J., Thomsen T., Vorobyev V.A., Hugdahl K. , 2005, "Brain Correlates of Sentence Translation in Finnish-Norwegian Bilinguals", *Neuroreport* 16, pp. 607-610.

Leischner A., 1948, "Über die Aphasie der Mehrsprachigen", in *Archiv für Psychiatrie und Nervenkrankheiten* 180, pp. 731-775.

Lieberman P., 2001, "Human Language and our Reptilian Brain: The Subcortical Bases of Language, Syntax, and Thought", *Perspectives in Biology and Medicine* 44, pp. 32-51.

–, 2000, *Human Language and our Reptilian Brain*: *The Subcortical Bases of Language*, *Syntax*, *and Thought*, Cambridge MA, Harvard University Press.

MacDonald M.C., Pearlmutter N.J., Seidenberg M.S., 1994, "Lexical Nature of Syntactic Ambiguity Resolution", *Psychological Review* 101/4, pp. 676-703.

Marsden C.D., 1984, "Which Motor Disorder in Parkinson's Disease Indicates the True Motor Function of the Basal Ganglia?", in *Functions of the Basal Ganglia*, Ciba Foundations Symposium 108, London, Pittman, pp. 225-241.

Mechelli A., Crinion J.T., Noppeney U., O'Doherty J., Ashburner J., Frackowiak R.S., Price C.J., 2004, "Structural plasticity in the bilingual brain", *Nature* 431, pp. 757.

Meguro K., Senaha M., Caramelli P., Ishizaki J., Chubacci R., Meguro M., Ambo H., Nitrini R., Yamadori A., 2003, "Language deterioration in four Japanese-Portuguese bilingual patients with Alzheimer's disease: A transcultural study of Japanese elderly immigrants in Brazil", *Psychogeriatrics* 3, pp. 63-68.

Nilipour R., Ashayeri H., 1989, "Alternating Antagonism between Two Languages with Successive Recovery of a Third in a Trilingual Aphasic Patient", *Brain&Language* 36, pp. 23-48.

Obler, L.K., 1999, Language and the Brain. Cambridge University Press.

Paradis M., 2004, *A Neurolinguistic Theory of Bilingualism*, Amsterdam, Philadelphia, J. Benjamins.

–, 2001a, "Assessing bilingual aphasia", in B. Uzzell, A. Ardila (eds.), *Handbook of Cross-cultural Neuropsychology*, Mahwah NJ, Erlbaum.

–, 2001b, "Bilingual and polyglot aphasia", in R. S. Berndt (ed.), *Handbook of neuropsychology* (2nd edition), Oxford, Elsevier Science, vol. 3, pp. 69-91.

–, 2000, "The Neurolinguistics of Bilingualism in the Next Decades", *Brain&Language* 71, pp. 178-180.

–, 1998, "Language and communication in multilinguals", in B. Stemmer, H. A. Whitaker (eds.), *Handbook of Neurolinguistics*, San Diego, Academic Press, pp. 418-431.

–, 1997, "The Cognitive Neuropsychology of Bilingualism", in A. De Groot, J. Kroll (eds.), *Tutorials in Bilingualism*: *Psycholinguistic Perspectives*, Mahwah, NJ: Erlbaum, pp. 331-354.

–, 1995, *Aspects of bilingual aphasia*, Oxford: Pergamon Press.

–, 1994, "Neurolinguistic aspects of implicit and explicit memory. Implications for bilingualism in SLA", in N. Ellis (ed.), *Implicit and Explicit Language Learning*, London, Academic Press, pp. 393, 419.

–, 1993, "Linguistic, psycholinguistic, and neurolinguistic aspects of 'interference' in bilingual speakers: The activation threshold hypothesis", *International Journal of Psycholinguistics* 9, pp. 133-145.

–, 1989, "Bilingual and polyglot aphasia", in F. Boller, J. Grafman (eds.), *Handbook of neuropsychology*, Amsterdam, Elsevier, vol. 2, pp. 117-140.

–, 1988, "Recent developments in the study of agrammatism: Their import for the assessment of bilingual aphasia", *Journal of Neurolinguistics* 3, pp. 127-160.

–, 1984, "Aphasie et traduction", *Meta, Translator's Journal* 29/1, pp. 57-67.

Paradis M., Canzanella A., 1989, *Test per l'afasia in un bilingue. Italian Version*, Hillsdale NJ, Erlbaum.

Paradis M., Goldblum M. C., 1989, "Selective Crossed Aphasia in a Trilingual Aphasic Patient Followed by Reciprocal Antagonism", *Brain&Language* 36, pp. 62-75.

Paradis M., Goldblum M. C., Abidi R., 1982, "Alternate Antagonism with Paradoxical Translation Behavior in Two Bilingual Aphasic Patients", *Brain&Language* 15, pp. 55-69.

Paradis M., Fabbro F., 1993, *Test pe afasie in t'un bilenghist. Friulan Version*, Hillsdale NJ, Erlbaum

Paradis M., Libben G., 1987, *The Assessment of Bilingual Aphasia*, Hillsdale, NJ: Erlbaum.

Partiot A., Verin M., Pillon B., Teixeiraferreira C., Agid Y., Dubois B., 1995, "Delayed Response Tasks in Basal Ganglia Lesions in Man - Further Evidence for a Striato-Frontal Cooperation in Behavioural Adaptation", *Neuropsychologia* 34, pp. 709-721.

Perani D., Paulesu S.G.N., Dupoux E., Dehaene S., Bettinardi U., Cappa S.F., Fazio F., Mehler J., 1998, "The bilingual brain. Proficiency and age of acquisition in the second language", *Brain* 121, pp. 1441-1452.

Perani D., Abutalebi J., 2005, "The neural basis of first and second language processing», *Curr. Opin. Neurobiol.* 15, pp. 202-206.

Perecman E., 1984, "Spontaneous Translation and Language Mixing in a Polyglot Aphasic", *Brain&Language* 23, pp. 43-63.

Perlman Lorch M., 2003, "The Jackson vs. Broca Debate of 1868: French and British 19th Century views on the Localization of Language in the Brain", *Brain&Language* 87, pp. 196.

Pickett E., Kuniholm E., Protopapas A., Friedman J., Lieberman P., 1998, "Selective Speech Motor, Syntax and Cognitive Deficits Associated with Bilateral Damage to the Putamen and Head of the Caudate Nucleus: A case study", *Neuropsychologia* 36, pp. 173-188.

Pinker S., 1994, *The Language Istinct*, New York, Morrow.

Pitres A., 1895/1983, "Aphasia in polyglots", in M. Paradis (ed.), *Readings on Aphasia in Bilinguals and Polyglots*, Montreal, Didier, pp. 26-49.

Pötzl O., 1930, "Aphasia und Mehrsprachigkeit", in *Zeitschrift für die gesamte Neurologie und Psychiatrie* 12, pp. 145-162.

Pramstaller P.P., Marsden C.D., 1996, "The Basal Ganglia and Apraxia», *Brain* 119, pp. 450-451.

Price C.J., Green D.W., Von Studnitz R., 1999, "A Functional Imaging Study of Translation and Language Switching", *Brain* 122, pp. 2221-2235.

Reiterer S., Hemmelmann C., Rappelsberger P., Berger M.L., 2005, "Characteristic functional networks in high- versus low-proficiency second language speakers detected also during native language processing: An explorative EEG coherence study in 6 frequency bands", *Cognitive Brain Research* 25, pp. 566-578.

Ridderinkhof K.R., van den Wildenberg W.P.M., Segalowitz S.J., Carter C.S., 2004, "Neurocognitive mechanisms of cognitive control: The role of prefrontal cortex in action selection, response inhibition, performance monitoring, and reward-based learning", *Brain&Cognition* 56, pp. 129-140.

Salmon L, 2006, "A Theoretical Proposal on Human Translation Processes", *Cognitive Systems*,

6-4, April, pp. 311-334.

– 2004, "La traduzione nella didattica della L2: riflessioni preliminari", in *Enseñanza-aprendizaje de Lenguas Extranjeras. Enfoques y contextos*, a cura di E. Klett, M. Lucas, M. Vidal, Buenos Aires: Araucaria editoria, pp. 78-92.

– 2003a, "Sobre el significado, el diccionario interno y la didáctica de la L2: valores y límites de las viejas y las nuevas tecnologías". *Didáctica del Léxico y Nuevas Tecnologías*, a cura di M.V. Calvi e F. San Vicente, Viareggio-Lucca: Mauro Baroni Editore, pp. 21- 38.

– 2003b, *Teoria della traduzione. Storia, scienza, professione*, Milano, Vallardi.

Wray, A. (2002), *Formulaic Language and the Lexicon*, Cambridge, Cambridge

University Press.

Sasanuma S., 1975, "Kana and kanji processing in Japanese aphasics", *Brain&Language* 2, pp. 369-383.

Silverberg R., Gordon H. W., 1979, "Differential aphasia in two bilingual individuals", *Neurology* 29, pp. 51-55.

St. Clair R.N., Rodriguez W.E., Joshua I., 2005, "The Basal Ganglia and the Serial Order of Communicative Signs", *Intercultural Communication Stidies* 16, pp.1-11.

Ullman M.T., 2001, "The Neural Basis of Lexicon and Grammar in First and Second Language: the Declarative/Procedural Model", *Bilingualism*: *Language and Cognition* 4/1, pp. 195-122.

Ullman M.T., Corkin S., Coppola M., Hickok G., Growdon J.H., Koroshetz W.J., Pinker S., 1997, "A Neural Dissociation within Language: Evidence that the Mental Dictionary Is Part of Declarative Memory, and that Grammatical Rules Are Processed by the Procedural System", *Journal of Cognitive Neurosciences* 9/2, pp. 266-276.

Ulmann M.T., Pierpoint E.I., 2005, "Specific language impairment is not specific to language: the procedural deficit hypothesis", *Cortex* 41, pp. 399-433.

Wallesch C.W., Papagno C., 1988, *Subcortical Aphasia*, in F.C. Rose, R. Whurr, M.A. Wyke (eds.), *Aphasia*, London, Whurr, pp. 256-287.

Watson P., Montgomery E.B., (2006), "The Relationship of Neuronal Activity within the Sensori-Motor Region of the Subthalamic Nucleus to Speech", *Brain&Language*, 97, pp. 233-240.

Weber-Fox C.M., Neville H.J., 1996, "Maturational Constraints on Functional Specialisation for Language Processing: ERP and Behavioural Evidence in Bilingual Speakers", *J. Cogn. Neuroscience* 8, pp. 231-256.

Zanini S., Tavano A., Vorano L., Schiavo F., Gigli G.L., Aglioti S.M., Fabbro F., 2004, "Greater Syntactic Impairments in Native Language in Bilingual Parkinsonian Patients", *J. Neurol. Neurosurg. Psychiatry* 75, pp. 1678-1681.

Zatorre R.J., 1989, "On the representation of multiple languages in the brain: old problems and new directions", in *Brain&Language* 36, pp. 127-147.