DOES KNOWLEDGE OF TECHNICAL LANGUAGE REQUIRE KNOWLEDGE OF STANDARD LANGUAGE?

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Abstract

The acquisition of a language necessarily requires some type of interaction with the surrounding environment. Language learning needs elements capable of stimulating new cerebral routes that in turn promote a better socio-biological adaptation and integration. The main role played by a technical language is to transmit information that must overcome the educational, linguistic and even cultural barriers of the reader or listener. More frequently, worldwide, doctors are asked to communicate in the English language. All these issues are addressed in the present paper with the aim to clarify the concept of fluency development, and to show that acquisition of a technical language does not necessarily require fluency in the corresponding standard language. The notion that language development and acquisition is actually a sensitive-motor process has been highlighted. The main models attempting to assess acquisition of fluency in reading have been crossed. The analysis was limited to reading and comprehension skills in a technical language such as medical and scientific language because these latter skills can be more easily developed in university students, and these two skills are necessary for future doctors to have access to international scientific literature. Therefore, to further investigate on these issues, three different types of translations were submitted to post graduate medical students.

Keywords: Technical language, standard English language, fluency, reading, understanding

Introduction

Language acquisition is always the result of an interaction between a person and the surroundings. Language learning needs inputs capable of stimulating new cerebral routes that in turn promote a better socio-biological adaptation and integration. Learning about science and becoming part of a specific professional and thus language community represent inputs stimulating new cerebral neuronal language routes. Neurobiology allows understanding of the elements of cerebral plasticity and clarifies the tight connections between the environment and the individual (Reichert, 1993). Such development continues caudal-cranially up to reaching the high circuits of the cerebral cortex. Therefore, the process of language development is tightly correlated with cerebral maturation. Myelination is a long developmental process that ends with adolescence. It favors the enhancement of the nerve conduction velocity of the afferent impulses reaching the brain and the efferent impulses leaving the brain and gaining their way toward motor systems. The subsequent stabilization of the nervous routes is linked with experience and education where hundreds of entering sensorial samplings create neuronal circuits, which later become representative of models of reality: for example, all the mistakes of a baby trying to learn how to talk. The emission of voice itself is modulated by bone and sound transmission of voice on the motor circuits of the language areas (Maier, 1998). All these processes continue to be active every time an individual undergoes any learning process, in a word - lifelong. Therefore, any constraint on either experience or education produces a block on the routes of language development, reducing the creative links among the cerebral circuits. The outside enters and modifies the inside and the cerebral structures. On the other hand, man is able to communicate with the outside only through cerebral motor outputs; consequently, it is impossible to separate the motor from the sensorial system (Robertson, 1999). Language development so evaluated is a ‘sensitive-motor process’, which reaches the peak of activity during childhood and adolescence. Also, some believe that language development is a maturation process and that it is genetically determined (Edelman, 1995).

Learning about science should serve as a means for conveying new stimuli into the synthesis of new cerebral routes, which intersect with the evolutionary ancestral routes and thus create new experience (Boncinelli, 1998). All memory processes including language acquisition are based on multiple experiences that result from multi-sensorial prompting. In order for stimulations to be multiple they must by definition contain more than one element and, thus, they have to necessarily contain a certain number of new elements, and such new elements themselves promote the language process that originates a thought, a form and an interpretative key to reality. Social systems can either inhibit or accentuate the expression of some language latencies. Indeed, ‘learning about science’ and becoming part of a particular professional language community expose to stimuli that are capable of either emphasizing or inhibiting the levels of language consciousness. In this context, man responds to the geography of the surrounding system, and reaches in such a sense a high language differentiation.

The brain undergoes important modifications in response to experience and to multiple stimuli, and thus it recognizes, it synthesizes and it integrates, leading to the creation of an individual form of language. Language learning is an interactive process also between the sensory-motor ways and the educational program (Amunts et al., 2004). A way to modify such ways is education, through the activation of sensorial channels and the creation of new experiences. In such a context, 'learning about science' represents the multiplication of cerebral stimulations, which tend to transform the central circuits into even stronger elements (Rose, 1994).

The main role played by a technical language is to transmit information that must overcome the educational, linguistic and even cultural barriers of the reader or listener. In order to achieve these aims medical scientific language has become, in time, more precise and synthetic. A technical language, also called specialized, special, LSP and ESP is by definition 'technical' in any language. Moreover, a language is 'technical' not because it is reported in one particular language, which in our case is English, but it is 'technical' when it embraces a specific group of professionals belonging in a particular language community. More frequently, worldwide, doctors are required to communicate in the English language, and especially to read and understand medical English in order to keep up to date both at home and at congresses. This is different for researchers working in universities and research institutions, who need to know also how to write, understand and speak the English language. This is still different for doctors working in multicultural settings who need to speak English in order to communicate with their patients.

The problem of language fluency was described by Ali, who set three different levels of fluency: technical, ordinary and demotic (slang) (Ali, 2003). Also, these three different levels of fluency can be present in various representations in relation to the four linguistic skills, i.e. listening, speaking, reading, and writing.

All these issues will be addressed in the present paper with the aim to clarify the concept of fluency development, and to show that acquisition of a technical language does not necessarily require fluency in the corresponding standard language.

What is Fluency?

Fluency is a very commonly used notion in foreign language acquisition (Chambers, 1997). In the evaluation of proficiency in a foreign language it represents an indication of oral performance. Volubility and loquaciousness represent synonyms for fluency, which has been defined as the property of a person or a system that delivers information quickly and with expertise. The term fluency is also used to denote fluid language use, as opposed to slow, halting use. Fluency is a term very much related to speech and it means the smoothness or flow with which sounds, syllables, words and phrases are joined together when speaking quickly. Fluency is necessary but not sufficient for language proficiency. For example, uneducated or even illiterate native speakers, who are fluent language users, may evidence poor vocabulary, limited discourse strategies, and inaccurate word use. Although some well known definitions of fluency do actually coexist, several interpretations can be evidenced. A purely quantitative definition of fluency does not allow the highlighting of the phenomena that facilitate efficient processes of speech production. On the other hand, a qualitative, linguistic analysis of the language reveals some of the links between linguistic knowledge and performance skills. In the sense of proficiency, fluency requires some related but separable skills: reading, which is the ability to easily read and understand texts; writing, which is the ability to write texts; comprehension, the ability to understand oral and/or written speech; speaking, the ability to speak and be understood by others.

It is important to realize that, to some extent, these skills can be acquired separately and, in the case of a foreign language, the later in life a learner is, the harder it is to acquire listening and speaking skills. On the other hand, in this context, reading aimed at reaching comprehension of what has been read is a capacity that can be acquired more easily later in life and, considering the aims of the present survey, only this language skill will be taken into account in the present analysis so excluding all other skolls and all the prosodicy features related to speech like pitch or intonation, stress or loudness, and duration or timing (Chall, 1996a, Chall et al., 1990,).

Reading fluency is often confused with fluency in a language. Reading fluency is the ability to read texts accurately and quickly (Therrien, 2004). Fluency bridges word decoding and comprehension. Comprehension is understanding what has been read (Pikulski & Chard, 2005). Fluency is a set of skills that allows readers to rapidly decode texts while maintaining high comprehension (Krashen, 2001). How can reading fluency be obtained? Chall (1996b) proposed six stages through which readers proceed, each of which emphasizes a particular aspect of reading development. The first stage sees the reader involved with deciphering the words, it represents the first literacy phase. During the second stage the reader begins to formally read. Next comes the period called confirmation and fluency or "ungluing from print" (Chall, 1996b). During this stage readers confirm what they have already experienced as developing their fluency. During the next stage readers begin to no longer read only for 'enjoyment' but also for what Chall called "learning the new" (Chall, 1996b). In this stage readers acquire more and more knowledge in a given area and in this way the reader is faced with what Chall called “multiple viewpoints.” In this stage the reader begins to evaluate critically what has been read. The last stage is represented by what Chall called “construction and reconstruction”. This is the period when the reader is able to not only critically evaluate what has been read but also to put into synthesis all the different viewpoints, and so the reader’s personal perspective can be developed. In other words, reading fluency is a necessary requirement when readers need to build meaning from a written text, which is the primary purpose of reading (Allington, 1983; Samuels, 1988; Schreiber, 1980).

A further way of developing reading fluency is through sight word reading. A definition of sight words includes either words with irregular spelling or words that are recognized as a result of their visual features or a particular method of instruction. This definition suggests that words become sight words only after an extremely accurate analysis of the orthographic structure of the word. Also assisted (Dowhower, 1989) and unassisted repeated reading are strategies for acquiring and stabilizing reading fluency (Samuels, 1979, and Dahl, 1979).

Ehri defined sight words as “all words that have been recognized accurately on several occasions” (1995). This full representation and recognition occurs in four phases. The first phase called the prealphabetic phase corresponds to Chall’s first stage during which readers begin to remember the words they have read and link them either to a certain pronunciation or to a meaning. The second phase is the partial alphabetic recognition during which readers read while linking together some letters of the written words. The full alphabetic phase is the third phase described by Ehri (1995) and it corresponds to Chall’s conventional literacy stage, during which the reader can easily identify words with similar spelling. During the last phase called the consolidated alphabetic phase, the reader identifies the patterns of letters occurring in words as units. Thus, the reader is able to accurately and automatically recognize the words. This phase corresponds to Chall’s confirmation and fluency stage (Ehri, 1995). This theory called the “automaticity theory” reports that if the reader’s attention is shifted towards the content of the text, rather than on the decoding of the word, then the building of understanding is notably improved. This further supports the notion that all single characteristics of a word are actually independent of each other, and their identification, recognition, recalling and thus knowledge is the result of practicing and training each feature separately. In other words, some readers may be able to recognize the spelling, pronunciation and meaning of a single word, others may be able to recognize only one or two of these characteristics. Whether the readers can recognize all of the features of a word or each of them separately depends on which features were practiced and which skills were trained.

What is Technical Fluency?

Ali reports technical, ordinary and demotic (slang) fluency. Technical fluency refers to the acquisition of specific competence and thus to a technical linguistic register belonging in a specific language community. Generally, individuals are fluent in a particular language when they are at the ordinary level of fluency. Fluency in slang is not obtained from schooling or other educational processes and mechanisms; instead, it derives directly from non conventional routes (Ali, 20003). Table 1 lists the six different types of language interactions that may occur within these three levels of fluency. Also, these three different levels of fluency can be present in different representations in relation to the four language skills, i.e. listening, speaking, reading, and writing (Tab. 2). Although this classification serves discussion and analytical purposes, it does not actually correspond to reality in which, instead, a number of different combinations take place in any specific linguistic context (Tab. 3).

Actually, when talking about fluency, the degree of knowledge of a language should be investigated in order to fully understand the complex relationships occurring among the three types of fluencies and the language skills, including understanding, because sometimes good knowledge of technical language can be obtained without necessarily going through the ordinary level. Also, a person who is fluent at the ordinary level is not necessarily fluent at the demotic level, which corresponds to a completely different language experience and involves a completely different way of acquisition and use. Thus the three types of fluencies are not related to each other in a consequential manner, meaning that one type does not precede or follow another.

In the previous sections the importance of the interaction between man and the environment to language acquisition has been highlighted. In this sense environment is everything and everyone capable of stimulating and producing a language experience. Indeed, demotic fluency is the result of the interaction between the person and ‘the street’. In other words, in terms of a language, individuals learn and repeat what they hear in the street without any contribution from schooling or other types of educational language acquisition strategies. In these conditions, slang is the only language individuals come to develop, because it is the only language they have ever been in contact with and experienced. This particular fluency is correlated only with two language skills, which are listening and speaking. This fluency does not require any reading or writing skills. Instead, ordinary fluency is obtained through home, schooling, reading, writing, listening and speaking, and through a variety of communicative experiences. Like demotic, also ordinary fluency could include only two language skills, which again are listening and speaking. Before alphabetization people spoke and understood and communicated only through oral interactions; however, today, writing, reading and comprehension skills are important for an adequate interaction with the environment. It is worthnoting that the demotic and the ordinary fluencies also include the complex of characteristics involving non-verbal communication. Certainly a combination of the two types of fluencies can be evidenced both in oral and written interactions; think of the way young people communicate through cellular phones and computers.

Different from demotic and ordinary fluency, technical fluency is obtained only through schooling, reading, writing, listening and speaking a technical, special or specialized language. Moreover, a good level of knowledge in listening and speaking, without knowing how to read, understand and write technical is almost impossible to reach. In other words, professionals could reach technical fluency in writing and reading without being able neither to speak nor to understand the corresponding standard language. The opposite is not true, meaning that speaking and understanding a standard language does not imply technical fluency as well. What makes technical fluency so extraordinary and peculiar is that its acquisition does not follow the conventional routes and the natural flow that lead to language acquisition (i.e. listening-speaking-reading-writing). In this strict sense technical fluency is different from demotic and ordinary fluency also because these latter two necessarily require some kind of oral interaction with the environment, while exposure to written texts is crucial to technical fluency acquisition, and the process of language learning is in some ways a solitary one. Another important difference between demotic and ordinary and technical fluency is the reason why they are acquired. Demotic and ordinary fluencies are crucial to survival, so any one of these two levels of fluency is acquired genetically and physiologically, meaning naturally and even without the contribution of any kind of schooling or training intervention. This is aimed at adequately interacting with the environment and the surrounding world, and also at effectively communicating our needs and at understanding the people around us. Instead, technical fluency is not crucial to survival, it is acquired only through schooling and specific training, and although it is not aimed at interacting with the surrounding world and it does not necessarily include the complex of characteristics involving non-verbal communication, its objective is indeed represented by some form of communication whose ultimate scope is what Chall called “learning the new”.

To test the hypothesis that knowledge of the standard language is not a prerequisite for fluent reading and understanding of a scientific text by professionals belonging in the language community, post-graduate medical school students were subjected to several different types of oral and written tests in order to evaluate their abilities in standard English language and their reading and understanding skills in the medical scientific language.

Subjects and Methods

The present paper is the second report of a wider research work including other translations performed by 1st, 2nd, 3rd, and 4th year medical school students, and also students from other courses and majors (Daniele, 2005). For the purposes of the present work, subjects participating in the study were post-graduate medical school students. During the past five years a total of 130 doctors were subjected to the study. They were all Italian native speakers and they all had quite homogeneous educational backgrounds. Indeed, all of them were from an Italian Medical School where they had studied English. None of them was fluent in listening, speaking, reading and writing in English language. Three different features of language knowledge were assessed: 1) their knowledge of English grammar and syntax; 2) their oral and written skills in the standard language; and 3) their oral skills in the technical-scientific-medical special language. To obtain this, all doctors were administered tests for both elementary level standard language and medical language. So, they were all subjected to a standard elementary English language proficiency written test that assessed writing and reading skills including spelling and reading comprehension exercises. Also, they all underwent an oral examination in order to evaluate their listening and speaking skills. The oral interview included simple questions and required simple answers. The oral testing also included questions (in Italian) on English grammar and syntax. All doctors took oral testing that included technical and sub-technical vocabulary and terminology.

Most importantly, in order to test their knowledge of written scientific and medical language, their reading and understanding skills in this technical language were assessed through administration of three abstracts that doctors were to translate. Abstracts were taken from PubMed Medline. Table 1 reports some of the characteristics of the three abstracts used. An attempt was made to compare terms belonging in different registers through the administration of three different types of medical abstracts that cover three branches of bio-medical studies. Thus three types of abstracts were translated: abstract 1 (BSA) was entitled “The Hemangioblast: Cradle to Clinic” published in the journal *Experimental Hematology* (Cogle and Scott, 2004). This paper can be included in the basic science research articles category, and it was chosen particularly because of its richness in compounds. Abstract 2 (MA) instead was a medicine research article entitled "The Role of the Renin-Angiotensin-Aldosterone System in Diabetes and its Vascular Complications" (Cooper, 2004), published in the *American Journal of Hypertension*. This particular article had a more 'medical' register and it was the only abstract reporting impersonal passive sentences. Abstract 3 (SA) was a surgery research article entitled "The Potential Role of Breast Conservation Surgery and Adjuvant Breast Radiation for Adenoid Cystic Carcinoma of the Breast" (Millar et al., 2004), published in the journal *Breast Cancer Research Treatment*. This particular article was chosen due to its many sub-technical words correlated with language of statistics (Tab. 5).

Regarding the choice of the language items that were used for assessment, it was based on their importance, frequency and prevalence in medical scientific articles, on the difficulty students have in translating them, and also on the fact that to my knowledge they have never been studied before. So technical terms as compared to sub-technical vocabulary were assessed. Furthermore, a quantitative analysis was carried out to evaluate knowledge of non-Anglo-Saxon derived words as compared to Anglo-Saxon derived words. Also, conditional verbs such as "*May*" were analyzed. From a syntactic point of view mainly compounds "*…circulating endothelial progenitor cells…*"; "*…hemangioblast stimulatory or inhibitory cues…*"; "*…bipotential hemangioblast activity…*" and impersonal passive sentences ("*…receptor blockade has been shown to prevent atherosclerosis…*"; "*Left ventricular hypertrophy has been shown to be predictive of cardiovascular and renal events…*"; "*…the RAAS blockade has also been shown, in several large randomized clinical trials…*") were assessed. Also, functional forms like "*both…and*", "*either…or*", "*whether*" and "*in addition to*" were evaluated.

Concerning abstract administration, first BSA was given, followed by MA and then SA. Only the translations that were completed were included in the analysis. Doctors had 45 minutes to finish each translation and they were not allowed to use a dictionary. Data were analyzed using a spreadsheet (EXCEL).

Results

Table 4 reports data on the test population and on standard language and oral medical scientific language assessment. Table 6 reports data on the test population and on completed translations. Table 5 reports abstract characteristics. The basic science abstract 1 (BSA), the medicine abstract 2 (MA), and the surgery abstract 3 (SA) were translated by 78 doctors and all (100%) of them completed the translations. Tables 7, 8, 9, and 10 show data from the three abstracts that were administered to doctors, and the percentage of mistranslations.

Zero percent (0%) of the technical terms (TT) in BSA (Tab. 8), in MA (Tab. 9) and SA (Tab. 10) were mistaken, so 100% of the TT were translated correctly by the doctors. This was quite true also for non-Anglo-Saxon derived words (NASDW), since most of the times scientific terminology has origins similar to its Italian equivalent. Indeed, 7% of such words in BSA (Tab. 8) were mistranslated, while 5% and 6% of NASDW were not translated correctly in MA (Tab. 9) and SA (Tab. 10) respectively.

Many doctors did not translate words like: "*harbor, gauge, cues, harvested, harnessed, deliver".* These are clearly Anglo-Saxon derived words (ASDW) and 12% of these words were translated incorrectly in BSA (Tab. 8). Furthermore, 9% of words like "*kidney, onset, store, end organ, injury*" in MA (Tab. 9) were not translated or mistranslated. Also, 9% of the words like "*purpose, breast, review, assess, relapse*" in SA (Tab. 10) were incorrectly translated or not translated at all. Moreover, words like "*finding, diseases, relapse, vessel, healing, wound, injury, complications, predictive, onset, differentiation purpose, breast, review, assess, median, recurrence rate, relapse*" show double difficulty, since they are both sub-technical (STW) and most of them are ASDW. When evaluating these words, 9% of mistranslations can be evidenced in BSA, while 3% and 2% of wrong translations can be found in MA (Tab. 9) and SA (Tab. 10) respectively.

Two percent (2%) of the compounds in BSA were translated in the wrong way (Tab. 8). Some of the compounds were: "*mesodermal precursor cell, hematopoietic stem cell, bipotential hemangioblast activity, circulating endothelial progenitor cells, adult hemangioblast activity, hemangioblast stimulatory or inhibitory cues, inhibiting vessel production, harvested HSC or EPC*". Instead, some of the compounds in MA were "*both BP-dependent and -independent mechanisms, end-organ injury, angiotensin-converting enzyme inhibition or angiotensin type 1 (at (1)) receptor blockade, several large randomized clinical trials*", and 3% of wrong translations were seen (Tab. 9). Also SA (Tab. 6) included compounds like "*adenoid cystic carcinoma, lymph-node positive disease, median follow-up time, relapse free survival (RFS) rates*" and 4% of these were mistranslated.

BSA (Tab. 8) and SA (Tab. 10) did not include any impersonals. MA included 4 impersonals: "*antihypertensive regimens have been shown to provide; angiotensin-converting enzyme (ACE) inhibition or angiotensin type 1 (at (1)) receptor blockade has been shown to prevent atherosclerosis; left ventricular hypertrophy has been shown to be predictive; the RAAS blockade has also been shown, in several large randomized clinical trials, to inhibit new onset of diabetes*" and 14% of the times these were translated in the wrong way or not translated at all (Tab. 9).

One of the most surprising observations was represented by conditional verbs like "*could be*" and "*would allow*", which were translated correctly only by few doctors. Also "*may cause*" and "*may be responsible for*" were mistranslated by some of them. These verbs received 8% mistranslations in BSA (Tab. 8) and 9% mistranslations in MA (Tab. 9). These items were not represented in SA (Tab. 10).

Furthermore, another surprise was to find out that only few doctors translated "*as to whether*" and "*whether*" correctly. Also items like "*given that*" had some mistranslations. However, probably the most striking observation was to see that only few doctors translated "*in addition to*" correctly. Also items like "*both…and*" and "*either…or*" were at times translated in the wrong way. Indeed, these functional forms received 15% and 18% mistranslations in BSA (Tab. 8) and SA (Tab. 10) respectively, and 16% mistranslation in MA (Tab. 9).

Globally, 100% of the doctors completed the translation of the three abstracts. Indeed, MA itself was longer than the other two; it had globally 2.111 characters as compared to 1.204 characters in BSA and 1.395 in SA (Tab.5). Table 7 shows the total data on all abstracts. Zero percent (0%) of the TT were mistranslated as compared to 4% of the STW, probably because most STW were also ASDW. Indeed, 10% of ASDW were mistranslated with either a wrong translation or without any translation at all. Instead, NASDW received 6% mistranslations because of the roots in common with the Italian language. Nonetheless, this number still remains low, especially when considering that most of the doctors reported the right translation. Three percent (3%) of the compounds were misinterpreted by the doctors and one or two of them did not translate them at all across the three abstracts. Impersonals were present only in MA and 14% of these forms were not translated at all. An interesting datum is the one derived from translation of other functional forms like "*both…and*", "*either…or*", "*in addition to*", "*whether*", etc. that had 16% mistranslations. Also the conditional forms like "*would allow, could be, may be*" received 8% mistranslations (Tab. 7). Another expected result was to see that a lot of doctors had difficulty in translating the past tense, especially when irregular verbs were involved (data not subjected to the statistical analysis in the present report).

Discussion of the Data

For this second phase of the study, only doctors were subjected to the test because they were the most acquainted with scientific medical terminology and syntax, thus they were the ones who were most familiar with the linguistic characteristics in scientific writings, and they were also 'the most contaminated' by scientific concepts and knowledge. These experimental conditions are standard, since they allow discerning the real difficulties of a student, or more generally of a doctor, in translating scientific writings, and they provide an opportunity to understand the elements on which we must concentrate and to which direct our future teaching strategies.

All the doctors had actually only rudimentary knowledge of English. They were pretty good with grammar, maybe because this particular phase of the testing was carried out in Italian. Another unexpected phenomenon was that the oral examination on technical language included exactly the same words as the abstracts, and almost all of the doctors were unable to understand the questions and provide an answer. This means that the same terms and words are recognized, in these conditions, only when they are seen visually and not when they are heard. This further supports the idea that the population studied had been in contact only with written scientific medical texts and had indeed developed only this specific skill. Furthermore, no correspondence could apparently be seen between their knowledge of standard English and their performance in translating the abstracts. In other words, even the few doctors who showed elementary knowledge of the standard language, performed exactly like the ones who had almost no knowledge whatsoever of standard English when translating the abstracts. It seems as if learning a language and learning how to read and understand a technical language follow two different routes that are almost completely independent from each other.

All the doctors finished the translations, and this could be due to multiple factors. First, it could be easily hypothesized that almost all of them had been previously subjected to some type of scientific translation. Also, the doctors knew that these translations were not going to be part of any final grade, and this somewhat relaxed them. So, they spent the available time proficiently in trying to translate correctly. Indeed, MA was longer than the other two (2.111 characters vs. 1.204 vs. 1.395). So, when comparing the three types of registers – basic science, medicine and surgery – it seems that the different specific registers were irrelevant, since all doctors were acquainted with all of them, showing that indeed knowledge of the specific terminology and subject matter does play a prominent role in scientific translations (Ulrych, 1999).

Indeed, all of the doctors correctly translated technical terms (TT) in all three types of abstracts. Technical terms do have similarities with Italian terms, and in fact most of the doctors showed knowledge of the roots of the terms and thus they translated them correctly into the corresponding Italian terms. This seems to be due to the total knowledge of the corresponding registers in their mother tongue language and even more central, to the adequate knowledge of the specific themes (Cortese, 1993) This is supported by the results showing that MA had 33 TT and 0% of them were mistranslated, and that SA had 25 TT and 0% of them were mistranslated.

When comparing SA and MA with BSA, 0% of the 15 TT were mistranslated in BSA.

Globally, (Tab. 3) doctors were unable to translate 4% of the sub-technical vocabulary (STW), and 10% of the Anglo-Saxon derived words (ASDW). Indeed, STW show two advantages. Firstly, most STW belong in registers mostly known by doctors. Secondly, most of them are also ASDW. This is supported by the results that as the number of STW increased in the three Abstracts (16 in BSA vs. 34 in MA vs. 40 in SA), the percentage of mistakes showed an opposite trend (9% in BSA vs. 3% in MA vs. 2% in SA), it declined. Though the difference is irrelevant, nonetheless this datum could suggest that doctors are more used to words belonging in the medicine and surgery registers as compared to words belonging in the basic science register (Daniele, 1999). When comparing ASDW with NASDW, only 3% appears (9% vs. 6%). Besides the few difficulties doctors showed, these data further evidence that it is easier for doctors to translate words that are similar to their own mother tongue language (Newmark, 1993; Nida, 1973). From compounds passing through impersonal and functional structures up to conditionals, these were almost all correctly interpreted and translated. Doctors had no difficulties in structuring a correct Italian sentence conveying the correct meaning of the English sentences including these linguistic items. Furthermore, the overuse of both impersonals and compounds represents a main characteristic of scientific writings, and doctors are all very familiar with such syntactic phenomena (Jacobson, 1989).

Conclusion

Neurobiology allows highlighting and understanding of all those complex neurological and biochemical mechanisms that take place in the central nervous system from embryonic life throughout all maturation years. Processes like the activation of the sensorial system and the process of myelination, and the continuous exchange between the brain and the environment are all crucial to language acquisition and learning. The notion that language development and acquisition is actually a sensitive-motor process has been highlighted. A sensitive-motor process involves both the sensorial system and the motor system. Then, the sensorial system is made up by the five senses, and in our specific case the senses involved with language development are represented mainly by the ears and the eyes. Finally, the ear and hearing are necessary to hear the words, while the eye and seeing are necessary to reading the words. On the other hand, the motor system involves complex structures like nerves, muscles, joints and bones. In terms of language acquisition the organs that are mainly involved are the nerves, muscles, joints and bones of the mouth and the face, and the tongue. Through them and their complex actions words can be effectively orally reproduced. A second set of structures in the process of language expression is represented by the nerves, muscles, joints and bones of the hands and arms. These are necessary for writing. Thus, the notion that language is a sensorial process identifies the mechanism through which a language is acquired by passing through the senses. From these the information arrives to the brain and to the specialized areas of the cerebral cortex; here the information is processed, and then a response is sent to the periphery through nerves, muscles, joints and bones that represent the means through which a language is articulated orally and reproduced in written form. So, the process of language articulation and reproduction is a motor one. Therefore, the sensorial system represents the receptive apparatus for language acquisition, while the motor system is the means through which a language is delivered. Thus if the definition that language acquisition is a sensitive-motor process were accepted, then the fact that the environment specifically affects all language learning processes and it determines language differences must be agreed upon.

Fluency as a term used to denote different language characteristics such as oral performance, and the property to deliver information, and fluid language, and the lack of language disorders has been adopted in the present paper. Although no comprehensive definition seems to exist for the term fluency, one feature of this phenomenon seems to have reached a consensus, the fact that there are different skills and capacities that, to some extent, can be developed separately and that later in life only some of such skills and particularly reading and writing can be acquired. The present analysis was limited to reading and comprehension skills in a technical language such as medical and scientific language because these latter skills can be more easily developed in university students, and they are necessary for future doctors to have access to international scientific literature. In this latter narrow sense, technical reading fluency is what Chall called “reading for learning the new”. Indeed, the main models attempting to assess acquisition of fluency in reading have been crossed. The five stages described by Chall have been evidenced, during which readers pass from simply having to recognize the letters in a word to synthesizing the different texts they have read, to building up their own perspective on a specific topic (Chall, 1996). Then, Ehri’s sight word reading process has been exposed, passing through the prealphabetic phase, up to quick and automatic recognition of a word and of words which are matched to a pronunciation and a meaning (Ehri, 1995). Finally, the automaticity theory supports that the attention of the reader must be fixed on the content of the text rather than on the form and/or shape of the words; in this way, reading serves its purpose to build meaning from a text (Samuels, 1988). Again neurobiology and physiology allow understanding these fine and complex mechanisms and processes, which again occur as a result of the interaction of the brain and the person with the environment. The brain responses to this process through a mental representation of the word, and the subsequent recalling of that brain representation allows recognition of the word quickly and automatically. In other words, the identification of a previously represented word includes information on spelling, pronunciation and meaning. However, these three features belonging to a word are not necessarily recognized immediately altogether. The brain stores only the information it has previously received from the external environment. Therefore, if the reader practices, for example, only spelling, then the process of recognition and recalling by the brain will include only spelling and not pronunciation and meaning. In this context a number of combinations can take place. Like all other mental processes, the features of a word must be learned and memorized separately. In this sense, again, reading fluency development is a sensitive-motor process. The three different levels of fluency described by Ali have also been critically analyzed, highlighting mainly their differences.

Finally, the following conclusions can be drawn from the analysis of the translations. Most technical and sub-technical words were correctly translated and the percentage increased as the number of TT and STW increased across BSA, MA, and SA. These data suggest that the doctors' knowledge of the correct equivalent term in their mother tongue language (Italian) could have played a role. Also these results seem to be a consequence of the fact that the translations were administered to post-graduate students who had had the necessary time to develop the scientific register also in Italian, and were acquainted with the scientific themes they were translating. This seems to be true also for both non-Anglo-Saxon derived words and Anglo-Saxon derived words, which suggests that knowledge of the specific root of the word helps translators in understanding the meaning the word it is conveying. Also, it means that it will help translators in reproducing the exact term in the target language, especially when the translators do actually know the words in the source language they are trying to reproduce. Impersonal type structures were mistaken only by a few doctors. This datum can be supported by the fact that although Italian does not contain anything that even verges on the impersonal and thus doctors are not at all familiar with such structures in their mother tongue, nonetheless, they are familiar with these structures that more literally and frequently belong in scientific language and to other technical languages, and indeed the study population included only doctors and surely they had had the time to get acquainted with English medical articles. This is also true for compounds. However, in this specific context compounds seemed to have been actually translated as a consequence of the good knowledge of the concepts the compounds were conveying. However, the hypothesis that if these doctors had been fronted with compounds constructed with strings of words taken from a register that was different from the one belonging in medical language, they would not have been able to translate such strings so easily as they did with the medical compounds can be put forward. This linguistic phenomenon is not present in Italian, however the over-exposure of this language community to this syntactic form is so common that compounding has been 'imported' also into Italian medical language, so resulting in compounding Italian sentences, for instance: '*diabete insulino-dipendente*'. The mistranslation of the functional forms seems to be due to the specific language background these doctors have. Certainly, the lack of deep knowledge of English is indeed a shortcoming. Concerning terminology and knowledge of the subject matter, in general the three abstracts did not pose particular problems since doctors are very familiar with both. However, when comparing the three types of abstracts, doctors showed decreasing difficulties when they passed from the BSA to the MA to the SA, and this was due to the fact that BSA included linguistic elements that doctors had probably seen only during their first years in Medical School, suggesting that forgetting is a process that does indeed occur when exposure to such items is not continuous in time. In this context it is interesting to note how there appears to be a perfectly reversible situation with the population study of the first report on this theme (Daniele, 2005). In other words it seems that, as the years move on, the students tend to forget what they have learned in high school and particularly standard English, and tend to instead learn how to recognize the special forms of the language, meaning the medical language.

This particular phenomenon will be part of future prospective studies. This study has focused only on doctors and only on a limited number of language items. More in-depth investigations are necessary to gain more insight into the mechanisms and processes that were only mentioned in the present paper and which do indeed deserve further debate.

Table 1 – Language interactions

technical-technical
technical-ordinary
technical-demotic
ordinary-ordinary
ordinary- demotic
demotic-demotic

Table 2 – Fluency and the 4 language capacities

fluency	**Language capacity**			
	listening	**speaking**	**reading**	**writing**
Ordinary	yes	yes	Not necessary	Not necessary
Demotic	yes	yes	Not necessary	Not necessary
Technical	Not necessary	Not necessary	yes	yes

Table 3 – Interactions and the 4 language capacities

fluency	**Language capacity**			
	listening	**speaking**	**reading**	**writing**
technical-technical	yes	yes	yes	yes
technical-ordinary	yes	yes	Not necessary	Not necessary
technical-demotic	yes	yes	Not necessary	Not necessary
ordinary-ordinary	yes	yes	Not necessary	Not necessary
ordinary- demotic	yes	yes	Not necessary	Not necessary
demotic-demotic	yes	yes	Not necessary	Not necessary

Table 4 – Standard language and oral skills in medical language assessment (frequency distribution)

	Total	**Passed**	**Failed**	**Passed**	**Failed**
Grammar and syntax	**78**	**6**	**72**	**8%**	**92%**
Listening (also medical)	**78**	**3**	**75**	**4%**	**96%**
Talking	**78**	**2**	**76**	**2%**	**98%**
Reading and understanding	**78**	**7**	**71**	**9%**	**91%**

Table 5 – Abstract characteristics

	Total Characters	**Words**
Abstract 1 BSA	**1204**	**200**
Abstract 2 MA	**2111**	**354**
Abstract 3 SA	**1395**	**256**

Table 6 – Test population and completed translations

	Total	**BSA**	**MA**	**SA**
No. of doctors taking the test	**78**	**78**	**78**	**78**
No. of completed tests	**234**	**78**	**78**	**78**
% of completed tests	**100%**	**100%**	**100%**	**100%**

Table 7 - Data from all Abstracts

	No. in English Abstracts*	No. in all Translations	No. Mistranslated	% Mistranslated
Technical terms (TT)	**73**	**5694**	**0**	**0%**
Sub-technical words (STW)	**90**	**7020**	**254**	**4%**
Anglo-Saxon derived words (ASDW)	**96**	**7488**	**752**	**10%**
Non-Anglo-Saxon derived words (NASDW)	**127**	**9906**	**599**	**6%**
Compounds	**28**	**2184**	**63**	**3%**
Impersonal forms	**4**	**312**	**44**	**14%**
Functional forms	**10**	**780**	**126**	**16%**
Conditionals	**4**	**312**	**26**	**8%**

*Function words (i.e. articles, prepositions, etc.) not included

Table 8 - Data from BSA

	No. in English Abstracts*	No. in all Translations	No. Mistranslated	% Mistranslated
Technical terms (TT)	**15**	**1170**	**0**	**0%**
Sub-technical words (STW)	**16**	**1248**	**112**	**9%**
Anglo-Saxon derived words (ASDW)	**33**	**2574**	**309**	**12%**
Non-Anglo-Saxon derived words (NASDW)	**46**	**3588**	**251**	**7%**
Compounds	**12**	**936**	**19**	**2%**
Impersonal forms	**0**	**0**		
Functional forms	**4**	**312**	**47**	**15%**
Conditionals	**2**	**156**	**12**	**8%**

*Function words (i.e. articles, prepositions, etc.) not included

Table 9 - Data from MA

	No. in English Abstracts*	No. in all Translations	No. Mistranslated	% Mistranslated
Technical terms (TT)	**33**	**2574**	**0**	**0%**
Sub-technical words (STW)	**34**	**2652**	**80**	**3%**
Anglo-Saxon derived words (ASDW)	**28**	**2184**	**197**	**9%**
Non-Anglo-Saxon derived words (NASDW)	**40**	**3120**	**156**	**5%**
Compounds	**8**	**624**	**19**	**3%**
Impersonal forms	**4**	**312**	**44**	**14%**
Functional forms	**3**	**234**	**37**	**16%**
Conditionals	**2**	**156**	**14**	**9%**

*Function words (i.e. articles, prepositions, etc.) not included

Table 10 - Data from SA

	No. in English Abstracts*	**No. in all Translations**	**No. Mistranslated**	**% Mistranslated**
Technical terms (TT)	**25**	**1950**	**0**	**0%**
Sub-technical words (STW)	**40**	**3120**	**62**	**2%**
Anglo-Saxon derived words (ASDW)	**35**	**2730**	**246**	**9%**
Non-Anglo-Saxon derived words (NASDW)	**41**	**3198**	**192**	**6%**
Compounds	**8**	**624**	**25**	**4%**
Impersonal forms	**0**	**0**		
Functional forms	**3**	**234**	**42**	**18%**
Conditionals	**0**	**0**		

*Function words (i.e. articles, prepositions, etc.) not included

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