

Metaphors in Medical English Prose: A Comparative Study With French and Spanish

Françoise Salager-Meyer

Abstract — The purpose of this work is to determine the patterns of analogy underlying medically terminologized words which carry a metaphorical status. A corpus of medical texts in English, French, and Spanish was studied; the metaphors were recorded and classified according to their analogy patterns (or underlying semantic transfer). Two broad likeness categories were found in the three languages: morphological metaphors, which refer to forms and structures (geomorphical, anatomical, zoomorphical, phytomorphical, and architectural), and physiological (or functional) metaphors, which refer to processes and functions. The results show that the patterns of analogy underlying medical metaphors are language independent and differ from those underlying nonscientific metaphors. A closer linguistic analysis of medical English metaphorical words indicates that the vast majority: (a) belong to the nominal group, (b) modify specialist nouns or adjectives, and (c) are of the nominal-compound type (an additional linguistic difficulty for NNS). Because it is well known that nontechnical vocabulary used in technical ways is a source of difficulty for NNS, pedagogical guidelines are also provided so as to encourage students to relate new vocabulary to existing knowledge structures.

Introduction

In the introduction of a recent issue of the *Journal of Reading*, Johnson (1986) maintains that the decade of the 80's could be characterized as the period of rediscovery of the importance of vocabulary instruction. It is in fact now well established that word knowledge and vocabulary instruction are integral components of specific and general reading comprehension and that vocabulary recognition is the factor that makes the most difference in group ability (Laufer & Sim, 1985; Weiss, 1984). However, although reading strategies are important for comprehension, these strategies cannot be applied satisfactorily if students are below the threshold level of L2 competence (Clarke, 1919; Cummins, 1979; Cziko, 1980).

Moreover, psycholinguistic research has shown that lexical and conceptual difficulties are greater than syntactic difficulties in general reading in L1 and L2 (Alderson, 1984; Alderson & Richards, 1977; Anderson & Freebody, 1981), in ESP reading (Bramki & Williams, 1984; Loots, 1987; Namakura, 1986; Ulijn, 1984; Ulijn & Kampen, 1976), and in LSP reading in general (Lutjeharms, 1984; Namenwirth, 1984; Ulijn, 1980). In spite of all this, Silberstein (1987, p. 32) claims that "there seems to be a growing consensus that vocabulary

building has not received the attention it must if L2 students are to be efficient readers." Thus, and especially in Third World countries where the prime concern of foreign language courses for scientists is reading comprehension, LSP courses should concentrate on improving students' vocabulary comprehension and on teaching them adequate procedures for puzzling out the meaning of unknown words. It is this author's experience (an observation also made in other linguistic contexts by Cohen, 1979; and Walsh, 1982) that, at advanced reading levels, students who have otherwise reached a quite adequate reading comprehension of academic materials still have problems understanding what Nelson (1975, p. 623) calls "special meaning words of the context." These are context-bound lexemes borrowed from the general language (or from another branch of human activity or science) which take on a special meaning dictated by the subject matter. This is not the specific vocabulary of the discipline (mainly of Latin/Greek origin) but the general language of a technologically aware consumer society. These lexical borrowings, called for by the development of new techniques¹, are accompanied by a diachronic enrichment of the scientific *signifié*, which then becomes a concept. In a previous article on medical English lexis Salager (1985a) refers to these terms as "bimodal frequency words," or "bold medical metaphors," whose stylistic coloring fades away in the course of time and usage. As Gläser mentions (n.d.: 12):

It is a matter of experience that every technical word stock has a certain number of words which are in fact bold metaphors or comparisons. In most cases these technical metaphors show a motivation based on the principle of analogy between the designated object and a familiar one.

Morris justifies the use of metaphors in scientific-technical vocabularies as follows:

Metaphor is defined as the transference of meaning between words and phrases by analogy, or by a comparison which shows some unsuspected likeness. The language of the scientist and engineer would be poorer indeed without the use of phrases such as *booster skirt*, *engine apron*, *rocket tail* and *wind sock*. The comparisons are conventional now, but at one time they had to be invented by some mind busy at analogical extension of the language from the old to the new. (1966; p. 80)

According to Nuttall (1982), Ulijn (1985), and Carrell (1987), metaphors, metonymy, and similar kinds of transferred meanings are always potential problems for foreign learners. Although these words do not always hamper overall comprehension, they constitute a sufficient hurdle to reading fluency. As Voraček (1987; p. 56) states: "Terms based on metaphors . . . constitute a difficult area with which advanced ESP students must cope" Nelson-Herbert (1986) adds that these words must be taught, not changed, or eliminated. Of course, the native speaker, by virtue of living in a technological society, can easily understand these metaphorical terms, simply by widening the application of known semantic concepts. In fact, most of our everyday language is metaphorical. For a thorough and exhaustive analysis of this point, see

Lackoff and Johnson (1980), Johnson and Lackoff (1980) and Lackoff (1989). But foreign students are in a very different situation for three principal reasons:

1. They may lack the prior conceptual knowledge in their L1 and thus be unable to make the appropriate transfer. This is what Carrell calls "lack of schema availability." (1987, p. 23)
2. They may be reluctant to use their extralinguistic competence to unlock the meaning of what Anders and Bos (1986) call "stopper words" (a rather frequent situation in Latin America, already noted by Akirov & Salager, 1985; Alderson, 1984). In such a case, the available schemata are not activated.
3. The students know the concepts in their L1 but their command of the target common language is far from sufficient. Indeed, the general English meaning of these metaphorical items is not part of the students' reading vocabulary. This prevents them from making a positive transfer from the common language to the specific language. Such a deficiency precludes bottom-up text processing.

Little attention has been devoted to the study of the metaphorical language of science. Indeed, as has been pointed out (Graves, 1984; Swales, 1985; Varantola, 1985), there is surprisingly little awareness among practicing speakers that many technical terms are of a metaphorical status. Furthermore, in the field of language teaching and learning, metaphors have not yet received the attention they deserve (Rösler, 1985) and their appearance in LSP has either been denied or overlooked and has seldom been taken as a matter of serious concern (Irgl, 1987). Only two researchers have dealt with this problem in depth: Pelletier (1980), who studied French metaphorical terms in the language of nutrition, and Irgl (1987), who analyzed metaphors in commercial English. Other researchers only briefly mention this topic: Morris (1976) and Gläser (n.d) in scientific-technical English in general, Salager (1977) in engineering English, Binon and Cornu (1985) in the English language of economics, Pica (1981) in legal French, and others who describe in general terms the relationship between specialized language and general language (Gallais-Hamonno, n.d.; Hoffmann, 1981; Qvisgaard, 1981; Voraček, 1985).

Purpose and Corpus

It is thus the purpose of this paper to identify and analyze metaphorical medical terms (quantitatively and qualitatively) so as to highlight their salient features. A classification of medical metaphors based on their patterns of analogy, or likeness, would allow us to present pedagogical guidelines which would facilitate the teaching of this component of medical lexis. "Since metaphors always involve an implicit comparison between A and B, one way of handling them is to analyze what A and B have in common" (Nuttall, 1982, p. 77).

The linguistic corpus is made up of 30 texts in medical English (ME), 30 in medical French (MF), and 30 in medical Spanish (MS) from 15 medical

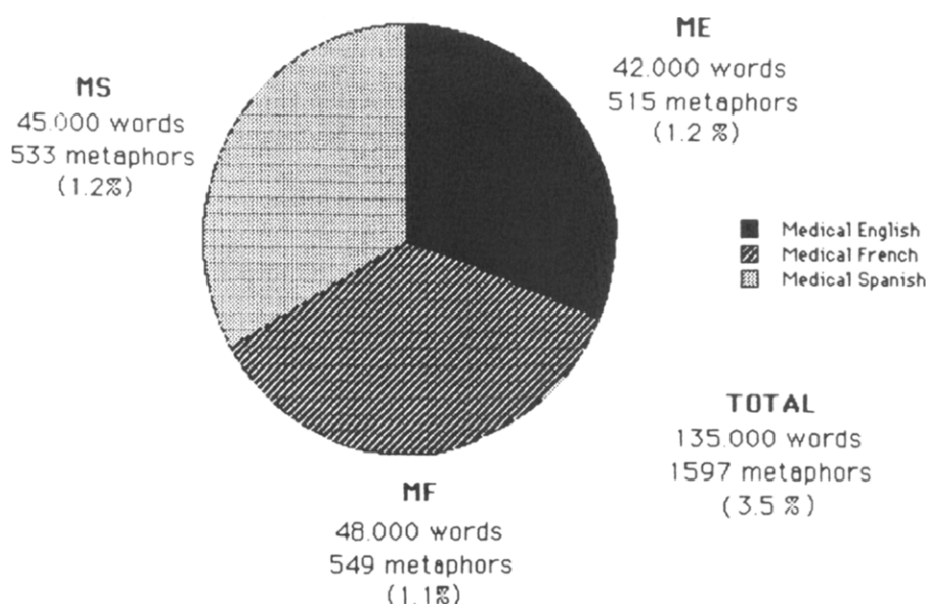


Figure 1. Frequency of metaphors in the three corpora.

specialities, totalling about 130,000 words. All the articles were randomly chosen from the University of The Andes Hospital Library. Two Spanish-speaking medical doctors, both fluent readers of French and English, acted as content specialists and helped classify the metaphorical expressions encountered in the corpus.

Results and Discussion

Global Quantitative Results

As Figure 1 shows, 1,597 metaphorical words or phrases were studied: 515 in ME, 549 in MF, and 533 in MS. Metaphors account for only 1% of the total number of words in the corpus. Although it is a small proportion, investigations into metaphorical scientific language are justified since the words which bear a metaphorical status usually refer to concepts which are crucial to an optimum understanding of the text and readers must be able to decipher their meaning. The incidence of these terminologized words is very similar in all three languages: 1.22% in ME, 1.14% in MF, and 1.18% in MS ($p < .001$).

A functional analysis of these terms allowed us to classify them into two broad categories: morphological, or structural metaphors, referring to forms and structures, and physiological, or functional metaphors, which refer to processes, functions, and relations. The number of metaphors in each group is displayed in Figure 2. This figure shows that metaphors in the morphological group are about three times more frequent than those in the physiological group (1129 vs. 468). In the corpus as a whole, the former account for 70.6%

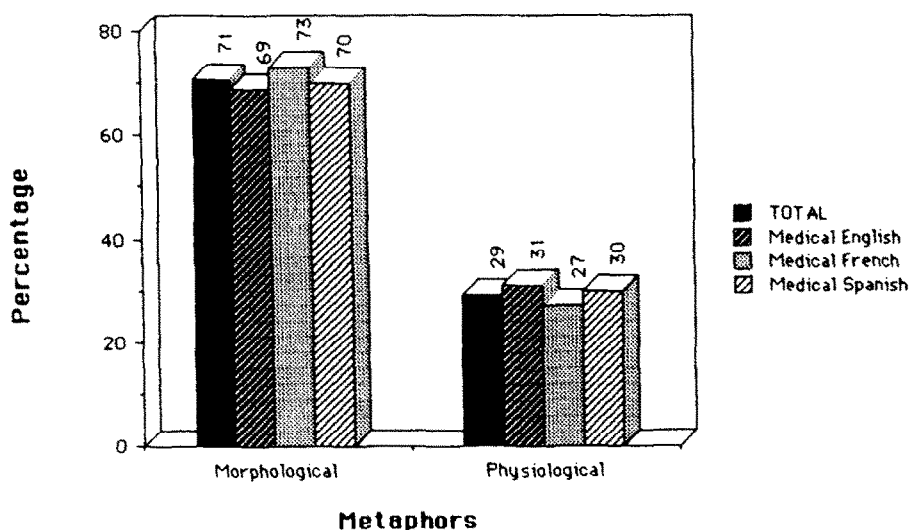


Figure 2. Distribution of morphological and physiological metaphors in the three corpora.

of the total number of metaphors recorded and the latter for 29.2%. It can also be pointed out that the difference observed in the ratios of morphological to physiological metaphors in ME, MF, and MS is not statistically significant ($p < .001$): 2.26 (69.3/30 or 6%) in ME, 2.71 (73/26 or 9%) in MF, and 2.23 (69.6/30 or 3%) in MS. The following factors might account for the difference observed in the number of metaphors in each group:

1. Medical sciences have tended through the course of history to maintain the Greek/Latin origin of the terms which denote functions much more frequently than for the terms which refer to structures. It is indeed more difficult to refer *analogically* to processes than to structures. For example, physicians refer to functional states, such as "lipolysis, diuresis, and hematopoiesis" with words directly imported from the classical languages, whereas they refer to structures such as abdominal *wall*, mitral *valve*, and coronary *tree* with words from the general language which have undergone an analogical semantic transfer.
2. Unlike the narrative quality of literary writing, medical language, like any scientific language, is basically descriptive. It thus much more frequently makes use of concept-expressing nouns and descriptive qualifying adjectives than of action- (or process)-expressing verbs.

Patterns of Analogy of Medical Metaphors

As previously noted, medical metaphors can be divided into two broad categories: morphological and physiological. In the coining of morphological

metaphors, scientific writers make use of a variety of conceptual domains (or semantic subgroups) which are, in decreasing order of frequency: architectural, geomorphical, phytomorphical, anatomical, and zoomorphical. The patterns of analogy underlying nonscientific metaphors are quite different. Carbonell (1981) showed that nonscientific metaphors are mostly used to say something about goals and plans, often about causal structures and functional attributes, sometimes about temporal ordering, attributes and tendencies, but almost never about descriptive properties and object identity. All the examples provided in Tables 1 and 2 express a unitary concept, idea, or phenomenon in an economical and condensed way thus corresponding to what Boyd (1979) has called "theory constitutive metaphors," for example, their function is to offer a new scientific terminology and to give the opportunity to accommodate the language to new facts or new hypotheses. They all have a definite and precise professional terminological meaning and present the following linguistic features:

1. The vast majority of the metaphorically used words belong to the nominal group: 88.5% (ME), 84.4% (MF), and 85.1% (MS), and to a much lesser extent to the adjectival and verbal groups (cf. Figure 3).
2. An analysis of the internal structure of metaphorical expressions shows the following results (see Figure 4). In English, the terms are mainly of the "compound-word" type (57.2%), followed by the "adjective-noun" type (37%), and by the "linking-preposition" type (5.7%). Within the "compound-word" group, the following structures are observed: "N+N" (40%), "N+N+N" (8.7%), "adjective+N+N" (5.7%), and "adjective+N+N+N" (2.8%). Modifying adjectives generally belong to a medical field (e.g., cardiac, pulmonary) and modifying nouns to what has been called elsewhere (Salager, 1983) "fundamental medical English lexis." In contrast, in French, the most frequent structures are of the "N+adjective" type (58.9%) and of the "N+linking-preposition" type (*de, à, du, des, de la*: 40.2%). It is interesting to note that the four examples of the "N+N" type (*solution tampon, plaquette témoin*) recorded in the French sample follow a typically English word order. Goffin (1968, p. 139) called this phenomenon *paresse linguistique* (linguistic laziness) because, for the sake of linguistic economy, such expressions violate French syntax. As far as Spanish is concerned, the most frequently encountered structure is of the "N+adjective" type (69.2%), followed by the "N+linking preposition" type (*en, a, de, con, par*: 30.7%). Not a single example of the "compound-word" type was recorded in the Spanish sample. The fact that most ME metaphorical expressions are of the "compound-word" type represents an additional linguistic difficulty for nonnative English speakers. Indeed, it is now well known that such compound nominals are characterized both by semantic unpredictability and syntactic ambiguity and that their decoding depends on the readers' prior knowledge of the relationship between the nouns (Kočourek, 1979; Salager, 1985b; Williams, 1984; and 1985).
3. One example only of a colorful metaphorical expression (of the phytomor-

TABLE 1
Most Frequently Encountered Morphological Metaphors
in English, French, and Spanish Medical Prose

Subgroup	English	French	Spanish
Architectural	fibrillation <i>threshold</i> dual <i>chamber</i> system acetabular <i>floor</i> aortic <i>arch</i> <i>tunnel</i> syndrome abdominal <i>wall</i>	<i>cloison</i> membraneuse <i>pont</i> musculaire <i>étage</i> de l'hernie <i>tunnel</i> sous-pectoral <i>toit</i> du cotyle vestibule du vagin <i>paroi</i> artérielle <i>coupole</i> diaphragmique <i>chambre</i> de remplissage	<i>céluas piramidales</i> <i>luz</i> de la arteria <i>pilares</i> del corazón <i>calota</i> cranial <i>boveda</i> cranial <i>trombo</i> mural <i>pared</i> abdominal
Geomorphical	<i>geographic</i> tongue urinary <i>stream</i> visual <i>field</i> peak <i>plateau</i> effect <i>constellation</i> of signs <i>cumulus</i> cells <i>stellar</i> angioma vertebrobasilar <i>territory</i>	<i>plateaux</i> vertébraux <i>lit</i> d'aval corps <i>caverneux</i> <i>défilé</i> bronquial <i>fosse</i> nasale <i>labyrinthe</i> de l'oreille <i>golfe</i> de la veine <i>carrefour</i> ventriculaire <i>vallées</i> sylviennes <i>traversée</i> bronchiale	<i>canal</i> costo-claviculaire <i>antro</i> del piloro <i>territorio</i> vascular <i>cráter</i> de la úlcera <i>lecho</i> vascular <i>fosa</i> nasal <i>campo</i> visual
Phytomorphical	coronary <i>tree</i> circumflex <i>branch</i> nerve <i>roots</i> brain <i>stem</i> embolus valve <i>vegetations</i> <i>florid</i> P. carinii pneumonia brain <i>stem</i> cauliflower ear main <i>trunk</i> of MCA	<i>faisceau</i> de His <i>bourgeon</i> génital <i>feuillet</i> s péricardiques <i>végétations</i> aortiques <i>tronc</i> commun <i>rameau</i> supérieur <i>branches</i> du <i>faisceau</i> <i>pédoncule</i> cérébelleux <i>racine</i> du <i>tronc</i> porte rétrécissement en <i>trognon-de-pomme</i>	<i>núcleo</i> reticular <i>árbol</i> bronquial <i>flora</i> intestinal <i>tronco</i> arterial bloqueo de <i>rama</i> <i>raíz</i> nerviosa <i>yema</i> pulmonar <i>hojas</i> embrionícas fractura en <i>tallo verde</i>
Anatomical	coronary <i>sinus</i> vertebral <i>bodies</i> sperm <i>head</i> femoral <i>neck</i> dorsal <i>lip</i> foreign <i>bodies</i>	corps vertébraux <i>tête</i> du pancréas <i>col</i> vésical bords <i>dentelés</i> <i>bras</i> de la capsule en <i>empreinte</i> de <i>pouce</i>	<i>cara</i> externa (huesos) <i>cuello</i> femoral <i>pelvis</i> renal núcleo <i>dentado</i> <i>cabeza</i> del metatarsio
Zoomorphical	double <i>pig-tail</i> catheter <i>butterfly</i> rash <i>horse-shoe</i> nuclei <i>buffalo</i> hump <i>bull's</i> eye lesion <i>ostrich</i> behavior	bruit de <i>galop</i> sutures en <i>sauterelles</i> <i>fourmillement</i> cellules en <i>oeil-de- hibou</i> sonde <i>queue-de-cochon</i> hemi-syndrome en <i>queue de cheval</i>	murmulo de <i>paloma</i> <i>nicho</i> de la úlcera <i>caracol</i> del oído

TABLE 2
Most Frequently Encountered Physiological Metaphors
in English, French, and Spanish Medical Prose

English	French	Spanish
<i>escape rhythm</i>	<i>age osseux</i>	<i>risa sardónica</i> (del tétanos)
<i>drug reservoir</i>	<i>exploration vasculaire</i>	<i>migración de fibras</i>
<i>opportunistic infections</i>	<i>rinçages vésicaux</i>	<i>gasto cardíaco</i>
<i>mechanical ventilation</i>	<i>vérouillage du genou</i>	<i>soplo piante</i>
<i>host reaction</i>	<i>pompe cardiaque</i>	<i>la íntima arterial</i>
<i>bacterial trapping</i>	<i>solution tampon</i>	<i>radicales libres</i>
<i>vehicles of infection</i>	<i>plaquette témoin</i>	<i>tránsito intestinal</i>
<i>endometrial echo</i>	<i>fuite auriculo-ventriculaire</i>	<i>invasión vascular</i>
<i>buffer solution</i>	<i>transit oésogastrique</i>	<i>doble enlace</i>
<i>double blind study</i>	<i>vidange vésicale</i>	<i>bomba cardíaca</i>
<i>migratory pain</i>	<i>appareil a balayage manuel</i>	<i>soplo rasposo</i>
<i>mitral valve</i>	<i>caisse du tympan</i>	<i>vesícula perezosa</i>
<i>bypass grafting</i>	<i>abdomen ballonné</i>	<i>bloqueo de rama</i>
<i>cell migration</i>		
<i>intraaortic balloon pump</i>		
<i>antibody titre</i>		
<i>aggressive therapy</i>		

- phical group) was found in the conclusion of a French article: “*la moisson de descellement cotyloïdien va être florissante.*” Surely, this is atypical of medical prose. No such example was recorded in the other two corpora. This means that, altogether, “witty” metaphors are rare in medical literature.
4. The fact that the same semantic transfer categories (or underlying analogies) are observed in very similar proportions in the corpus studied suggests that medical metaphorical expressions, at least in the three

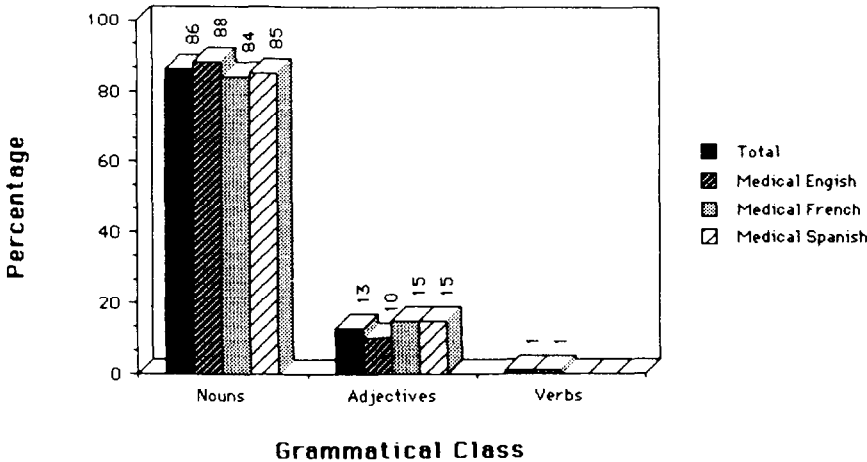


Figure 3. Grammatical class of metaphorical terms in the three corpora.

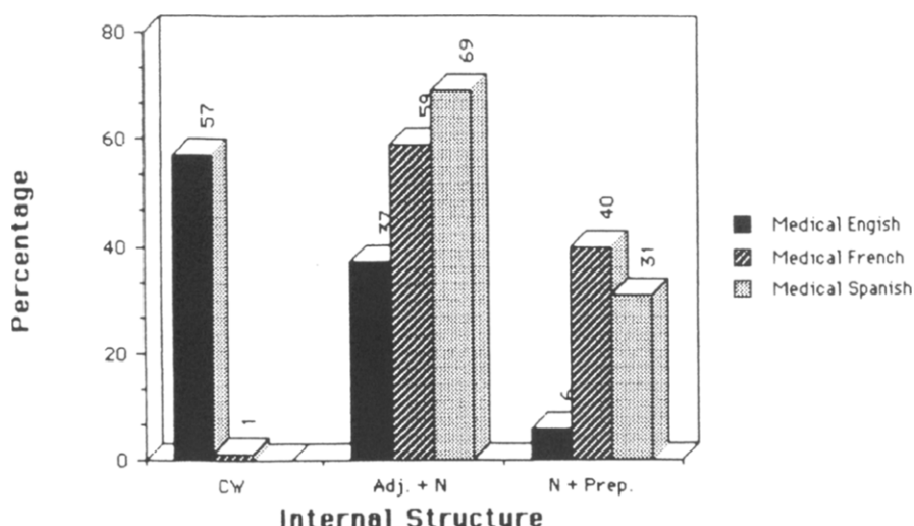


Figure 4. Internal structure of metaphorical expressions in the three corpora.

Latin-based languages considered here, are not complicated by culture-specific idiosyncracies. It is in this sense that Widdowson (1979) has claimed that scientists belong to one academic culture regardless of nationality. It would of course be essential to carry out similar studies in non-Indo-European languages before asserting that the above mentioned underlying analogies are semantic universals in the coining of scientific metaphors. However, because science is a product of Western thought, it could be expected that scientific metaphors do not differ cross-linguistically. The results of previous rhetorical contrastive analyses would also support such an hypothesis: Vasquez Correa (1987) and Mage (1978) in EST and SST (Spanish for Science and Technology), Konečni (1978) in EST and Macedonian, and Sugimoto (1978) in EST and technical Japanese, all state that similarities exist in the type, amount, and manner in which information is conveyed in scientific discourse, hereby confirming Widdowson's hypothesis on the universals of scientific and technical discourse.

Pedagogical Implications and Recommendations

Although explaining teaching methods was not the purpose of this paper, a strategy that focuses on the process of comparison and activation of prior knowledge can be proposed. Assuming that medical metaphorical terms have been generally mastered in the students' L1 (but not in the L2), instructors might consider the following interrelated instructional points:

1. Strive to activate the learners' underlying prior knowledge by stimulating deep processing and schemata in order to enable them to relate new vocabulary to existing knowledge structures. Indeed, activating students'

preexisting knowledge helps them merge new information with old knowledge (Rumelhart, 1980) and, as Thompson claims (1986, p. 105), "understanding metaphorical language is the real instructional goal and the means to the goal is the thought process of comparison which relates the old to the new." For example, if the metaphorical expression "pig-tail catheter" is encountered, the instructor could activate his/her students' prior knowledge by asking them what different kinds of catheters they know.

2. Point out the similarity of the semantic transfer (i.e., of the metaphorical conceptual links) between the students L1 and the L2. In other words, underline the lexical enrichment of the technical language with respect to the general language (metaphorical meaning is derived from literal meaning) in both languages. It is precisely at this point that a real transfer of knowledge takes place between teachers who generally lack the conceptual network hidden behind the words or have only a hazy idea of the concepts, and students, who possess the scientific concepts in their L1. For example, the terminological meaning of the metaphorical expression "drawer test"² (a test used in orthopedics/traumatology to explore the stability and integrity of the knee ligaments) is very likely to be unknown to the ESP instructor, and the general meaning of the lexeme "drawer" may be unknown to the students. Since the same semantic transfer is used in Spanish for referring to this particular test (*prueba de la galleta*), the ESP instructor will simply have to explain to his/her students what a "drawer" is in general English, and the students, helped by their background knowledge, will be able to make the necessary semantic transfer. The same teaching technique could be applied to the French metaphorical term (used as such in MS and ME cardiology articles) *torsade de pointe*, which refers to a type of ventricular tachycardia.³
3. Actively involve the students in the "discovery process" of metaphorical meanings. As an old Chinese proverb, slightly adapted by Benjamin Franklin, says: "Tell me and I forget, teach me and I remember, involve me and I learn." By giving students time to think critically and respond, classroom interaction will become more enlightening for all concerned. The phytomorphical "family" of metaphors (branch, tree, trunk, root, stem) can simply be taught by underlining the relationship which exists between the anatomical structures and the concept of a tree in the common language.
4. Present metaphors in their natural habitat use contextual information to unlock their meaning: "A clear understanding of metaphors independently of context is impossible." (Bosch, 1984, p. 9). The context is obviously crucial (as it is in almost all language learning activities) if we want our students to quickly and efficiently unlock the meaning of the metaphorical expression "butterfly rash," — a sign typical of lupus erythematosus.

These suggestions lead to certain implications with respect to the role the mother tongue plays in such a situation. As was said before, comparisons with the L1 can be used to stress the similarity of analogy between L1 and L2 metaphorical lexis. A comparative analysis would show, as Widdowson (1979)

has already stated, that there is more in common between certain varieties in different languages than among different varieties in the same language. Therefore, lists of the most frequent patterns of underlying analogy along with some examples will prove helpful, especially at the graduate level where English is taught in the course of the students' specialization. Referring to the designing of a French reading course for economists and social scientists to Dutch-speaking students, Ulijn (1981, p. 264) says that:

"the inclusion in the course material of an index with specialized terms which have another meaning in general French would increase the possibilities of systematic lexical training."

On the other hand, Gläser (n.d., p. 14) notes that most textbooks on semantics do not include technical vocabularies. To her viewpoint, this is "a shortcoming since semantic processes affect the whole field of lexis of all registers."

Lastly, we can at this point reiterate Williams' advice to reading teachers (1985): examine your own cognitive strategies and apply a pragmatic, common-sense approach to the selection and invention of suitable exercise types which, we may add, should allow the students to mobilize their knowledge of the discipline and that of the foreign language in order to combine them with a view to effective understanding. The results, undoubtedly, would then be growth in reading ability.

Acknowledgments — are due to Dr. Abdel Fuenmayor and Dr. Jesús Gorroinda for their constructive suggestions and comments. This research was supported by grant No 260-86 from the *Consejo de Desarrollo Científico, Humanístico y Tecnológico (CDCHT)* of the University of the Andes and grant No S-1-1985 from the *Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICIT)*.

NOTES

¹Hutchinson and Waters (1981, p. 63) mentioned "silicon" as one of the most recent pieces of linguistic borrowing which, along with other terms and because of the spread of home computers, have become far more frequent in every day context as well as expressions such as "floppy disks," "memory capacity," "modems," and "interface." We can also mention the French words *logiciel* and *matériel* which have been coined lately to refer to computer "software" and "hardware."

²The drawer metaphor here is based on the movements of the knee and the kneecap.

³A *torsade* is a "twisted cord." By analogy, the peaks (*pointe*) of a *torsade de pointe* ventricular tachycardia are "wavy". These "waves" can be seen on the electrocardiogram.

(Received February 1990)

REFERENCES

- Akirov, A., & Salager, F. (1985). Difficulty analysis and reading comprehension: An experimental study with Venezuelan science students. *English for Specific Purposes Newsletter*, 94, 8–11.
- Alderson, J.C. (1984). "Reading in a foreign language: A reading problem or a language problem?" In J.C. Alderson, & A.H. Urquart (Eds.), *Reading in a foreign language* (pp. 1–21). New York: Longman.
- Alderson, J.C., & Richards, S. (1977). *Difficulties which students encounter when reading tests in English*. (Research and Development Report, 8) Mexico City: UNAM.
- Anders, P.L., & Bos, S.C. (1986). Semantic feature analysis: An interactive strategy for vocabulary development and text comprehension. *Journal of Reading*, 29(3), 610–617.
- Anderson, R.C., & Freebody, P. (1981). Vocabulary knowledge. In J.T. Guthrie (Ed.), *Comprehension and teaching: Research reviews* (pp. 77–117). Newark, Delaware: International Reading Association.
- Binon, R., & Cornu, A.M. (1985). The degree of systematization to define the relationship between general and functional language. In Perrin, M. (Ed.), *Pratiques d'aujourd'hui et besoins de demain* (pp. 25–47). Bordeaux, France: Université de Bordeaux.
- Boyd, R. (1979). Metaphor and theory change: what is a metaphor for? In R. Ortny (Ed.), *Metaphor and thought* (pp. 356–408). Cambridge: Cambridge University Press.
- Bramki, D., & Williams, R. (1984). Lexical familiarization in economics texts and its pedagogic implications in reading comprehension. *Reading in a Foreign Language*, 2(1) 169–182.
- Carbonell, J.G., Jr. (1981). *Metaphor comprehension*. (Technical report, Department of Computer Science) Pittsburgh, PA: Carnegie Mellon University.
- Carrell, P.L. (1983). Some issues in studying the role of schemata or background knowledge in second language comprehension. *Reading in a Foreign Language*, 1(2) 81–92.
- Carrell, P.L. (1987). Readability in ESL. *Reading in a Foreign Language*, 4(1), 21–44.
- Clarke, M.A. (1979). Reading in Spanish and English: Evidence from adult ESL Students. *Language Learning*, 29, 121–150.
- Cohen, A., et al. (1979). Reading English for specialized purposes: Discourse analysis and the use of students' informants. *TESOL Quarterly*, 13(4), 551–564.
- Cummins, J. (1979). Cognitive and academic language proficiency, linguistic interdependence, the optimum question and some other matters. *Working Papers on Bilingualism*, 19, 107–205.
- Cziko, G.A. (1980). Language competence and reading strategies: a comparison of first and second language oral reading errors. *Language Learning*, 30, 101–114.

- Gallais-Hamonno, J. (n. d.) Les emprunts reciproques de la langue de specialite et de la langue commune. Unpublished master's thesis, Oregon State University, Corvallis, OR.
- Gläser, R. (n. d.). *Emotive features in technical and scientific English*. Unpublished manuscript.
- Goffin, R. (1968). La terminologie multilingue et la syntagmatique comparée au service de la traduction technique. *Babel*, 14(3), 132-141.
- Graves, M.F. (1984). Selecting vocabulary to teach in the intermediate and secondary grades. In J. Flood (Ed.), *Promoting Reading Comprehension* (pp. 245-260). International Reading Association: Newark, Delaware.
- Hoffman, L. (1981). The Linguistic analysis and teaching of LSP in the German Democratic Republic. In J. Hoedt & R. Turner (Eds.), *New Bearings on LSP* (pp. 25-47). Copenhagen: UNESCO/ ALSIED.
- Hutchinson, T., & Waters, R. (1981). Performance and competence in English for specific purposes. *Applied Linguistics*, 11(1), 56-70.
- Irgl, V. (1987). The metaphor in the language of commerce. In L. Baten, A.M. Cornu, M. Delahaye, & J. Vanparijs (Eds.), *Beads or bracelet? how do we approach LSP?* (pp. 258-163). Oxford: Oxford University Press.
- Johnson, M., & Lakoff, G. (1980). *Metaphors and communication*. Trier: LAUT.
- Johnson, D.D. (1986). Journal of reading: a themed issue on vocabulary instruction. *Journal of Reading*, 29(7), 5-6.
- Kočourek, A. (1979). Lexical phrases in terminology. *Travaux de terminologie. GIRSTERM*, 1, 121-153.
- Konečni, K.E. (1978). Contrastive analysis of the rhetoric of EST and Macedonian. In L. Trimble, M. Trimble, & K. Drobnic (Eds.), *English for Specific Purposes: Science and Technology* (pp. 167-177).
- Lakoff, G. (1989). The invariance hypothesis: Do metaphors preserve cognitive typology? (Paper No. A-266). Linguistic Agency of the University of Duisburg (LAUD).
- Lakoff, G., & Johnson, M. (1980). *Metaphors we live by*. Chicago: University of Chicago Press.
- Laufer, B. & Sim, D.D. (1985). Taking the easy way out: Non-use and misuse of clues in EFL reading. *English Teaching Forum*, 23(2).
- Loots, M. (1987). Compiling a list of academically relevant words. In L. Baten, A.M. Cornu, M. Delahaye, & J. Vanparijs (Eds.), *Beads or bracelet? how do we approach ESP?* (pp. 264-273). Oxford: Oxford University Press.
- Lutjeharms, M. (1984). Testing reading comprehension: An example from German for academic purposes. In J.M. Ulijn, and A.K. Pugh (Eds.), *Reading for professional purposes: Methods and materials in teaching languages* (pp. 159-164). Leuven: Acco.
- Mage, T. (1978). Contrastive discourse analysis: EST and SST. In L. Trimble, M. Trimble, & K. Drobnic (Eds.), *English for specific purposes: Science and technology* (pp. 154-167). Corvallis, OR: English Language Institute.
- Morris, J.E. (1979). *Principles of scientific and technical writing*. New York.
- Nakamura, K. (1986). A practical procedure for developing students; aware-

- ness of English imports into language. *The ESPecialist*, 13, 19–24.
- Namenwirth, E. (1984). The importance of OGOS in reading French texts for Dutch speaking engineering students. In J.M. Ulijn, & A.K. Pugh (Eds.), *Reading for professional purposes: Methods and materials in teaching foreign languages* (pp. 159–164). Leuven, Belgium: Acco.
- Nelson, J. (1975). Readability: Some cautions for the content area teacher. *Journal of Reading*, 21, 620–625.
- Nelson-Herbert, J. (1986). Expanding and refining vocabulary in content areas. *Journal of Reading*, 29(7), 626–632.
- Nutall, C. (1982). *Teaching reading skills in a foreign language*. London: Heinemann.
- Pelletier, S. (1982). Recherches de neologismes dans le domaine de l'alimentation des collectives. *GIRSTERM*, 1, 73–111.
- Pica, P. (1981). Quelques remarques à propos des problèmes posés par l'élaboration d'une théorie propre au traitement des languers de spécialité. In J. Hoedt & R. Turner (Eds.), *New bearings on LSP* (pp. 25–47). Copenhagen: UNESCO/ALSED.
- Qvistgaard, J. (1981). La place des langues de specialte dans l'enseignement des langues vivantes. In J. Hoedt & R. Turner (Eds.), *New Bearings on ESP* (pp. 107–131). Copenhagen: UNESCO/ALSED.
- Rosler, D. (1985). *Transporting metaphors from 1 to 2: Implications for an intercultural approach to foreign language teaching* (Paper 116). Linguistic Agency of the University of Duisburg (LAUD), Duisburg, DDR.
- Rumelhart, D.E. (1980). Schemata: the building blocks of cognition. In R.J. Spiro, C. Bruce, & W.F. Brewer (Eds.), *Theoretical issues in reading comprehension* (pp. 6–26). Hillsdale, NJ: Erlbaum.
- Salager, F. (1977). *Optimum foundations of English technical literature and their applications to the comprehension training of non-english speaking scientists*. Unpublished doctoral dissertation, Austin, TX: University of Texas.
- Salager, F. (1983). The core language of English medical literature: Classificatory framework and rhetorical foundations. *Reading in a Foreign Language*, 1(2), 5–18.
- Salager, F. (1985a). Specialist medical English lexis: Classificatory framework and rhetorical functions. *EMP Newsletter*, 2(2), 5–18.
- Salager, F. (1985b). Syntax and semantics of compound nominal phrases in medical English literature: A comparative study with Spanish. *English for Special Purposes Newsletter*, 95, 6–12.
- Silberstein, S. (1987). Let's take another look at reading instruction. *English Teaching Forum*, 25(4), 28–35.
- Sugimoto, E. (1978). Contrastive analysis of English and Japanese technical rhetoric. In L. Trimble, M. Trimble, & K. Drobnic (Eds.), *English for special purposes: Science and technology* (pp. 177–198). Corvallis, OR: Oregon State University.
- Thompson, S.J. (1986). Teaching metaphoric language: An instructional strategy. *Journal of Reading*, 30(2), 105–109.

- Ulijn, J.M. (1980). L'apprentissage de la lecture du français scientifique et la langue maternelle. *Frazosischheute*, March, 15-33.
- Ulijn, J.M. (1981). Reading in a foreign language for professional purposes. *System*, 9(3), 259-266.
- Ulijn, J.M. (1984). Reading for professional purposes: Psycholinguistic evidence in a cross-linguistic perspective. In J.M. Ulijn & A.K. Pugh (Eds.), *Reading for Professional Purposes: Studies and Practices in Native and Foreign Languages* (pp. 148-159). London: Heinemann.
- Ulijn, J.M. (1985). The scientific and technical register and its cross-linguistic constants and variants. *UNESCO/ALSED Newsletter*, 8(2), 148-158.
- Ulijn, J.M. & Kempen, G.A.M. (1976). The role of the first language in second language reading comprehension: Some experimental evidence. *Proceedings of the Fourth International Congress of Applied Linguistics*, 1, 495-507.
- Varantola, K. (1985). The turning of laymen students into specialist translators. In M. Perrin (Ed.), *Pratiques d'aujourd'hui et besoins de demain* (pp. 343-351). Bordeaux, France: University of Bordeaux.
- Vasquez Correa, F. (1987). *A comparative study of the rhetorical structure of the discussions sections in English and Spanish medical articles*. Unpublished doctoral dissertation. Birmingham, England: Aston University.
- Voraček, J. (1987). ESP superstructure and microlanguage. *The ESP Journal*, 6(1), 53-56.
- Walsh, V. (1982). Reading scientific texts in English. *English Teaching Forum*, 20(3), 24-28.
- Weiss, R. (1984). Vocabulary, syntax and cohesion in reading comprehension. In A.K. Pugh, & J.M. Ulijn (Eds.), *Reading for professional purposes: Materials and methods in teaching languages*. Leuven, Belgium: Acco.
- Widdowson, H. (1979). *Explorations in applied linguistics*. Oxford: Oxford University Press.
- Williams, R. (1984). A cognitive approach to English nominal compounds. In J.M. Ulijn, & A.K. Pugh (Eds.), *Reading for professional purposes: Studies and practices in native and foreign languages* (pp. 146-154). London: Heinemann.
- Williams, R. (1985). Teaching Vocabulary recognition strategies in ESP reading. *The ESP Journal*, 4(2), 121-131.