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TECHNICAL METAPHOR AND THE CREATION OF FIELD
A metáfora técnica e a criação do campo

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Abstract:
A considerable piece of research into the construction of knowledge in specialised fields has been carried out within the paradigm of systemic functional linguistics (Wignell, Martin and Eggins, 1987; Eggins, Wignell and Martin, 1987; Halliday, 1987, 1988; Halliday and Martin, 1993). This paper attempts to represent an extension of that body of research into the electronics and telecommunications field. Drawing on White's distinction between the technological and the scientific, it examines how the discourse of these disciplines construct specialised knowledge through the creation of technicality (White, 1998). With this purpose a representative corpus of data has been analysed. The analysis shows that these disciplines favour elaborately pre-modified nominal groups built from items drawn from the vernacular lexicon and the acronyms derived from these complex groupings. It is suggested that there is an operational and social purpose underlying the communication purpose when these disciplines choose the lexico-grammatical resources in order to construct the phenomenon of their 'non-commonsense' ideational domain, and that such lexis provides for a direct connection between the specialist ideational domain and that of vernacular experience.

Key-words: *terminology; technical discourse; lexical metaphor: grammatical metaphor.*

Resumo:
Várias pesquisas sobre a construção do conhecimento em campos especializados têm sido realizadas dentro do paradigma da lingüística sistêmico-funcional (Wignell, Martin & Eggins, 1987; Eggins, Wignell & Martin, 1987; Halliday, 1987, 1988; Halliday & Martin, 1993). Este artigo busca ampliar esse corpo de pesquisas, focalizando o campo da

eletrônica e das telecomunicações. Com base na distinção de White entre o tecnológico e o científico (White, 1998), o artigo investiga, através da análise de um corpus representativo, como o discurso dessas disciplinas constrói o conhecimento especializado, através da criação da tecnicalidade (technicality). A análise mostra que essas disciplinas favorecem grupos nominais pré-modificados elaboradamente, construídos a partir de itens retirados do léxico vernacular e dos acrônimos derivados desses agrupamentos complexos. Sugere-se que há um propósito operacional e social subjacente ao propósito de comunicação quando essas disciplinas escolhem os recursos léxico-gramaticais para construir o fenômeno do seu domínio ideacional "não-senso-comum", e que tal léxico fornece uma conexão direta entre o domínio ideacional especializado e o domínio da experiência vernacular.

Palavras-chave: *terminologia; discurso técnico; metáfora lexical; metáfora gramatical.*

1. Introduction

New technological fields are constantly being developed, each with its specific lexical structures, which are increasingly more specialised and barely related to other disciplines, frequently giving rise to the setting up of real microlanguages. Such is the case for digital systems (electronics) or telecommunications, which have recently been incorporated into the engineering industry as new disciplines.

Scientists use several lexico-grammatical resources in order to construct their field of knowledge, that is, their ideational domain. Electronics discourse is concerned with physical systems. In particular it is concerned with the quantitative behaviour of such systems. To facilitate understanding and analysis of such systems, several resources have been evolved. In addition, the communicative purpose of technological discourse is functional in nature, since technology is concerned with modus-operandi machinery and engineering application of scientific theory. As a matter of fact, technological products, which are the result of scientific investigation and explanation, have an impact on almost all areas of our daily lives. The text-book for engineers *Digital Design*, for instance, is replete with actual commercial component descriptions "whose function and use in a system context naturally extends the fundamentals in the previous chapters" (1994:xv). In the Introduction to the book *Power Electronics*, we read that the intention is to give "a cohesive presentation of power electronics fundamentals for applications and design in the power range of 55 kW or less, where a huge market exists and where the demands for power electronics engineers is likely to be." Several examples which account for the functionality of technical discourse can also be found in telecommunications. In addition, global communication is becoming more and more intensified through electronic media facilitating trade contacts and international projects, thus approaching the mass-media to technical discourse.

This operational purpose underlying the communicative purpose of technical discourse is reflected in the selection of the lexico-grammar resources when these technological fields construct the phenomenon of their "non-commonsensical" ideational domain. White (1998) has already shown some differences in the discourse of science and technology when construing their own ideational domains. As a rule, science seeks to construe the world in terms of a system of *valeur* where "category membership is determined by systematic, stable, explicit, verifiable and theoretically motivated criteria" (White, 1998: 288). In contrast, as Wittgenstein, Labov and Rosch, among others, have demonstrated, vernacular categories are frequently unsystematic, contingent and *ad hoc* and may be determined by family resemblance and prototypical examples, and often have fuzzy boundaries. (Wittgenstein, translated by Auscombe 1978; Labov *et al*. 1973; Rosch, 1973, 1975; Taylor, 1989). As P. White has suggested this commitment to establishing absolute, "clearly bounded categories" defined by "necessary and sufficient features" (Aristotle, translated by Tredennick, 1993) is clearly reflected in scientific definitions (White, 1998: 288). These are typically concerned to specify both the superordinate category to which the term in question belongs and the necessary and sufficient criteria by which it enters into the taxonomy. Thereby, the categorisations that inform scientific terminology are clearly distinctive from those of everyday experience. From this point of view it may be said that scientific terminology is at odds with the vernacular lexis.

By contrast, technological categories are not usually defined by necessary and sufficient features but mainly focus on functionality and social purpose. Categorisations of technological discourse have, therefore, more in common with those of the vernacular than the scientific.

These features are clearly reflected in the way both discourses construct their terminology. Halliday, in his discussion of Chaucer´s Treatise on the Astrolabe (Halliday and Martin, 1993) saw a clear distinction between “concrete technological terms” and abstract scientific terms. Picking up on this distinction, White (1998) has suggested that there is a tendency in scientific text to use a higher number of neologisms –generally derived from Greek and Latin- than in technological texts, whereas technology favours vernacularly derived lexical items. To a similar conclusion arrived the author in his study of the construction of technicality in the discipline of plastics (González & Val, 1993). Even when science uses vernacular words it puts them to a different use. That is, science takes the terms, but redefines them, thereby assigning them a different *valeur*. As Martin said, phenomena classified formally and scientifically “often already have vernacular names and vernacular classifications. Much scientific taxonimising, then, is a process of renaming in order to reclassify the vernacular” (Martin, 1993: 143). In this sense, scientific terms “challenge vernacular experience” (White, 1998). Technology, however, uses such terms in a more prototypical or canonical way, thus connecting vernacular experience to the specialist ideational domain. As White suggests, the lexicogrammar in technical texts acts not to “challenge or displace the vernacular system of valeur, but to extend it” (White, 1998: 267).

Drawing on this distinction between science and technology, this paper attempts to represent an extension of that body of research into the electronics and telecommunications field. We will particularly focus on the creation of English terminology in the discipline of digital systems, since it is a new technological field. The data for the analysis consisted of texts such as processes, material descriptions, functions systems etc. from specialised books, catalogues, specialised dictionaries and thesaurus, journals and complementary material from these disciplines, though some examples from other technological fields have also been included to illustrate some point.

It is argued that these technological disciplines, unlike traditional science that favours morphologically non-native forms derived from Greek and Latin, favours elaborately pre-modified nominal groups built from items drawn from the vernacular lexicon and the acronyms derived from these complex groupings, mainly through lexical metaphor, and that these choices, as White suggests, are oriented towards social, functional and communicative purposes, thus providing for a direct connection between the specialist ideational domain and that of vernacular experience (White, 1998).

In analysing the terms we have taken into account:

- whether we can identify patterns of analogy with the vernacular underlying technical lexis and, in this case, what type of analogy;
- whether the term is a single-word form or a nominal group constituent, typically a nominal of the type Classifier^Thing structure;
- whether the term involves word forms from the vernacular lexis or neologisms (usually from Greek and Latin);
- whether the term is an acronym with full or partial lexical form.

2. Technicality

Science involves trying to understand the world by looking at it through a technical perspective, that is, turning commonsense understanding into technical understanding. It does this by creating a technical language, arranging those terms taxonomically and then using that framework to explain how the world came to be as it is. Martin

(Halliday & Martin, 1993) has demonstrated how much of the specialist lexico-grammar of scientific language acts to establish experiential categories that reconstrue and hence re-valeurise commonsense experiences of reality, a syndrome which he has termed *technicality*. Martin defines technicality as "the resource a discipline uses to name and order its 'emic' (*meaningful or relevant*) phenomena in a way distinctive to that field. Through technicality a discipline establishes the inventory of what it can talk about, and the terms in which it can talk about them" (Wignell, Martin and Eggins, 1993: 383). That is, the technicalising process involves both the creation of terms and the organisation of such terms into scientific taxonomies.

In the language of sciences the functions of classifying and explaining natural or artificial phenomena necessarily involve a shift from the everyday use of language to the technical. *Naming a thing always implies a classification and the same thing with the same name can be classified differently depending on who is classifying* (Martin 1993: 137). People in the street would probably classify the topic "food" into such things as vegetables, fish, oranges, etc., attending to prototypical, or more familiar, features. A scientist, however, would probably classify food attending to other characteristics such as glucose, lactose and other components and chemical reactions. The definition of "food" also varies depending on the field of application. Thus, in the Longman Dictionary of Contemporary English the word food is defined as: *things that people and animals eat, such as vegetables or meat*, whereas in the Academic Press Dictionary for Science and Technology, we read:

> *Food; biology*. "A general term for any nutrient that is taken in or ingested by an organism and used by it to produce energy, build and repair tissue, and regulate body process."

Scientific categorisation of food, then, would include substances such as lactose, glucose, iron etc, which do not enter in the more comonsense everyday classification of food. That is, under the vernacular system of *valeur* (in Saussure´s terminology) the term is defined prototypically by reference to items such as meat, oranges etc. which belong to everyday experience, whereas science favours cohyponym-to-cohypony and hyponym-to-superordinate relationships to articulate its taxonomic space. As Martin points out, in science the move from the describing to the classifying "is a move from talking about things to talking about processes" (Martin, 1993:137).

The technicalising process has a field-creating function (Martin 1993). Field, for systemicists, refers to the way the experiential world is divided up into institutional areas of activity. It is closely linked to the experiential meaning in the grammar, and realised through patterns of transitivity and lexis (for further discussion see Halliday & Hasan, 1989 and Halliday, 1985) A characteristic of all fields is to name the entities concerning them. Thus, each field develops its own vocabulary, and we can easily recognise the field from just looking at the lexis. However, fields do not only name the things that interest them, they also order them taxonomically. A technical term, then, refers, not to a single word, but to a precise taxonomy of terms used to explain scientifically processes and relations. The creation of taxonomic relationships among entities is realised thanks to the resources of grammar. As Halliday points out, "we cannot separate these (*grammar and words*) from each other; it is the total effect of the wording -words and structures- that the reader is responding to, and technical terms are part of the overall effect." (Halliday, 1989: 14-15). Technical terms, then, cannot be defined in isolation: each one has to be understood as part of a larger framework, and each one is defined by reference to all the others since creating a technical term is in itself a grammatical process.

3. The process of naming

Technicality, then, as explained above, refers to the use of terms or expressions (generally nominal group constituents) with a specialised field-specific meaning, that is, the term will not enter into the same taxonomic oppositions as in the vernacular language. In order to create their specific terminological fields, science and technology draw on the following resources (Martin, 1993, White, 1998):

1. The use of words which already have a vernacular meaning but have been assigned a new *valeur* in the specific field. This is normally done through lexical metaphor and distillation (see Halliday & Martin, 1993) Some words are used technically in other technological fields, but with a different meaning. The word *beam*, for instance, is used in electronics and construction to name different things. Some technical terms are words which are indexical of that field; i.e. unlikely to have a vernacular or other field usage. For example, *polyethilene, polimerisation.*

2. The use of neologisms. In scientific and technical English, neologisms are clearly derived from Greek and Latin.

3. The use of nominal group compound, with a Classifier^Thing structure. These compounds can be derived from the vernacular or through implication sequences.

4. The use of nominalisation. Halliday (1985) has shown us how our meaning-making potential is enlarged when the verbal resources normally used for one function -such as nouns for things- are deployed also for another -such as nouns for processes- which thereby become semiotically both in some ways thing-like, in others process-like, thus constituting a new semiotic hybrid reality, a phenomenon which he calls grammatical metaphor.[1] The use of nominalisation is a typical feature that English language uses to create technical terms, since in order to organise and classify with language, it is necessary to turn phenomena into things or nouns (Martin, 1993: 145).

In the following example the technical term (*lateral voltage drops*) is introduced as a verb (process: *to drop*), and then immediately treated as a noun (thing: *lateral voltage drops*):

- ...the voltage *to drop*. *Lateral voltage drops* in *the p2 region*....will result in *current crowding* during *the turn-off.*

In addition, technical terms, as we shall see later, can be derived through implication sequences.

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[1] Carol: mal-redifido e muito longo!!

Whether these words are borrowed from the vernacular language or the language of another field, once they are set up as technical terms within a specific field, they acquire a meaning specific to that field (Martin, 1993).

The analysis of terms being set up as technical within the electronics and telecommunication field reveals that they have been derived in a number of ways:

1. Some technical terms are a single nominal. They are words which already have a vernacular meaning, such as *chip*, *mouse*, *flip-flop,traffic*, *scanner...*These types of technical terms tend to be the names for things where there is a connection between the vernacular and the technological application of the term.

2. Some technical terms are established vernacular lexical items in nominal groups where specific meaning is provided by means of premodification*: edge-triggered J-K flip-flops, the Non-return to Zero invert-on 1s(NRZ1).*

3. Some technical terms are neologisms. Non-vernacular terms are clearly derived from Greek or Latin: *pulse, plexus, multiplexor, telex, television, telecommunications, camera, oscilloscope.*

4. Some technical terms are nominal groups where the head is of vernacular origin but premodification includes some clearly non-vernacular element*: pulse modulation, metastability resolution time, current spike, Digital phase-locked loop (DPL).*

5. Some technical terms are nominal groups, where both the head and some element of the premodification are of non-vernacular origin: *random memory , silicon-controlled rectifier, Parity-check matrix, Floating-point arithmetic...*

6. Some technical terms are nominal groups where both the head and premodification are of non-vernacular origin: *Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM), Metal Oxide Semiconductor(MOS).*

7. Some technical terms are acronyms and abbreviations: PC, PAM, CD-ROM.

The analysis shows that:

- Electronics favours terms derived from the vernacular mainly through lexical metaphor, both in its single and complex forms;
- Such terms are used as an analogous extension of the vernacular and convey a functional meaning;
- The setting up of technical terms (*technicality*) in these fields is typically done through definitions and further elaborated through implication sequences (cause/effect. sequencing etc). As a result, the definition structures act to identify the functionality of items.

4. Extending the vernacular: Technical metaphor

It is claimed here that the main source of technological terminology for the specific fields studied is drawn from the vernacular through lexical metaphor and that, though categorisations that inform technical terminology are distinctive from those of everyday experience, technical metaphors, rather than displacing the vernacular, act as an extension of the vernacular language, focusing on functionality and social purposes.

A glance at a glossary of computing terms, for instance, will show that lexical metaphor is the single most productive source of new terminology in the computer language (e.g.*: bit, byte, bug, menu, window mail...)*. It is obvious that there is a clear connection between the vernacular and the technological application of the term. For instance, the idea of a *menu* in computer terminology is logically related to the more common dinner menu. In the Applesoft BASIC manual we read "*Computerniks call this list of numbered descriptions a "menu". It works like a menu at a roadside café. If you want scrambled eggs with hash brown potatoes, toast, jelly and coffee you can just say, "I´ll have a number 5"* (p 17).

The same semantics can be observed operating generally within basic technological terms derived from the vernacular. For example, the technological use of the term *memory* involves a metaphor of storing and retrieving information in comparison to the human mind. Furthermore, computer memories come in "sizes": small, medium, large, compact, huge. A similar relationship exists between the vernacular *traffic* –the movement of vehicles- and its technical counterpart *traffic*, which in the specialist domain of telecommunications refers to the movement of signals through the telecommunications network. The technological meaning of *dumb*, for instance, when applied to machines or systems is identical to the vernacular meaning. There is not much difference between a *dumb terminal* (*a visual display unit used to display information and which has little or no intelligent functions),* and a dumb person.

In all these cases technology uses an everyday, popular lexical item. Obviously, the categories referenced by such terms are not the same as those referenced by the terms in vernacular contexts, but it can be observed that technology does not replace or displace the original everyday meaning of the term, but rather projects it into a technical context. This is mostly done by broadening the polysemous variation of the vernacular lexical item through lexical metaphor. Thanks to the polysemous nature of much vernacular lexis, different phenomena may be referenced by the same lexical item when there is some salient point of similarity. Thus the polysemous range of the word *neck* extends to include the neck of a person, the neck of an animal and the neck of a bottle. As Glässer mentions (apud Salager Mayer, 1990: 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".*

This polysemous extension is also observed in metaphors that name parts. For example *H-beams, I- beams* (construction) and *C-clamps* (mechanics) are similar in shape to the letters they are named after. A *tree network* and a *mesh network* (telecommunications) represent spatial configurations which are similar in shape to a tree or a mesh. Therefore, the relationship between these technological terms and the vernacular lexis is of the same order as that between the neck of a person and the neck of a bottle.

The functionality of technical metaphor is clearly seen in many terms indicating function. Thus, the *guard rings* in a pn-junction diode help to prevent *the depletion layer boundery* from having too small a radius of curvature. The term *beveling* refers to *topological contouring* used to minimise *field crowding* due to depletion layer curvature. The relationship between these technological terms and the vernacular lexis is further enhanced with the use of visuals.

Fig. 20-12 from *Power Electronics*: shows a pn-junction diode with guard rings. None or very little difference can be observed if we compare this graph with, for instance, a typical map showing depletion layers or boundaries or guard rings.

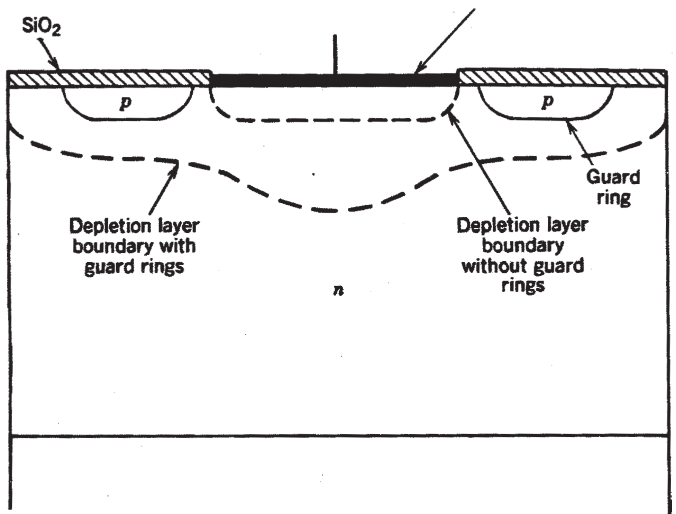

Fig. 20: A pn-junction diode with both an n-type drift region and guard rings to improve voltage capabilities. The guard-rings help to prevent the depletion layer from having too small a radious of curvature. (Mohan et al, 1995: 530)

Similar polysemous extension can be observed in those metaphorical terms that describe action. The purpose of this kind of technical metaphor is to help the reader understand or reproduce the action named. The term *choke*, for instance, (Butler, 1986: 143), when used in the context of engines, is an example of a metaphor denoting action. To choke the engine, the operator pushes a lever which is attached, via cable, to a butterfly valve (again a metaphor denoting parts), pivots on an axis, covering the throat (again a metaphor) of the carburator, and thereby cutting off the air flow. The verb *to choke*, then is a verb that signifies a series of mechanical events, but in relating these events to a more familiar kind of *choke*, the term reduces the events to essentials. Similar semantics operates in many technical terms in the electronics domain, such as *scanning, digitalising, squaring up, debugging, crowbarring*. All of them help the reader understand a series of operations, processes and actions. For instance, the process of converting an item of data or speech signals into digital form for transmission has been reduced to the single term *Digitalising*. The term *interlaced scanning* refers to a technique used in television broadcasting to reduce the signal bandwidth.

These examples show that the abstracting function of the metaphor, keeps readers from being distracted by mechanical sequences. By cutting off the unessential actions, the epitomising action of the metaphor also suppresses correspondences of space, so that the readers can understand the *what* rather than the *how*.

Similar polysemous extension can be observed throughout the lexicon. Thus, *to scan* is extended to name a device –*scanner*- which rapidly produces a copy of a document. *To display* is extended to *a display unit*, *to counter* to *a counter*, a device which *records a number of events to assist in the control and coordination of a logical process*. The term *routing* is an extension of the noun *route* and refers to the operation which takes place to connect two users. Similarly, *networking* has been derived from *net* and *work* and refers to the techniques and principles concerned with *maintaining a system of communication in which users in different locations are able to communicate with one another*. The action of connecting two users is called *routing. A squaring circuit* "*squares up*" the transfer characteristics of the LS-TTL circuit, etc.

It has to be noticed that in all such expressions the process (verb) is realised by the nominal element, the Range, while the verb itself is lexically empty. It would be difficult to express through the verbal group the meanings of specificness, quantification and quality present in many technical terms, such as *the turn-off, fanout, latch up, flip-flops, floating-point arithmetic, division overflow* and many others. In all these cases there has been a transcategorising (Halliday, 1998) of processes and qualities into nouns, relators into verbs etc., with resulting semantic junction.

The extension of vernacular lexis is of more conceptual nature when applied to models. Models are used to explain the structure and function of a relatively complex device. Correspondences created by models represent a conceptual mapping (Butler, 1986) which readers can use to predict the existence and function of various parts. Butler says that describing the way a plane wing operates as an *airfoil* can be used as a technological model to describe the way sailboats use *airfoils* (Butler, 1986: 144). Similarly, a number of metaphorical terms can be derived from a model. For instance, when we talk about *electricity* using the image of a fluid, we are using it as a model for our conception of electricity. However, when we speak of the "rate of flow" of an electrical current we are using metaphorical language (e.g. *flow* = quantity of electricity, resistance, condenser, etc.).

Most technological terms belonging to nominal groups, that is, terms in which the Head is sub-classified through pre-modification, have a similar lexical constitution and are directed towards the same communicative objective. They are typically derived from items drawn from the vernacular lexicon, both in their Head and in their pre-modification: *Edge-Triggered J-K Flip-Flop, The Non-Return to Zero Invert-on-1s, Trunk Exchanges, gate beam tube.*

A related sub-type of elaborated term uses common vernacular terms to establish reference to the specific technological category. The Head of such terms often has highly generalised reference to, for example, some location, area or field *(local area network, National area network, Electro-magnetic field, n-type drift region...*), or to some means or process or system (*optical fibre transmission system, central processing unit*) which are also derived from our everyday experience.

As Martin points out (1993), this naming process makes quite explicit that the term is being set up as technical, thus "...giving a field-specific gloss to phenomena which may be known as something else in another field or in folk taxonomies." (Martin, 1993: 149). The use of technical metaphor has, therefore, a communicative and functional purpose, since the lexical metaphor, by manipulating time and space, is mainly used in technical writing "to help readers perform certain physical and mental operations" (Butler, 1986: 144). All these examples express a unitary concept, idea or phenomenon in an economical, concise, clear and condensed way, corresponding to what Boyd (1962) has called "theory constitutive metaphors". Their function is to offer a new technical terminology. In this sense technical metaphors differ from emotive or expressive metaphors which are used to express feelings, plans, goals, casual structures, functional attributes, but almost never about descriptive properties and object identity (Carbonell, 1981 apud Salager Meyer,1990: 150).

5. Acronyms

The second primary source used in the construction of terminology in the technical fields examined is the use of acronyms and abbreviations. Acronyms and abbreviations occur widely throughout all discourses, particularly in scientific and technical discourses. Halliday states that both acronyms and technical terms are commonly used in scientific discourse to condense information, but whereas "acronyms compact information on the expression plane technical terms compact information on the content plane" (Halliday, 1993:29). However, the underlying semantic functionality of the various technical specialist vocabularies is also manifested in the ability of technical language to incorporate acronyms to its lexicon as independent, full lexical forms with at least some, or all, of the features of the nominal group they stand for. That is, acronyms in technical language differ in the way they occur and in the way they are used.

Acronyms are formed by combining the first letters of complex nominal group forms. All acronyms begin as abbreviations, as a way of "speeding up the expression plane...acronyms function as reductions on the expression plane; they make it quicker to write or say a wording" (Halliday & Martin 1993: 229). This speeding up is not however the only possible lexicogrammatical outcome of acronymisation (White, 1998). Once the complex nominal group has been reduced to a single word-like form, it is possible for that reduced form to lose its status of abbreviation and to become a word in its own right, replacing the original complex form as the name of the item in question. This potential of full lexicalisation has been realised in terms such as *Laser* (light amplification by stimulated emission of radiation) PC (personal computer), *Modem* (modulator/demodulator), DOS, BASIC, CD- ROM, ABS and many others.

Most of these terms achieve this full or partial lexicalisation without any reference to the original complex nominal and speakers use them without knowing or needing to know that they are derived from complex nominals (e.g. .*RAM*, *CD-ROM*). Such terms have a "valeur" within the lexicon *which the speaker can access without a knowledge of the original complex nominals from which they have been derived (*White, 1998: 280). This tendency towards lexicalisation is strongly manifested in the technical domains studied and is reflected within the lexicogrammar in a number of ways.

For instance, when first mentioned, the full form comes first, followed by the acronym in brackets. The full form is never mentioned in the subsequent texts:

- A *digital phase-locked loop* (DPLL) is an analogue/digital circuit that can be used to recover a clock signal from a serial data stream. The DPLL works only if the serial data stream contains enough 0-to-1 and 1-to-0 transitions to give the DPLL "hints" about when the original clock transitions took place. With NRZ-coded data, the DPLL works only if the data does not contain any long, continuous streams of 1s or 0s. (Digital design)

However, very often the acronym is presented first, with the full form following in brackets:

- PROM (programmable read-only memory)

One striking feature of the electronics domain examined is the high number of independent lexicalised acronyms, that in many occasions have not been previously defined:

- The CPU in ring and bus topologies can be located anywhere in the network, making for truly decentralised processing, whereas it controls every operation in a star network. In contrast to LAN suppliers, the effort of PABX suppliers has been placed, for the main part, on replacing electromechanical systems with modern, electronic PABXs where the customer's requirements have been almost exclusively for voice-only systems. (telecommunications)

- Modern UPSs normally use the PWM dc-to-ac inverters...

When the full form is not provided it is because the writer assumes the expert reader may have the intertextual knowledge required to provide the full form of the term or he/she knows the full form by recalling other texts where the elaborated form is provided. Within the electronics and telecommunications texts, a much higher proportion of acronyms achieve independence of the full form they initially acted to name. They freely occur without the full form present at any point in the text:

- The "DD" in the name Vdd" refers to the drain terminal of a MOS transistor. This may seem strange, since in the CMOS inverter Vdd is actually connected to the *source* terminal of a PMOS transistor. However, CMOS logic circuits evolved from NMOS logic circuits, where the supply *was* connected to the drain of an NMOS transistor through a load resistor, and the name Vdd" stuck. Also note that ground is sometimes referred to as "Vss" in CMOS and NMOS circuits. Some authors and circuit manufacturers use Vcc" as the symbol for the CMOS supply voltage, since this name is used in TTL circuits, which historically preceded CMOS. (Digital Design)

- The safe operating area (SOA) of an MCT...

Acronyms are freely used instead of the full lexical form they stand for in linguistic functions such as comparison, classification or measurement:

- A normally *–on JFET* is very similar to the *MOSFET* as far as its switching characteristics are concerned
- The *i-v* characteristics of a normally –off FCT are similar to those of a BSIT except that....
- At present MCTs have *dv/dt* ratings of 500-1000 V/ms

The presence of these acronyms can be explained in terms of communicative functionality and practical reasons, though surely they were first incorporated in standardised terminological banks as longer nominals. The independent acronym forms are preferred because within technological discourse it is the acronym itself, rather than the underlying complex nominal, which is the primary lexical item, the primary form operating within the lexicon to reference the category in question. Since it represents the preferred name for the category, the acronym, rather than the underlying elaborated form, will be used within the text as a full lexical form. That the acronym is a word in its own right is also manifested in the use of the upper cases and in that they can be used as plural, typically with a small 's' (MCTs), or with some prepositions (an *-on JFET*, an *–off FCT*). Even occasionally the pronunciation of the acronym is provided by the authors. A look at a technical dictionary of Electronics will show this potential of lexicalisation in the field studied. Terms such as CCR, CCITT, CEEFAX, and many others appear as first entry followed by the full form.

In addition, acronyms behave as nouns rather than as abbreviations when they are into noun-like processes within the nominal group. Therefore acronyms can act as Classifiers in expanded nominal groups as in the following examples:

- MOS transistor; floating-gate MOS transistor; CMOS (Complementary Metal Oxide Semiconductor) NMOS (Negative Complementary Metal Oxide Semiconductor).

- ROM (read-only memory; RAM /random access memory); PROM (programmable read-only memory); EPROM (erasable programmable read-only memory); EEPROM (electrically-erasable programmable read-only memory), etc.

A good example of full lexicalisation is the term EBCDIC which is pronounced as ébbseedik´ and is the contraction of *extended binary coded decimal interchange code*, a code much used by IBM and offering 256 unique 8-bit character combinations.

Acronyms can also act as the Heads of premodified nominal groups, as the following examples can illustrate:

- *packed- BCD*

- *PWM-SI (pulse-with-modulated voltage source inverter) diode rectifier*

- *square-wave VSI* (square-wave voltage source inverter

In addition, they can act as Heads of nominal groups which enter into further recursive process of acronymisation:

- Most of today´s PROMs are actually EPROMS housed in inexpensive packages without quartz lids, these are sometimes called one-time programmable (OTP) ROMs.

As White suggests, the shift from an extended nominal group to a single word can be expected to have semogenetic consequences (White, 1998). The single-word form or acronym seems to be, in principle, more stable than the complex, expanded nominal group from which it is derived. That is the case of *Laser*, RAM or CD-ROM. Even if this stability may be limited to the text in which the acronym occurs, "it is nevertheless a semantic outcome" (White, 1998: 285). When the acronym operates inter-textually and begins to achieve lexical independence, "then the sense of stability and salience attached to the item it references is enhanced." The upper-case form also acts to signal a connection with the complex nominal form from which the acronym was derived. That complex nominal term typically involves categories drawn from the vernacular system of *valeur*. Technological acronyms, in this sense, are specialist terms which are self-defining. The reader familiarised with the content simply infers the underlying meaning of the full form.

The lexicalising acronyms of technology, then, provide for new, unfamiliar single-word forms with some of the qualities of basic terms and at the same time provide for a connection through the underlying full form "to established, familiar, vernacular categories. They are thus well suited to the task of extending vernacular reality" (White, 1998: 287).

6. Neologisms

Most basic, simple nominal forms are neologisms borrowed from Greek and Latin. Such as *electronics*, *telecommunications*, *electricity*, *pulse*, *modulation*, *plexus*, *syncronous*, *digital*, *analog*, and many other words formed with suffixes or preffixes such as *tele-*, *multi*, *-plexus*, *–pulse*... Obviously, new technology is based on terms that previously existed in classical science but they have been assigned a new meaning.

Neologisms occur most frequently in nominal groups where the Head is of vernacular origin but premodification includes some clearly non-vernacular element: *Silicon-controlled rectifier*, *Complex polyurethane moulding, pulse modulation, metastability resolution time, current spike, Digital phase-locked loop (DPLL)*, *Parity-check matrix*, *Digital phase-locked loop…*

In a few Nominal groups both the head and premodification are of non-vernacular origin: *Pulse Amplitude Modulation (PAM)*, *Pulse Code Modulation (PCM)*, *Metal Oxide Semiconductor (MOS)*, *Time division multiplex system (TDM)*, *Binary-coded decimal (BCD).*

7. Creating field

As it was commented on earlier, once the phenomenon is named the second stage is to assign to each term its field-specific meaning

(Martin, 1993). This is done by defining the term. Defining a term is a process analogous to naming. Just as a name identifies a person, a technical name identifies some phenomena. This is normally realised in the grammar through the roles of token and value (Halliday, 1985; Wignell, Martin and Eggins, 1987).

Halliday (1985: 115) points out that the thing that is doing the identifying can specify the identity of the target thing in one of two ways: (a) by specifying its form, how it is recognised; (b) by specifying its function, how it is valued. These two sides to an identifying relationship give the two grammatical functions of token and value. Halliday assigns the value function as realising the "meaning, reference, function, status, role", and the token function as realising the "sign, name, form, holder, occupant". The movement is from commonsense to technical.

Example:

A computer	is	an *electronic device* (that processes information)
(Token)		(Value)
Stress	is	the force inside a body resisting deformation
(Token)		(Value)

The elaboration of technical terms can be further realised in a variety of other grammatical ways, such as embedded relative clauses.

The definitions of the electronics and telecommunications domain tend to be very descriptive and functional. The technical term is normally introduced first in one clause or group (typically in a token-value relationship), but it is elaborated in one or a number of following clauses. This elaboration of the technical term is usually done through implication sequences. Implication sequences refer to the set of activities in which the technical term is involved, and include grammatical resources such as cause and effect, conditions and time sequence (Wignell, Martin and Eggins, 1987).

There is a tendency to elaborate technical terms through implication sequences in the fields studied. In the following example the technical terms are defined in terms of the set of activities they perform. One can observe how acronyms achieve here full, independent lexicalisation:

- The data switching exchange (DSE) controls the set-up and clear down of data calls, and monitors the connections and functions of the network. This exchange, which is capable of handling 100 calls per second, may be supplemented at a later date with a special service centre (SSC) for the introduction of certain new facilities. The DSE is connected to a data circuit concentrator (DCC). The purpose of the concentrator is to collect traffic from a number of individual subscriber circuits. This traffic is passed via time division multiplexed-high speed links (TDM) to the exchange. These TDMs, which consist of time division multiplexed streams (64 Kbps) also transfer traffic between the DCC and one of the multiplexors (RMX). The multiplexors (RMX and DMX) connect several subscriber lines either directly to the DSE or to the DCC which passes traffic to the DSE. Between the RMX and the DMX and the data terminal equipment (DTE), the data circuit terminating equipment (DCE) is located in the subscriber's premises. It primarily provides the standardised interface between the DTE and the network. Lastly, the DTE, which consists of a printing or alphanumeric visual display terminal or a computer, provides the subscriber with the data reception facilities. (Telecommunications)

The following implication sequences showing function and process can be seen if we deconstruct the text into stages:

1. The data switching exchange (DSE)
   controls the set-up and clear down of data calls, and monitors the connections and functions of the network.
   may be supplemented at a later date with a.

2. The DSE
   is connected to a data circuit concentrator (DCC).
3. (This traffic)
   is passed via time division multiplexed-high speed links (TDM) to the exchange.
4. These TDMs,
   transfer traffic between the DCC and one of the multiplexors (RMX).
5. The multiplexors (RMX and DMX)
   connect several subscriber lines either directly to the DSE or to the DCC
6. the DCC
   passes traffic to the DSE.
7. Between the RMX and the DMX and the DTE, the DCE
   is located in the subscriber´s premises.
8. it (DCE)
   provides the standardised interface between the DTE and the network.

This way a relationship is being established between the introduced technical term and the activity sequences which produced it. The information here is clearly organised into given and new, thus giving rise to a chain-like effect pattern in which given information in each sentence topic refers anaphorically to the new information in the last occurring comment.

In these activity sequences typically more terms (acronyms) are introduced and defined. The relationship between the technical term and its subsequent definition is established through reference. For example,

- A *digital phase-locked loop* (DPLL) is *an analog/digital circuit* that can be used to recover a clock signal from a serial data stream. The DPLL works only if the serial data stream contains enough 0-to-1 and 1-to-0 transitions to give the DPLL "hints" about when the original clock transitions took place. With NRZ-coded data, the DPLL works only if the data does not contain any long, continuous streams of 1s or 0s.

The definition of the technical term A *digital phase-locked loop* and its acronym (DPLL) is related to the term *an analog/digital circuit* which, at its turn, has been previously defined somewhere. The elaboration of the term is again achieved through implication sequences. As can be observed, the definition structures focus on use and purpose, and are oriented towards the functionality of items.

Language uses a number of lexical and grammatical resources for creating the taxonomic relationships of superordination and meronymy. In the electronics/ telecommunications domain, the main recourses used are relational processes (is, are) and nominal groups of the Classifier^Thing structure realising superordination; that is, once a technical term has been defined and established it is then open to sub-classification through the addition of a classifier element as the following example illustrates.

Signals: information transmitted within a network to control the handling of messages and the set-up, clearing and maintaining of connections.

- Access-barred signal /a signal sent back to a calling terminal, to indicate that the caller is not allowed to be connected to the called location
- Blocking signal /depending upon the type of network an end-of address signal
- Address-complete signal...
- Address incomplete signal...

As this example shows, taxonomies of terms in electronics texts are not always informed by classical principles such as cohyponym-to-cohyponym and hyponym-to-superordinate relationships as it occurs in science; rather, they are closer to a more prototypical categorisaton, again following functional purposes. Since the Latin and Greek binomial system is not used, grammatical resources, i.e. implication sequences and definitions, are used instead to set up the names for things in the taxonomies.

8. Concluding remarks

The analysis of the texts shows that a high amount of terms in the disciplines studied have been derived from the vernacular lexicon by analogy through lexical metaphor. Though most basic single terms come from Greek and Latin, they appear as 'icons' of a more scientific nature, and they typically occur in nominal groups in conjunction with vernacular lexis. It has also been shown that acronymisation has also proved to be a potential resource in the construction of terminology in novel technological domains and that there is a significant tendency for acronymisation to move toward lexicalisation in the specific fields studied, thus confirming White's findings.

It has been suggested that this may be due to the fact that there is a semantic functionality underlying technical lexis. The use and function of lexical metaphor in specialist technical discourse provides a bridge between the technological categories and those of the vernacular experience.

The construction of the specialist terminology, reflected in the definition of lexical structures through implication sequences and in the categorisation of technical terms, is focused towards the category's functionality and social context, rather than to the systematic mapping out of taxonomic space as that of other scientific domains. As a result of this, the lexico-grammar of the technical discourse is informed by function and by social practice principles and therefore it is subjected to changes and oscillation.

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