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# Analyzing Specialized Verbs in a French-Italian-English Medical Corpus: A Frame-based Methodology

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## Abstract

The aim of this study is to investigate the semantics and syntax of verbs in French, Italian, and English medical discourse by exploring the relationship between verb semantics and argument realization. The verbs under consideration are common lexical units which have acquired the status of a term through their specialization of meaning, such as *affect*, *involve*, etc. Unlike terminological verbs (e.g. *keratinize* or *lyophilize*), they have a lower level of technicalness, and co-occur with arguments (usually terms) in syntagmatic units. The data are extracted from the parallel EMEA corpus including documents published by the European Medicines Agency. The description of the verbs is based on the theoretical model of Frame Semantics (Fillmore1977a-b, 1982, 1985; Fillmore and Atkins 1992) and on the FrameNet methodology (Ruppenhofer et al. 2010). The resultant analysis of the collected data reveals a sentence-level scenario (i.e., the Damaging frame) which groups together verbal forms which share similar syntactic and semantic valence patterns, both within and across languages.

**Keywords:** specialized verbs; medical domain; parallel corpus; intra-/cross-linguistic equivalents; Frame Semantics; FrameNet methodology

## 1 Introduction

The special status of the verb in terminological resources, rather than the noun, is an issue which has been widely discussed in literature over the last fifteen years. See, among others, Picht (1987), L’Homme (1995, 1998), Lorente and Bevilacqua (2000), Valente (2000), Costa and Silva (2004), and more recently De Vecchi and Estachy (2008), Tellier (2008), Pimentel (2012) and Pettersson (2013). Verbs, like nouns, tend to have particular usages within situational communication between experts of specific fields.

The initial stage of this study focuses on the analysis of certain verbs that can have an unusual significance, or a meaning which is specific to the medical field, such as *affect*, *involve*, *enhance*, etc. Unlike terminological verbs (e.g. *keratinize* or *lyophilize*), they have a lower level of technicalness.

The observation of the behaviour of verbal forms in a corpus of medical texts has been explored by Tellier (2008) and Pettersson (2013) in French. In this work, verbs are examined in French, Italian and

English. The data are extracted from the parallel (translation) EMEA corpus from the EMA (European Medicines Agency). The corpus-based analysis of specialized verb equivalents (lexical units which have the same meaning and usage intra- and cross-linguistically) may be useful for the elaboration of a multilingual terminological resource which covers the subject field of medicine. This could be useful for translators, the teaching of specialized translation and terminological or technical writers.

The description of the verbs in question is based on the theoretical model of Frame Semantics (Fillmore 1977a-b, 1982, 1985; Fillmore and Atkins 1992) and on the FrameNet methodology (Ruppenhofer et al. 2010), because verbs are “frame-evoking” or “frame-bearing” words par excellence (Pimentel 2012: 5). Each specialized verb evokes a semantic frame representing a sentence-level scenario which groups together verbal forms that share similar syntactic and semantic valence patterns. The study also tests the hypothesis that semantic frames can function as “interlingual representations” in the organization of a multilingual lexicon (Boas 2005).

This paper is organized as follows. Section 2 provides a brief description of the research methodology: the instruments used for the data collection (2.1., 2.2.) and the theoretical model of Frame Semantics as well as the FrameNet methodology (2.3.). Section 3 illustrates the frame of the specialized verbs examined in this study (The Damaging frame) and their morphological and syntactic patterns. Section 4 follows with some concluding remarks.

## **2 Methodology**

### **2.1 Corpus**

The data are extracted from the multilingual parallel (translation) corpus EMEA from the European Medicines Agency (available in 22 European official languages). The corpus is made up of PDF documents which are representative of a genre of written medical discourse, specifically, package leaflets for medicinal products (Tiedemann 2009). The leaflets are specialized texts that make use of one of the different types of communication between experts and non-experts, such as doctor-patient interactions.

The corpus includes over 311,65 million tokens in all, 14,9 million of which are in French, 14,1 million in Italian, and 12,1 million in English. The corpus is available through the OPUS site (<http://opus.lingfil.uu.se/>) and can also be accessed through the Sketch Engine interface (Kilgarriff et al. 2004). The verbal items are collected and organized using the Sketch Engine to facilitate their quantitative and qualitative analysis.

Table 1 illustrates the verbal word-types and word-tokens in each language (i.e. French, Italian and English):

Language	Type-frequency	Token-frequency
French	1862	1,836,737
Italian	1855	1,256,154
English	1843	1,328,560

**Table 1: Type and token frequency of verbs in EMEA.**

The Type- / Token-frequency lists also include verbs which do not have any kind of specific value in medical discourse. Thus, specialized verbs have to be selected from the list of concordances for each language. The contexts which have been examined thus far show a large number of specialized verbs among the three languages. This article simply presents the preliminary results on 8 verbal lexical items (see table 2 below), which actually allow us to observe their special status within medical terminology and lexicology.

## 2.2 Data

The specialized verbs in question are those which Lorente (2000) calls *verbos fraseológicos* (Eng. ‘phraseological verbs’), which are different from the *verbos terminológicos* (Eng. ‘terminological verbs’). The former are predicative verb units that appear in specialized texts in order to express states, actions and processes. When isolated, their meaning is similar to the meaning of the verbs in non-specialized contexts, e.g. (Fr.) *administrer*, (It.) *somministrare*, (Eng.) *administer*. However, when they co-occur with arguments (usually terms) in syntagmatic units they acquire a specialized value. For example, we usually say (Fr.) *administrer un médicament*, (It.) *somministrare un farmaco*, (Eng.) *administer a medicine*, but not (Fr.) *donner un médicament*, (It.) *dare un farmaco*, (Eng.) *give a medicine*, even if their respective meanings in such contexts could justify the alternation of verbal forms. See examples in (1a-c):

- (1) a. Lorsqu’il est nécessaire d’administrer des produits radiopharmaceutiques chez la femme en âge de procréer, [...].  
 b. Quando è necessario somministrare un prodotto radioattivo ad una donna potenzialmente gravida, [...].  
 c. Where it is necessary to administer radioactive medicinal products to women of childbearing potential, [...].

Phraseological verbs include verbs that appear in collocations (strict lexical selection), in fixed phrases and also in support verb constructions.

The verbs examined in the first stage of this study are listed in Table 2:

French	Italian	English
affecter	coinvolgere	affect
atteindre	interessare	involve
intéresser		
toucher		

**Table 2: Verbs examined in French, Italian and English.**

Consider the Italian verb *interessare* and its French equivalent *intéresser*. Such verbs are mainly used by experts in the field, and they can be substituted by other words related to the general language (see table 2) without affecting the ‘scientific’ meaning which is given to them (see forward Section 3). Seriani (2005) labels the verbs *interessare/intéresser* as “tecnicismi collaterali” (subtechnical terms), i.e., words (nouns, adjectives, verbs and phrases) which are used to maintain a high, formal register in specialized languages.

Unlike the phraseological verbs, the terminological verbs correspond to those units whose meanings are specifically related to the specialized field, as in (2a-c):

- (2) a. Des études in vitro ont montré que l’irbésartan est oxydé principalement par l’isoenzyme CYP2C9 du cytochrome P450 [...].
- b. Studi in vitro indicano che irbesartan viene principalmente ossidato tramite il citocromo P450-enzima CYP2C9 [...].
- c. In vitro studies indicate that irbesartan is primarily oxidised by the cytochrome P450 enzyme CYP2C9 [...].

These verbs often have deverbal nouns, which are terms themselves and should be included in terminological resources, e.g. (Fr.) *oxidation*, (It.) *ossidazione*, and (Eng.) *oxidation*.

## 2.3 Theoretical framework

Over the last few years, some researchers have proposed frame-based organizations of specialized fields, in other languages as well as English, such as environmental science (see Faber et al. 2005, among others), law (see Alves et al. 2005, among others), soccer (see Schmidt 2006 and his following writings), molecular biology (Dolbey et al. 2006 and his following writings), computing and the Internet (see L’Homme 2008).<sup>1</sup>

Frame Semantics (Fillmore 1977, 1982, 1985; Fillmore and Atkins 1992) is a theory of language understanding based on the principle that the meaning of a linguistic item (Lexical Unit, LU) interacts with the scene which it has activated (“meanings are relativized to scenes”, Fillmore 1982). Thus, Fra-

1 For a full bibliography on the application of Frame Semantics within LSPs, see Pimentel (2012).

me Semantics contributes towards understanding the significance of the verbal syntactic patterns, as well as the understanding of the components (Frame Elements, FEs) that form them semantically. For instance, defining the verbal lexical unit *learn* presupposes an educational teaching strategy (i.e., Education\_teaching frame). Specialized verbs are often accompanied by other information (non-core Frame Elements, non-core FEs) that may be optionally added to a sentence.

The methodological approach applied to the analysis of specialized verbs is both bottom-up and top-down: the verbs are analyzed and grouped into frames for each language separately, and the use of specialized dictionaries and other reference resources provides helpful background information (Faber et al. 2009: 6). Thus, the analysis of text corpus allows us to observe how the arguments (core FEs and non-core FEs), the organization of syntax and the semantic connection between words put together specialized verbs and their suitable equivalents intra- and cross-linguistically.

The possibility of creating a multilingual specialized lexicon using the FrameNet database of its English-specific lexical descriptions is considered by Boas (2005), since semantic frames are conceptual structures independent of language. In this study, frames are assumed to be “interlingual representations” that can group together not only verbs in one language but also across several languages (French-Italian-English), by transferring semantic annotations from one language to another (Padó 2007; Baker 2009). Thus, frames can group together intra-linguistic and cross-linguistic equivalents (synonyms, near-synonyms, hyponyms, related LUs), as described in the next section.

### 3 Results

All the verbs examined in this study (see table 2) can be grouped together in the Damaging frame, since they all mean ‘to have a strong effect on something or someone’, or ‘causing physical damage to something or someone’, as shown in Table 3 (below). However, the Lexical Unit *to affect* is semantically identified with a general meaning in the FrameNet database, and it is linked to the Objective\_influence frame.<sup>2</sup> This frame is the Parent frame of the Transitive\_action frame from which the Damaging frame originates. Therefore, the Damaging frame is a Child frame which inherits from more than one Parent frame (multiple inheritance). Unlike *to affect*, the verb *involve* is not listed as a Lexical Unit in the database. Only the adjective *involved* and the noun *involvement* are included, and both belong to the Participation frame.<sup>3</sup> The corpus shows that the verb *involve* is used frequently as a synonym of the

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2 The definition of the Objective\_influence frame is as follows: “An Influencing\_variable, an Influencing\_situation, or an Influencing\_entity has an influence on a Dependent\_entity, Dependent\_variable, or a Dependent\_situation”.

3 The definition of the Participation frame is as follows: “An Event with multiple Participants takes place. It can be presented either symmetrically with Participants or asymmetrically, giving Participant\_1 greater prominence over Participant\_2. If the Event is engaged in intentionally, then there is typically a shared Purpose between the Participants. It is, however, possible that an expressed Purpose only applies to Participant\_1.”

verb *affect* in medical discourse, and therefore it can be considered as a Lexical Unit of the Damaging frame.

Frame	Damaging
Definition	An AGENT affects a PATIENT in such a way that the PATIENT (OR some SUBREGION of the PATIENT) ends up in a non-canonical state. Often this non-canonical state is undesirable, and some lexical units (marked with the Negative semantic type) specifically indicate that the PATIENT is negatively affected.
Core FEs	AGENT [Agt] The conscious entity, generally a person, that performs the intentional action that results in the damage to the Patient. CAUSE [cau] An event which leads to the damage of the Patient. PATIENT [Pat] The entity which is affected by the Agent so that it is damaged.
Non_core FEs	CHARACTER_OF_END_STATE, DEGREE, INSTRUMENT, MANNER, MEANS, PATIENT, PLACE, PURPOSE, REASON, RESULT, SUBREGION, TIME
Contexts	<p>Selon le NCI-CTC, les réactions cutanées de grade 2 sont caractérisées par une éruption <b>intéressant</b> jusqu'à 50 % de la surface corporelle, alors que les réactions de grade 3 affectent 50 % ou plus de la surface corporelle.</p> <p>Secondo i criteri NCI-CTC, le reazioni cutanee di grado 2 sono caratterizzate da rash che <b>interessa</b> fino al 50 % della superficie corporea, mentre quelle di grado 3 <b>interessano</b> il 50 % o più della superficie corporea.</p> <p>According to NCI-CTC, grade 2 skin reactions are characterized by rash up to 50 % of body surface area, while grade 3 reactions <b>affect</b> equal or more than 50 % of body surface area.</p> <p>Cette nécrose peut <b>atteindre</b> fascias musculaires ainsi que le tissu adipeux et peut par conséquent provoquer la formation d'une cicatrice.</p> <p>Questa può essere estesa e può <b>interessare</b> lo strato muscolare così come lo strato adiposo causando quindi la formazione di cicatrici.</p> <p>It can be extensive and may <b>involve</b> muscle fascia as well as fat and therefore can result in scar formation.</p> <p>Sintomi che coinvolgono il cervello e i nervi che si sono <b>manifestati</b> nell'arco di un mese [...]</p> <p>Réactions <b>touchant</b> le cerveau et les nerfs apparues dans le mois suivant la vaccination [...]</p> <p>Symptoms <b>affecting</b> the brain and nerves that have occurred within one month after vaccination [...]</p> <p>Les cas les plus graves ont été rapportés chez des patients prenant d'autres médicaments ou atteints de maladies pouvant <b>toucher</b> le foie (exemple alcoolisme, infection sévère).</p> <p>I casi più gravi sono stati osservati in pazienti trattati anche con altri medicinali o affetti da disturbi che possono <b>interessare</b> il fegato (ad es. abuso di alcolici, infezioni gravi).</p> <p>The most serious were reported in patients taking other drugs or who were suffering from diseases that can <b>affect</b> the liver (e.g. alcohol abuse, severe infection).</p> <p>S'ils ne sont pas <b>atteints</b>, la main et le pied doivent être protégés par une bande d'Esmarch, un garrot doit être placé au niveau proximal du membre.</p> <p>Mano e piede, se non <b>interessati</b>, devono essere protetti da bendaggi Esmarch (espulsione).</p> <p>Hand and foot, if not <b>affected</b>, should be protected by Esmarch (expulsion) bandages.</p>

Table 3: The Damaging frame.

The Damaging frame groups together 8 candidate equivalents, i.e. 4 French verbs, 2 Italian verbs and 2 English verbs, more specifically 16 likely combinations of equivalents, as shown in more detail in Table 4:

French			Italian			English		
Cause	target	Patient	Cause	target	Patient	Cause	target	Patient
éruption	intéresser	surface corporelle	rash	interessare	superficie corporea		-	
réaction cutanée	affecter	surface corporelle	reazione cutanea	interessare	superficie corporea	reaction	affect	surface area
nécrose	atteindre	fascia musculaire	questa (necrosi)	interessare	strato muscolare	it (necrosis )	involve	muscle fascia
-	atteint(e)	osseuse	tumore maligno	interessare	osso	malignancie	involve(ing)	bone
maladie	toucher	foie	disturbo	interessare	fegato	disease	affect	liver
affection parodontale	toucher	gencive	disturbo parodontale	interessare	gengiva	periodontal	affect	gum
réaction	toucher	cerveau	sintomo	coinvolgere	cervello	symptom	affect	brain
	affect(ion)	moelle osseuse	patologia	coinvolgere	midollo osseo	conditions	affect(ing)	bone marrow

**Table 4: Cross-linguistic comparison of verb (or *noun*) equivalents and FEs.**

Most of the FEs in Table 4 are synonyms (or semantic equivalents) because they have similar meanings and distributions (uses). In a few cases, the corpus presents transcategorization phenomena from the verbal to the nominal form, as exemplified in (3a-c):

- (3) a. des patients atteints de pathologie maligne à un stade avancé avec atteinte osseuse  
 b. tumori maligni allo stadio avanzato che interessano l'osso  
 c. in patients with advanced malignancies involving bone

According to L'Homme (2004), the presence of deverbal nouns, such as (Fr.) *atteinte* (<*atteindre*), (It.) *interessamento* (<*interessare*), (Eng.) *involvement* (<*involve*), establishes the specialized value of these verbs (see Section 2.2. for nouns derived from terminological verbs).

French is the language with the most verbal equivalents, since it distinguishes 4 items, whereas Italian and English contexts show 2, respectively. The English verbs *affect* and *involve* have peculiar features that characterize them as synonyms. In Italian as well as in French, the verbs can also be defined as hyponyms or hyperonyms. For instance, the Italian verb *coinvolgere* is a hyponym of *interessare*. All the verbs in Table 4 are equivalents because no particular differences have been observed: they have the same number of arguments (NP/Subject, NP/Object), the semantic nature of the arguments does

not differ (CAUSE and PATIENT) (they refer to the same kind of entities), and their syntactic patterns are similar (see Pimentel 2012 for the criteria identifying equivalents). Only in a few cases, are the verbs not translated because of a syntactic change, e.g. (Fr.) *réaction allergique sévère touchant le corps entier*, (It.) *una grave reazione allergica dell'intero organismo*, and (Engl.) *a severe, whole-body allergic reaction*.

The analysis of the data allows us to identify the typical verbal features (tense, person, number, voice, and mood) which characterize the leaflets, and medical discourse in general. The grammatical persons are the singular and plural third-persons. The realis mood (indicative) is obviously the commonest, whereas the unrealis moods, such as the conditional, imperative and subjunctive forms are less frequent. For instance, the use of the conditional form in Italian and in French are 0,87% and 0,63%, respectively. In relation to the grammatical tense, the present is the most common tense when the indicative is used: (Fr.) 34,56%, (It.) 33,74%, (Engl.) 17,57%. A further note deserves to be made for the grammatical voice: the use of the passive construction placing the thema of a sentence at the beginning of the clause and the rhema at the end is very common in medical discourse, and generally allows one to omit the agent, e.g. *COX-2 is also thought to be involved in ovulation*.

## 4 Concluding remarks

The exploitation of specialized parallel corpora makes it easy to identify the repertoire of both intra-linguistic and cross-linguistic verb equivalents which acquire specialized value when used in medical texts. The Frame Semantics analysis of each verb pattern as well as the FrameNet methodology allow us to make a description of the interaction of the lexeme, syntax and conceptual background frame. All the verbal items evoke the same frame (Damaging) describing physical damage to something or someone. Thus, the lexicological findings could be useful for the development of a multilingual lexicographical resource specialized in the medical field which could give support with L2 writing. This of course involves a comprehensive and systematic investigation.

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