

Insights into the Lexicon of Vision in Domain-Specific English

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1. Introduction

Lexicological and lexicographic studies of domain-specific languages typically focus on features of specialized lexis (Gotti 2003, 2005, Bathia 1993, Cortese and Riley 2002). However, we strongly believe and would like to claim that specialized discourse also influences the general lexicon of domain-specific texts by providing a frame which constrains the internal organization of the whole text as a system.

The theory of lexical complexity (Bertuccelli Papi 2003, Bertuccelli Papi and Lenci 2007) can account for the processes at work at the lexical level, not only in technical terms but in the lexical texture of the whole text. The lexicon is seen as a complex dynamical system and the single lexical items as complex dynamical microsystems in which “nothing is lost, nothing is created, everything is transformed” according to general organizing principles whose nature has been discussed at some length in Bertuccelli Papi and Lenci (2007). In specialized discourse the system is reorganized so as to constrain the construal of specific meanings of lexical items due to the fact that it acts as an overarching frame which favours processes of foregrounding/backgrounding of conceptual semantic components and the selection of the relevant frame.

These processes are evident in the behaviour of verbs of vision in specialized texts, where only some meaning components are foregrounded and participate in the construal of the final reading whereas other components are left in the background and are not activated. In the following sections we discuss and exemplify our argument through a corpus-based study of the verb *observe* in economic and scientific discourse.

2. Lexical Complexity

The theory of Lexical Complexity was first introduced in Bertuccelli Papi (2003) and then further developed in the PRIN project by the Pisa research group (see Bertuccelli Papi and Lenci 2007). It aims at defining informational complexity and the processes that regulate lexical meaning construal in the actual context of use. The theory is founded on the hypothesis that both language and the lexicon can be compared to other complex dynamical systems present in nature, with which they share fundamental properties, such as dynamicity, non-linearity, nestedness and adaptability, self-organization and stochasticity.

2.1. Complex Dynamical Systems and the Lexicon

Bertuccelli Papi and Lenci (2007:15) define a dynamical system as “a set of integrated and interrelated dimensions or aspects of the world that change and evolve through time” and that can be described in terms of the number and types of their dimensions and of the forms and predictability of their organization. This latter is seen as the result of the interaction among the components of the system and between the system and its environment. Organization, moreover, entails the existence of redundancies, i.e. schemata, rules, or regular patterns, which constrain the system’s behaviour and reduce the amount of information necessary to describe it (p.18).

Complexity and organization act as two competing forces. A system can be considered as more complex if it is composed by a higher number of dimensions interacting with one another. Organization on the other hand imposes structure, constraints and regularity to different extents, so that the system dynamics become more (easily) predictable.

Languages can be seen as *organized complex systems* (Collier and Hooker 1999; Bertuccelli Papi and Lenci 2007), and as such, as autonomous, adaptive systems capable of preserving their integrity and organization when they come in contact with external stimuli and of adjusting to changes in the environment in a self-organized way (Mac Whinney 2002). Nestedness is another property of complex dynamical systems, in that they include parts which are in turn complex systems themselves.

Since these characteristics, along with the ability to evolve over time (dynamicity) and the identifiability and predictability of behavioural patterns, can also be found in the lexicon of natural languages, it seems

reasonable to assume that this latter can indeed be treated as an example of a complex dynamical system nested in language and that the principles at work in such systems can also explain the processes at work in lexis.

2.2. The Lexicon as a Complex Dynamical System: The Principles and Forms of the Organization

Complexity is a defining property of the lexicon and depends on two main parameters, namely the types and quantity of information necessary to describe the meaning of a lexical domain or item and the organizational properties of such information. In this view, polysemy and context-sensitiveness are taken to be inherent qualities of lexemes (Croft and Cruse 2003; Vigliocco et al. 2004) and the disambiguation of senses, or meaning construal, to be the result of the stabilization of the system at a specific time. Words are considered as “pointers to conceptual structures (semantic spaces) out of which meanings are dynamically construed in context-sensitive modalities, following a non-linear process, but emerging in recurrent configurations with some degree of statistically relevant stability” (Bertuccelli Papi and Lenci 2007:21). The meaning of lexical items may therefore be viewed as variable combinations of portions of conceptual information, encyclopaedic in nature and dynamically recruited and “when no routine is available, resulting in different organization patterns with different associative links both from individual to individual and [...] from language to language” (Bertuccelli Papi and Lenci 2007:26). Different contexts of use and the linguistic and extralinguistic context act as constraints that dynamically select the “portions” to enter into the construal of a certain “contextualised meaning” (Croft and Cruse 2004).

We assume that the organization of the various conceptual dimensions is regulated according to some general semiotic principles such as those proposed in Merlini Barbaresi (2003b) as the basic dimensions of the notion of complexity, which, at a higher level, are connected to more general cognitive procedures such as those identified in Bertuccelli Papi (2003) and in Bertuccelli Papi and Lenci (2007). The work of these principles as devices which help shape a steady state of the system at a certain time can surface at all levels of the linguistic structure, i.e. in grammar as well as in the organization of utterances, text and discourse (see Merlini Barbaresi 2003a). Such principles are:

- *figure-ground* as the prerequisite to the processes of attention, perception, memory and reasoning;
- *biuniqueness* as ideally inversely related to the principle of economy;
- *iconicity/diagrammaticity* related to mapping and matching processes underlying human patterns generation and recognition;
- *indexicality* based on recognition of contiguity and similarity;
- *transparency* related to the type and number of processes that make meaning identification possible with respect to some other parameter or dimension.

Bertuccelli Papi (2003) and Bertuccelli Papi and Lenci (2007) take lexical complexity to be hierarchically recursive and they identify in Fillmore’s frames one of the most relevant, plausibly conceivable ways in which semantic information is organized, without excluding other types of patterns found in the literature on the lexicon such as scenarios, schemata and scripts. In line with Barsalou (1992), frames are here seen as dynamic relational structures evoked by lexical items and whose format would be the emerging results of external pressure and of the interplay of different types of constraints, both intralinguistic (syntactic, morphological, textual) and extralinguistic (encyclopaedic knowledge, contextual input, cognition), self-organized and not built according to some pre-established intention.

The level of organization of the individual microsystems represented by lexical items determines the semantic stability of the lexemes. When the organization of the meaning dimensions is insufficient or weak for lack of a strong pattern of regularity or of strong external constraints, meaning is characterized by a higher level of plasticity, which, in turn, can result in a loss of stability of the term semantics and in an increase in lexical complexity (see also Masi *forthcoming*).

The theory of Lexical Complexity hypothesizes that the semiotic principles implicitly structure the complexity of semantic representations in the lexicalization process. Bertuccelli Papi (2003) and, later, the Pisa research group participating in the PRIN project “Glossari, dizionari, corpora: lessicologia e lessicografia delle lingue europee” have tested this hypothesis by applying the theoretical framework to the analysis of verbs of vision in general discourse, in particular to the lexical semantics of the highly polysemous verb *to see* (Franceschi 2007, Masi *forthcoming*, Cappelli and Bertuccelli Papi *forthcoming*). The study of the lexicalization patterns of English verbs of vision has led to the identification of three main conceptual schemata to which all the various combinations of conceptual material can be traced: cognition,

perception and affect. These schemata are themselves complex, in that they can be reduced to a number of other (plausibly more basic) schemata, such as agency schema, attention schema, intensity schema, etc.

If we take words to be pointers towards a conceptual space and as means to evoke a certain frame, script or schema when they interact with the context, the figure-ground principle explains how lexical items pointing towards the same conceptual material or to the same frame can lexicalize very similar conceptual dimensions in a different way by perspectivising in a foreground-background manner one or another dimension. It also explains the plasticity of the meaning of a single lexical item that can be construed in different ways when used in different contexts. The principle of biuniqueness is, on the other hand, connected to the specificity of meaning. The more biunique a lexical item is, the steadier the combination of the conceptual dimensions, hence the steadier the microsystem. When the combination of the dimensions lexicalized is visible or recognizable at the surface level, a lexeme is said to be transparent. Iconicity refers, on the other hand, to the “degrees of proximity to the basic cognitive schema as degrees of diagrammaticity along the relevant schematic dimensions” (Bertuccelli Papi 2003:109), and finally, indexicality refers to the presence of pointers towards contextual elements.

According to this analysis, a verb like *to see* that can lexicalize a large portion of the frame of vision and a wide range of the conceptual dimensions of the perception, cognition and even affect schemata according to the context of use and the dimensions that it brings to the fore or relegates to the background is more diagrammatic than *to stare*, in that its semantic schemata can be mapped onto the cognitive schema of vision without any crucial gap. It is however less biunique (and therefore less specific and semantically less rigid but also more ambiguous) than a verb like *to stare* (see Masi *forthcoming* for a thorough discussion) and less transparent than an expression like *to turn the eyes* if we consider the perception schema.

3. Lexical Complexity and Specialized Discourse

The theory of Lexical Complexity can contribute to the discussion on specialized discourse in that it can explain in a principled way the processes at work in the lexicon of specialized discourse and account for some of the widely discussed features of specialized lexis, namely monoreferentiality, lack of emotion, and precision, since specialized discourse can be seen as a constraint acting on the system, which, in turn, self-organizes so as to adapt itself to external pressures of pragmatic and situational-contextual nature. Specialized discourse itself could be seen as “emerging” from the pressure of situational-contextual factors on the linguistic system (Merlini Barbaresi 1989).

Discourse is a difficult notion to describe and as in the case of most linguistic terms, there is no universal agreement on the exact definition (Gotti 2003, Schiffrin 1987, 1994, Stubbs 1983). The term is often used to refer to whole units of communicative exchanges produced in a particular speech community for a particular purpose. Discourse is a multidisciplinary concept, since its roots are not just in linguistics (Hymes 1974) but also in the social sciences, from which it inherited the idea of “social fact” (Durkheim 1895) and of constraint external to the individual on forms of social life and small group interactions (Simmel 1911) which, according to Foucault (1972) often goes unnoticed, despite the fact that it acts as a “social boundary” defining what can be said about a specific topic and that it is not possible to escape it (see also Cappelli 2006:13-16).

The definition of specialized discourse endorsed here is the definition proposed by Gotti (2005:24), that is to say “the specialist use of language in contexts which are typical of a specialized community”. This definition goes beyond the original idea of specialized discourse as a socially and contextually bound variety of general language and stresses the role of the user, of the domain of use and of the special application of language in a setting (academic, professional, technical, etc.). This view is akin to that proposed in Trosborg (1997) which sees specialized discourse as the result of the interrelationship of various factors representable as a coordinate system with the disciplinary domain dealt with marked on the horizontal axis and the sociological layer with all its variables marked on the vertical axis. This appears to be in line with the hypothesis that we can actually conceive of specialized discourse as of an emergent system and, interestingly, Gotti (2005:23-24) underlines that, contrary to what some studies claim, it is not void of the expressive richness of standard language and does not always share the constraints and simplification assumed by some scholars, but, on the contrary, it “possesses all the lexical, phonetic, morphosyntactic and textual resources of general language”.

The plasticity of specialized discourse is also evident in the necessary distinction between three levels of specialization according to the differences between the participants in the communicative exchange: specialist to specialist (high degree of specialization, e.g. a legal document), specialist to non-specialist

(medium degree of specialization, e.g. a textbook), non-specialist to non-specialist (low degree of specialization, e.g. two people talking about a legal action). Terminology is obviously more common in specialist-to-specialist communication than in non-specialist-to-non-specialist communication, monoreferentiality and precision will certainly be more frequent in the former than in the latter.

Lexical complexity can indeed explain why even non-specialists can construe without any effort the meaning of lexical items that also occur in general language in a more precise, biunivocal and non-emotionally-charged way when they find them in specialized discourse. Discourse, as a cultural, hence pragmatic, force constrains the choice of a relevant frame evoked when a word is uttered according to general cognitive and communicative principles such as the principle of Relevance (Grice 1989, Sperber and Wilson 1986/1995). Moreover, within the relevant frame, specialized discourse constrains the selection of certain conceptual dimensions bringing them to the foreground and relegating other less or non-relevant perspectives to the background, so that there is an increase in the biuniqueness of the meaning of a lexical item, whereas its diagrammaticity decreases.

It would be a mistake to think that the influence of discourse acts only in the case of specialized terminology. As a matter of fact, the whole system is affected and even the meaning construal of what we could define the “general lexicon in specialized text” emerges from the influence of such forces on the system itself. The changes are clearly subtler and therefore less obvious than in the case of specialized lexis, but no less significant nor of different nature. We believe that the processes at work are indeed the very same and that whereas in the case of specialized terminology they mostly contribute to increase the precision and monoreferentiality of terms - thus reducing ambiguity even though often without completely eliminating it (Keynes 1973, Gotti 1994) - in the case of the “texture lexicon”, besides producing similar foregrounding-backgrounding effects, they can even produce significant shifts in the selection of the relevant frame to the extent of producing a real shift in meaning or in function (Lorenzetti *forthcoming*, Masi *forthcoming*) and a remarkable distantiation from the unmarked, “prototypical” meaning construal.

By providing “patterns” for the organization of the system, in some cases even very formalized and conventionalized, we believe that specialized discourse reduces the lexical complexity of specialized lexis. However, the question remains as to whether it also provokes a reduction of the complexity of “texture lexical items” in specialized texts or not. The data discussed in section 4 and 5 below seem to show an interesting picture, which we feel can contribute to the study of English for special purposes.

4. The Verb *Observe* in Economics Newspapers and Journals

In the remainder of the paper, two case studies are presented, in which a lexical item from the general lexicon is examined in two different text types, namely economic (this section) and scientific discourse (sec.5). As mentioned earlier in this contribution, in line with the tenets of the theory of Lexical Complexity, we argue that the meaning of lexical items is organized according to a set of conceptual-semantic dimensions (or components), whose dynamic interaction in situated contexts triggers the emergence of pragmatic meanings, according to mechanisms of ‘figure and ground’ (Talmy 2000). Starting from the presumption that none of these components are completely cancelled in the derivation of contextualised meanings, but only perspectivised (Fillmore 1976), we argue that the study of collocations and co-occurrence patterns of a word in a specific text domain will enable us to delineate its semantic profile in that text, (Stubbs 2001). The latter, although relying on the same set of conceptual components outlined for the same lexical item in a general context, will be text-specific, and thus potentially different from the one of the lexeme in other typologies of texts.

4.1. The English Verb *Observe*

The English verb *observe* is a central instance among verbs of vision. Even though it is not as complex as *see*, which represents the prototypical term of the entire domain, whose definition is included in that of all the other verbs in the field, and displays the full range of complementation patterns relevant to the entire category (see Lorenzetti 2006 and *forthcoming*), it has a high degree of representativity in the lexicon, as testified by corpus attestations in the British National Corpus (7358 occurrences).

Observe displays a wide range of complementation patterns, and compared to verbs which are reported as its synonyms in the perception sense in dictionaries (Atkins 1994), we can notice that, even if they roughly

cover the same conceptual area, very rarely are they used interchangeably in discourse. Moreover, *observe* is deeply entrenched in the texture of discourse and is frequently employed in argumentation, in order to link different blocks of discourse, or as a text organiser (Bondi 1998).

Some of the components which are involved in the organization of the cognitive schema of vision verbs (Bertuccelli Papi 2003) are particularly relevant in the case of *observe*, namely the attention, awareness, intention and purpose components. However, agency, visual field and temporal components, which are more strongly connected to perception, are also crucial, thus testifying to the relationship between *observe* as a speech act verb, or as a verb of cognitive attitude and *observe* as a perception verb. An empirical basis for the remarks made is almost always presupposed, since visual analysis and inspection are frequently used as a starting point, in order to make further claims and derive inferences on a topic at stake (Sweetser 1990, Viberg 2001).

On the basis of dictionary definitions and corpus attestations of the verb, it is possible to isolate four main senses for *observe* in general discourse:

- To watch something carefully, especially in order to learn more about it
 - He spent a year in the jungle, observing how deforestation is affecting local tribes.
 - I want you to observe her reaction to the judge's question.
- Notice or see
 - He observed the passers-by in the street.
 - Jack observed a look of anxiety on his brother's face.
- To make a remark about something
 - "I've always found German cars very reliable", he observed.
 - She observed that literary criticism had changed a lot in the last few decades.
- Conform one's action or practice to
 - As Catholics we are accustomed to observe Palm Sunday.
 - Clients were bound to observe the terms of the contract.

(*Oxford English Dictionary* 2008)

From a frame semantics perspective, the verb is reported as participating in 4 different frames:

- The **Perception-active** frame, including all the verbs whose perceivers intentionally direct their attention to some activity or phenomenon.
- The **Becoming aware** frame, related to cognitive activity, and specifically dealing with a cognizer who becomes aware of a certain phenomenon.
- The **Compliance** frame, concerning acts and states of affairs for which protagonists are responsible, and which violate some sets of rules or norms.
- The **Statement** frame, related to the use of *observe* as a speech act verb. In this case we have a speaker addressing a message to another interlocutor.

4.2. Data and Method of Analysis

In our study of *observe* in economic discourse, we focused in particular on the analysis of information-oriented economics newspapers. A sample of 1000 occurrences of the verb was examined in a corpus of articles taken from *The Financial Times* on cd-rom edition (2002-2005). A smaller corpus of papers taken from a set of academic journals in the field of economics was analysed for confrontation. Results from the analysis of academic journals are presented in 4.4.

All the tenses and moods of the verb were examined conjugated at the various persons. Some preliminary considerations can be made from a statistical perspective, concerning the attestation frequency of the various lexical forms (

Table 1).

Lexical Forms	Frequency %
<i>Observe</i>	17
Observes	26
Observed	47
Observing	10

Table 1. Frequency of lexical forms of *Observe* in *The Financial Times* (cd-rom ed. 2002-2005)

Observed, which can occur as past participle and past tense of the verb, and hence participates in both active and passive constructions, is the most frequent form. As we shall see in the following sections, a preference for passive constructions and the impersonal form of discourse are typical features of specialized discourse, and specifically of economics texts (Gotti 2003, 2006), while only in a minority of cases does the verb occur in the *-ing* form.

4.3. *Observe* in Economics Journals

The verb can occur in various syntactic constructions, whose frequency is related to the lexical entry of the verb which is more strongly associated to them, since particular syntactic constructions tend to occur more frequently in conjunction with specific senses of the verb (Table 2).

NP₁VP+NP₂

- (1) Countries are required to *observe* the "normal" fluctuation bands within the European exchange rate mechanism for at least two years.
- (2) We can *observe* this trend in the humble local area network.

NP1VP+ *that*-clause

- (3) Mr Levi at Chase *observes* that some companies, including Geotek Communications, Earthwatch and International Wireless Communications are facing serious challenges.
- (4) Mr Shirling *observes* that while share buy-backs are still rare enough among quoted companies for news of one to make newspaper headlines, they are part of the strategy of private owners.

NP1VP+ quotation

- (5) "The sort of risk management that led to such a hefty exposure would not occur in terribly many organisations", one analyst dryly *observes*.
- (6) "In Panama the party is not a vehicle to put ideological positions or principles," *observes* Marco Gandasegui, a political analyst with the Centro de Estudios Latinoamericanos in Panama.

NP2VP-ed + (by NP1)

- (7) There is a remaining role for exchanges in most of these areas, for example in ensuring that the standards set by external regulators are *observed*.
- (8) Earlier this week, the inquiry was told that it was not until 1995 that the agriculture ministry realised that vital safeguards introduced in November 1989 were not being properly *observed*.

Syntactic Constructions	Frequency of Attestations %
NP ₁ VP+NP ₂	35%
NP ₁ VP+ that-clause	7%
NP ₁ VP+ quotation	11%
NP ₁ VP-ed + (by NP)	47%

Table 2. Frequency of syntactic constructions with *Observe* in *The Financial Times*

The verb tends to occur in the passive construction in the majority of attestations. The second most frequent syntactic construction in which the verb occurs in this context is the transitive construction. The verb appears in the quotative construction in 11% of occurrences, while in 7% of cases, it is followed by a *that*-clause. We also have to report that the null object construction appears as irrelevant to the verb in this context, as testified by the presence of only one attestation in the entire corpus.

4.3.1. Typologies of Subjects

The majority of nominals occurring with the verb in subject position are plural nouns (54,5%) characterising corporate individuals with a special knowledge authority in the field (9), while in some cases, plural nouns refer to inanimate entities representing a collection of individuals (*stores, mortgage banks*) (12). 29% of nouns occurring in subject position are singular (10), (11), and 14% of them also represent collective entities (*firm, company, or bank*). Only 9% of nominals occurring in subject position are proper nouns. However, it is more frequent that proper nouns be followed by an apposition qualifying the job of the subject person, a feature which, given the persuasive aim of this kind of text, can be interpreted as an attempt to display the knowledge authority of the observer.

A list of the most frequently encountered nominals in subject position can be found in (Table 3).

- (9) It takes some time, M&A specialists *observe*, for sellers to grasp that the fall in their share price may be other than purely temporary.
- (10) “In negotiations you always say to these people (from large companies), ‘your equity is your pension’,” *observes* Peter Keen, managing director of Merlin Ventures.
- (11) However, market strength has been narrowly based on the often frothy end of the high technology sector, prompting David Menlow, president of the IPO Financial Network, to *observe* that “it’s not the steak that’s selling, but the sizzle”.
- (12) Under Danish law, the mortgage banks must observe the balance principle between funds received from borrowers and payments made to bondholders.

PLURAL NOUNS	SINGULAR NOUNS
dealers	bank
clients	company
taxonomists	movement
governors	Banking rescue plan
member states	president
countries	employer
organizations	director
observers	intermediary

Table 3. Most Frequent Nouns in Subject Position

4.3.2. *Typologies of Objects*

As for the nominals occurring with *observe* in object position, the majority of them denote specific tasks or activities related to the business domain (13), (14). A significant number of nominals belong to the semantic area of rules and regulations (15).

- (13) Mannesmann Arcor, the fixed line business operated by Mannesmann, said it was “*observing* the market” closely and could react swiftly.
- (14) Mr Koehler, who has urged German industry to restructure, said: ‘We are *observing* the German developments and if the government does not get the reforms right, we will consider moving our head office out of Germany.
- (15) The resulting job insecurity means staff are *observing* the rules of the Bank’s complex internal market to the letter, which in turn means it is still not operating as efficiently as it could.

The most frequent co-occurring nominals in object position are:

- price stability
- Law firm mergers
- signs, characteristics, changes
- manoeuvres
- monetary system
- market share pattern
- standards
- rules/regulations/ principles/terms of the contract

4.3.3. *Co-occurring Modifiers and Modals*

The presence of a wide range of adverbial modifiers can provide us with additional clues, so as to delineate the senses of the verb which are more frequent in economics journals. Apart from two adverbials which have no relation to any of the specific senses of the verb (*previously, recently*), it is possible to outline two main categories of adverbials which tend to co-occur with *observe* in this context. On the one hand, we have a group of modifiers related to the manner in which a verbal observation is made (16), or the way an inference can be derived (17), which thus present an evaluation of somebody else’s utterance:

- *with a smile; with envy; shrewdly; dryly; wryly; harshly; correctly; sagely; readily.*

On the other, a smaller group of adverbials are strongly associated to the compliance with an established rule or principle, as in (18) and (19).

- *correctly; properly; strictly; to the letter; loosely.*

- (16) The mainstream parties, as Ms Hanson *correctly observed*, “ganged up” on One Nation, placing it last in their preferred voting order, even as they vied for the preferences of One Nation's own supporters.
- (17) Innovation is not easy, even in technical functions where results can be *readily observed*. In areas such as marketing it is even less easily measured.
- (18) Last week the inquiry was told it was not until 1995 the ministry realised safeguards against “mad cow disease” introduced in November 1989 were not being *properly observed*.

- (19) Job insecurity means staff are *observing to the letter* the time-consuming internal market procedures through which people's services are in effect bought and sold within the organisation.

The presence of an adverbial like *more closely*, which occurs only in four cases, testifies to the background presence of the perceptual component of the verb, as an empirical basis for more cognitively-oriented observations (20). Moreover, it shows that a limited number of occurrences of the verb in this context are related to perception.

- (20) Consumers are being *observed more closely* than ever before as retailers join the drive for globalisation, reports Peggy Hollinger.

A significant number of occurrences report the presence of modal auxiliaries or semi-modals in conjunction with the verb. The most frequent of them are: *may, might, have to, must, should* and *be required to* (see examples from (21) to (23) and (12)).

- (21) Any banking rescue plan will *have to observe* a few basic principles: it must provide a means of removing bad debts from banks' balance sheets, it must protect good loans within bad banks, and it must involve a reduction of capacity.
- (22) Countries *are required to observe* the "normal" fluctuation bands within the European exchange rate mechanism for at least two years, without devaluing against the currency of any other member state.
- (23) If the valuation of internet stocks has anything to do with earnings prospects, internet investors might *do well to observe* the plight of the chipmakers.

It is worth mentioning that the presence of modal auxiliaries occurs, only when the meaning of the verb is that of "complying with a rule or principle".

4.4. *Observe* in Academic Journals In Economics

Before deriving our conclusions on the emergence of senses of the verb in general business newspapers and magazines, a confrontation with scholarly publications¹ in the field might give us insights into the behaviour of *observe*.

A preliminary difference between these two types of publications is related to the level of specialisation of the language employed and to the target audience. Specifically, even though the so-called general business publications are directed to a target audience of people working in this domain, readers of academic articles are experts and specialists. Differences in the target audience also reflect differences in contents and in the language employed. In more "popular" publications, the language tends to be simple enough to be understood by almost everyone, even though it may include jargon specific to the industry. On the contrary, in scholarly publications the register is more formal, the tone tends to be very serious and the lexicon employed is highly specific to the discipline. Moreover, contents also differ, since in the case of general business newspapers or magazines, articles provide an overview on a topic, often report experts' opinions and might reflect the industry's point of view, particularly on regulatory and legislative issues. Conversely, academic articles are more structured, provide in-depth analysis on a given topic and usually communicate research findings in a given field.

Occurrences of the verb are especially high in the passive form ((24) and (25)).

- (24) The modified model is easier to reconcile with observed data, where extreme changes to specialization are not *observed*.
- (25) A similar change over time is *observed* for the impact of A-level scores.

¹ Issues were examined from the following academic journals, e.g. *Applied Economics* (Taylor and Francis), *Journal of Institutional Economics* (Cambridge Journals), *Macroeconomics Dynamics* (Cambridge Journals).

Observation in this case starts from available data and from phenomena which can be measured, as shown in the following example (26).

- (26) In the data used for this paper, there is no information on when the individuals entered university. Therefore I do not *observe* whether a graduate has been assigned to the four- or five-year regime of university education.

Frequent expressions are *observable* and *unobserved*, in relation to the possibility to detect and measure the presence of a given phenomenon. The target audience plays a crucial role in guiding to the interpretation of the verb in this context, and in posing additional constraints. Differently from what happens in the case of general business publications, where perception is always backgrounded, all the occurrences of the verb examined are related to the perceptual sense of the verb, where the presence of data, or a visual stimulus serve as a basis to derive further conclusions.

4.5 Emergence of Senses of *Observe* in Economics Journals

The analysis of collocations and syntactic constructions of the verb lead us to outline a lexical profile for *observe* in general business newspapers. Meanings are constrained in economic discourse, which guides the verb to specific trajectories. The degree of language specificity is also responsible for the emergence of certain senses in a privileged way. Of the four main senses of *observe* in general discourse, i.e. ‘watch carefully’, ‘determine’, ‘remark’ and ‘comply with’, only three of them are relevant to the general business context. More specifically, the perceptual component is almost totally absent, while the majority of nominals in object position refer to highly abstract entities related to the ‘comply with’ sense of the verb. Hence, the senses of the verb outlined in economics newspapers are closer to the domain of *observance*, as an act performed in accordance with prescribed usage, rather than to *observation*, as the detection of a particular phenomenon on the basis of perceptual evidence.

In relation to the semiotic parameters of complexity outlined in (2.2), we can conclude that the verb *observe* presents a low value on the parameter of biuniqueness, since it can have different senses. It has a moderately low value on the parameter of transparency, as a number of inferential processes are necessary, in order to get to the meaning of the verb in a specific context. Finally, considering the semiotic parameter of diagrammaticity², we can affirm that the senses of *observe* outlined in economics texts are final instantiations and specifications of meanings already activated as part of the verb prototypical meaning. This results in a simplification of first-order mapping from signans to signatum.

5. The Verb *Observe* in Scientific Discourse

According to the *Oxford English Dictionary*, the first attestation of the verb *observe* in scientific discourse dates back to 1559 and it referred to the act of detecting or taking note of celestial phenomena by means of an instrument:

- (27) I can with my..Quadrant *obserue* the height of the sonne, and sterre, vntill that he come to the meridian.
(1559 W. CUNINGHAM Cosmogr. Glasse 162)

In the first half of the 1600s, especially after the introduction of the telescope, the verb continued to be strongly associated with astronomical measurements:

² The notion of *diagrammaticity* is a highly debated one and derives from the semiotic principle of *diagrammaticity* (Peirce 1965) It is a typical instantiation of the principle of iconicity. From a morphological point of view (Dressler et al. 1987), diagrammaticity entails a relation of biuniqueness between segmentability of signans and compositionality of signatum. A diagrammatic word is perfectly segmentable and semantically motivated. In other terms, the transparency of its complex signans reflects the compositionality of its signatum. If we consider this concept of diagrammaticity, also expressed in Merlini Barbaresi (1988, 2003b), the verb *observe* in economic discourse might be considered low on this parameter, since only some of the possible senses of the verb are foregrounded.

- (28) *Obserue* the height, that is, at twelue a clocke to take the height of the Sunne.
(1627 J. SMITH Sea Gram. ix. 42)

In contemporary English, instead, the use of the verb *observe* in a scientific context is not just restricted to the field of astronomy and it has two main senses. It can either denote the punctual action of noticing and discovering the presence/existence of something or the telic-durative process of attentively watching a certain phenomenon in order to reach a conclusion. This latter meaning is closer to that of the originally Latin term, obtained from the combination of *ob-* ‘over’ and *servare* ‘watch’. Two different frames³ can thus be constructed, namely one based on the concept of unintentionally becoming aware (29) and the other implying active perception (30) instead:

- (29) Jacobs wounded internodes of *Coleus* and *observed* the regeneration of xylem under various conditions.
- (30) He *observed* babies using ultrasound and discovered that each showed a preference for one or the other thumb.

How do the different structural realisations contribute to the onset of one or the other sense of *observe*? A sample of approximately 1,100 occurrences retrieved in the *Natural and Pure Science* section of the *British National Corpus* was examined in order to provide a description of the changing behaviour of the verb at the syntax-semantics interface.

Observe typically appears in passive constructions which represent 83% of all the occurrences retrieved. It also has a general tendency to bear the overt morphological mark for perfectivity (*observed*) highlighting its intrinsically telic *Aktionsart*. Both active and passive sentences construe different interpretations of the verb depending on the nature and the behaviour of their constituting elements. Important aspects to take into consideration both for explicative and predictive purposes include the type of collocating subjects, objects and adverbials as well as the valency patterns of the verbal predicate. Tense and aspect also play a significant role in channelling the reading of *observe* in one or another direction.

5.1 The *becoming aware* frame

The verb *observe* in the active diathesis occurs with human subjects (names of scientists are usually retrieved) and objects referring to processes in which entities can be involved. It appears almost exclusively in association with the simple past and with locative prepositional phrases headed by *in*:

- (31) The nature of the other chemical product of photosynthesis – organic matter – was demonstrated by Julius Sachs in 1864, when he *observed* growth of starch grains in illuminated chloroplasts;

The act of observing results in the awareness of a certain phenomenon, but it does not give any information about the subject’s evaluation of facts. In other words, what gets foregrounded here is a more perception-oriented meaning of the verb. The lexical item seems to undergo the same process when it occurs in passive constructions, especially if accompanied by modal auxiliary verbs indicating ability:

- (32) Fibres [...] elongate at both ends by intrusive growth (Fig. 9.12). They can be *observed* by means of a lacmoid clearing method;

In this case subjects are non-human, but concrete and well-defined entities (e.g. cells, fibres, nuclei), visible through the use of a microscope. Hence, the high frequency of prepositional phrases containing details about the medium of observation:

- (33) [...] flagella are so thin they cannot be *observed* directly with a bright-field microscope [...]

³ <http://framenet.icsi.berkeley.edu/>

The instrument and means needed in order to carry out the act of observation have to be regarded as ‘core elements’ within the *becoming aware* frame, since they appear in syntactic dependants necessary for evoking it.

When subjects in passive sentences are elaborate noun phrases referring to dynamics and phenomena in which entities are engaged, there is an abstractification of the observation act. In other words, the cognitive dimension is foregrounded and the verb *observe* has to be understood metaphorically, with the meaning of *finding* or *establishing*:

- (34) A direct correlation has been observed between the level of the expressed metallothionein and accumulation of Cd²⁺ and Cu²⁺ within the cells.

Prepositional phrases indicating the instrument used for the observation are no longer to be found in co-occurrence with this construal of the verb, but locative expressions remain common. Furthermore, adverbs of frequency (e.g. *often*, *usually*, *rarely*) tend to emerge, particularly in the company of the present simple and present perfect forms of the verb. The present perfect emphasises the current relevance of the observation made and can carry complex implicatures which go beyond what is overtly stated. The perceptual meaning component of the verb *observe* is thus backgrounded.

5.2 The perception active frame

Attention can also be intentionally directed to some entity or phenomenon in order to gain some information about the state it is in. As a consequence, the verb *observe* can be complemented with a strong inference to a conclusion reached after mental elaboration. This reading emerges when, in the active construction, the object is substituted by structurally and conceptually complex *that*-clauses that summarise the perceptual experience made. This seems to bring to the foreground the cognitive dimension while relegating the perceptual dimension to the background. Because of this cognitive shade of meaning, the verb *observe* is construed in a reportive sense and could hypothetically be replaced by any other predicate expressing the idea of a decision made (e.g. *conclude*, *agree*, *decide*). The interpretation of the sentence would not change significantly⁴:

- (35) a. Munthe & Natvig *observed* that a greater percentage of the plasma cells in the synovium displayed an anti-IgG specificity following treatment with this enzyme;
- b. Munthe & Natvig *concluded* that a greater percentage of the plasma cells in the synovium displayed an anti-IgG specificity following treatment with this enzyme;
- c. Munthe & Natvig *agreed* that a greater percentage of the plasma cells in the synovium displayed an anti-IgG specificity following treatment with this enzyme;

Even in this interpretation, the verb *observe* continues to appear occurs almost exclusively with the simple past. The use of locative prepositional phrases remains common, whereas the tool or method used for the observation is not mentioned.

6. Conclusions

The corpus-based study of the verb *observe* in economic and scientific discourse appears to confirm our initial hypothesis, namely that specialized discourse acts as a constraint that produces a reorganization of the entire system. At the level of lexis, this is not only perceivable in the well-known features of terminology but also in the general lexicon. In line with the tenets of Lexical Complexity, *observe* has been shown to undergo a process of specialization in both economic and scientific texts, since the discursive environment acts as an overarching frame which favours processes of foregrounding/backgrounding of the various meaning

⁴ Sentences (35)b and (35)c are prefabricated examples.

components of the verb. In economic discourse the *comply with*-sense and the *statement* sense tend to be statistically more prominent, while the perceptual dimension tends to be backgrounded. Meaning selection dynamics also constrain the semantics of *observe* in scientific discourse, where the foregrounded dimension is either the physical act of unintentionally noticing something by means of an instrument or its metaphorical extensions referring to more cognitive processes.

To conclude, the data indicate the presence of a tendency even for generic lexical items – such as the verb *observe* – to exhibit increased biuniqueness in the verb conceptual portion selected by the text, and a more articulated manner of diagrammatic mapping, which overall tend to reduce the complexity of the lexical item, when it occurs in specialized texts. The pressure exerted by domain-specific language towards the reduction of ambiguity inherent in natural languages is revealed in this process of “specialization” affecting the whole system, which reaches its extreme fulfilment in the widely acknowledged features of specialized terminology.

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