

6 Teaching compound nouns in ESP: insights from cognitive semantics

Marie-Hélène Fries¹

Abstract

The objective of this chapter is to explore the relevance of cognitive linguistics for teaching [noun] + [noun] constructions to French learners of English for Specific Purposes (ESP), and more specifically, for process engineering. After a review of research on Compound Nouns (CNs) and explicit versus implicit learning, three basic tenets of cognitive linguistics are highlighted: the encyclopedic meaning of words (i.e. drawing on specialised knowledge in order to understand [noun] + [noun] compounds), the continuum between grammar and lexicon (learning CNs as terms, rather than as a grammar rule), and the symbolic nature of language (explaining CNs graphically). This chapter then reports on a case study of the use of [noun] + [noun] constructions by French learners of English for process engineering. Learners received explicit instruction on compound noun formation in two conditions: the experimental group (eight students) were taught via a cognitive-semantic approach, while the control group (eight students) received training in grammar (morphosyntactic approach). Data include CNs produced by the learners in summaries based on note-taking from specialised videos and in slideshows for internship presentations. Analysis and discussion claim an advantage for the experimental group in terms of implicit learning of specialised CNs, stylistic accuracy, and relevance of the graphical representation of CNs.

Keywords: cognitive linguistics, compensation strategies, compound nouns, implicit learning, specialised domains.

1. Université Grenoble-Alpes, Grenoble, France; marie-helene.fries@univ-grenoble-alpes.fr

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1. Introduction

Noun Phrases (NPs) cover a wide grammatical category which can include adjectives (as in ‘high pressure liquid chromatography’), participles (for instance ‘scanning tunnelling microscope’), adjunct nouns (as in ‘computer software’), and clauses, etc. This study has been prompted by research showing that NPs are far more frequent in English texts for Science and Technology (S&T) than in general English (Biber & Gray, 2016; Salager-Meyer, 1984), corroborated by the repeated observation, in the author’s teaching experience, that [noun] + [noun] constructions are especially difficult to master for French S&T students.

Although CNs have officially been part of the English syllabus for undergraduate S&T students in the University of Grenoble since 1990 at least (Upjohn, Blattes, & Jans, 2013) and are now formally taught again in some Master’s degree classes, especially chemistry and process engineering, students seem to have problems with the [noun] + [noun] construction, especially those who have a weaker level of English (A2 level on the Common European Framework of Reference for languages (CEFR) especially, and B1 in some measures). These difficulties can be largely explained by a comparison between French and English NPs. French is a Romance language and favours post-modification of the head noun, placing it first (for example *technologie de l’information*), whereas English, as a Germanic language influenced by Latin, mostly allows pre-modification, with the head noun coming last (*information technology*). In the British National Corpus, for example, Rossi, Frérot, and Falaise (2016, p. 175) counted about 12 times as many CNs as ‘of’ constructions per million words (16,460 [noun] + [noun] compounds versus only 1,330 instances for [noun] of [noun] NPs). In addition, whereas the relationships between the different nouns are stated explicitly in post-modification, through the use of prepositions and determiners, these semantic links are absent in pre-modification, as the [noun] + [noun] construction is simply based on juxtaposition (Downing, 1977). This may result in ambiguity in the absence of a clear context. For example, in S&T, a ‘satellite company’ can either be a type of subsidiary (metaphorically, in economics) or a firm producing and/or selling satellites.

The [noun] + [noun] construction is especially important in S&T, because it is a common way of coining new terms (Cabre, 1999). This issue is even crucial in some disciplines, such as chemistry, where the International Union of Pure and Applied Chemistry favours the [noun] + [noun] construction in naming chemical compounds (carbon dioxide, sodium chloride, etc.). The difficulties French students encounter with CNs are therefore professional, terminological and grammatical issues, which can best be addressed at the interface between ESP and didactics. The meanings of the word ‘compound’ seem to exemplify this link: in grammar, ‘compound nouns’ means nouns consisting of two or more words (and more particularly nouns in Upjohn et al., 2013), whereas in chemistry, a compound is a substance composed of two or more atoms.

The present study will start with a review of research already conducted on CNs in linguistics and terminology, as well as with the distinction between explicit and implicit learning in Second Language Acquisition (SLA), a dichotomy which could be useful in order to take a step back from the local teaching context. The relevance of a cognitive-semantic approach to CNs will then be explored through a case study conducted with 16 lower-intermediate Master students in process engineering during autumn 2016.

2. Research framework

Research on NPs in English includes various linguistic approaches, among which generative theory (Lees, 1963; Levi, 1978), pragmatics (Bauer, 1979), cognitive views (Benczes, 2011), and corpus studies (Bauer & Renouf, 2001; Biber & Gray, 2016). It covers morphology and syntax (Berent & Pinker, 2007; Olsen, 2000), phonology (Fudge, 1984; Giegerich, 2004), and semantics (Ryder, 1994). It is applied in translation studies (Maniez, 2007; Torres, 2015) as well as language acquisition (Parkinson, 2015; Wilches Alvear, 2016). Corpus studies are especially relevant for ESP, because they provide evidence for the frequency of written [noun] + [noun] compounds in science. Biber and Gray (2016, p. 148), for example, have found that the number of pre-modifying nouns increased steeply during the 20th century in their S&T sub-corpus.

Morphology, syntax, semantics and phonology are precious resources for English teachers, enabling them to understand the compounding process better. SLA studies have shown that learners' first languages (L1) have an influence on their use of [noun] + [noun] compounds. Parkinson (2015), for example, found that native speakers of Mandarin Chinese, whose L1 allows [noun] + [noun] constructions, use compound nouns more correctly in their writing than learners whose L1 does not allow such constructions, such as Portuguese students. Moreover, because [noun] + [noun] compounds often become lexicalised, students routinely encounter them every time they come across texts or videos linked to their main field of study, which implies that they could be learnt implicitly (through exposure to specialised language), as well as explicitly (thanks to the teaching of syntax and practice exercises, which are still common in France). The concept of implicit learning can be traced back to Krashen (1981, 1987) and has been the focus of two thematic issues of the journal *Studies in Second Language Acquisition* (vol. 27(2) 2005, vol. 37(2) 2015). There is now widespread agreement that explicit and implicit learning can be seen as two autonomous but interrelated processes (Ellis, 2003, 2005; Hulstijn, 2005). This quick survey of the research on [noun] + [noun] compounds suggests that it stands at the crossroads between ESP and didactics, drawing its basic materials (terms, texts and concepts) from specialised domains, and its epistemological stance (grammatical versus lexical, explicit versus implicit) from a conceptualisation of language learning.

At the University of Grenoble, the current English course in the Masters in Process Engineering allows for one hour of explicit teaching of CNs (including practice exercises). It would be difficult to devote more teaching time to the [noun] + [noun] constructions, as contact hours are limited (36 hours in the first year and 24 hours in the second) and all the Master students in process engineering need to validate the three competences the Association of Language Teachers in Europe considers essential for students at the B2 level at the crossroads of linguistic and professional skills, namely to be able to “give a clear presentation on a familiar topic, [...] scan texts for relevant information, [...] and make simple notes that will be of reasonable use for

essay or revision purposes” (Council of Europe, 2001, Appendix D, pp. 251-257). Accordingly, the syllabus focuses on Task-Based Language Teaching (TBLT): poster sessions based on popular science articles or research papers (to improve reading comprehension) for the first year and oral presentations and note-taking (based on process engineering topics), in the second year.

In these conditions, it seems tempting to explore alternative ways of explaining CNs that encourage implicit learning. Cognitive semantics seem to offer a suitable theoretical framework in this perspective. Firstly, cognitive linguists posit that the meaning of words is encyclopaedic and includes everything a user knows about these words (Croft, 2003; Langacker, 1987). This prompts a first research question: does the encyclopaedic meaning of words encourage S&T students to use the knowledge they have of their specialised domains to understand CNs? In other words, when French S&T students are in a situation where they are not just required to learn new words in order to please their English teacher, but really need to use the terminology of their specialised field while completing a ‘real life’ task, does it encourage implicit learning of [noun] + [noun] constructions? Secondly, cognitive linguistics has shown that there is a continuum between grammar and lexicon (Langacker, 1987, p. 3). This is exemplified by many lexicalised [noun] + [noun] compounds, which are examples of composition in the nominal group but have also found their way into dictionaries (e.g. iron oxide). This leads us to a second research question: could repeated exposure to key lexicalised CNs in a given specialised domain help students to use these CNs correctly? Thirdly, cognitive semantics, while agreeing with Saussure on the arbitrariness of signs, claims that “grammar is symbolic in nature” (Langacker, 1987, p. 2), particularly through the role played by metaphors and metonymies (Ruiz de Mendoza & Otal Campo, 2002). The naming process based on [noun] + [noun] composition can be interpreted as a “recursive sub-classification of the head” (Martin, 1988, as cited in Ormrod, 2001, p. 10). In Langacker’s (1987) words:

“The schema describing the basic pattern for English compounds identifies the second member of the compound as the profile determinant: football thus designates a ball rather than a body part,

carrot juice names a liquid rather than a vegetable, blackbird is a noun rather than an adjective, and so on” (p. 290).

This means that, in a [noun] + [noun] construction, the head (i.e. the last noun) represents a whole domain, or category, and that the first noun defines the profile (a sub-category within that domain). An analogy can be drawn between this compounding process and metonymies, i.e. tropes in which a phrase is substituted for another closely related expression. Croft (2003) convincingly argued that a metonymy basically consisted in highlighting an active zone (a sub-category) within a domain and Ruiz de Mendoza and Diez (2003) have developed a clear graphical representation system by showing that all types of metonymies can be reduced to part-for-whole or whole-for-part relationships, representing this with an arrow pointing either to the whole or the part, see Figure 1. The examples they give include “She’s taking the pill, where ‘pill’ stands for ‘contraceptive pill’” and “All hands on deck, where by ‘hands’ we refer to sailors who do physical work in virtue of the hands playing an experientially prominent role” (Ruiz de Mendoza & Diez, 2003, pp. 496-497).

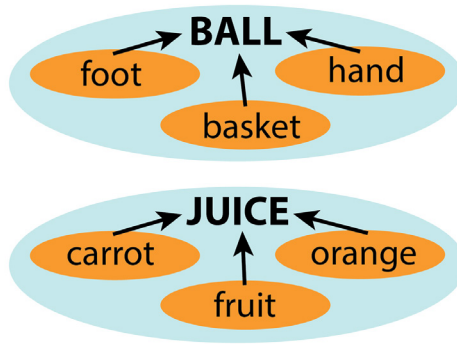
Figure 1. Diagrams inspired from Ruiz de Mendoza and Diez (2003, pp. 513-515)



This figure could easily be adapted for CNs, for example football or carrot juice, see Figure 2.

If we admit there is an analogy between metonymies and [noun] + [noun] compounding, because both are based on a highlighting mechanism, and if the graphic design used for metonymies can be used for CNs as well, we now come to a third and last research question: would this type of illustration help students find the correct word order in a [noun] + [noun] construction?

Figure 2. Adaptation for CNs



3. Methods

The case study reported below was carried out with process engineering students, because this Master's degree course covers a wide range of applied scientific topics. It has three main specialisms: energy engineering (including alternative sources of energy), environmental engineering (dealing with effluents and pollution), and chemical formulation (for the production of cosmetics or medicines). All the French students involved in this study were in the second year of their Master's degree. They had taken a computerised adaptive test² benchmarked on the CEFR on September 6th and were split into two comparable groups with the same English teacher. Sixteen students' results could be taken into account for this study (five learners at the A2 level and three at the B1 level in each group). The decision to take into account students' proficiency levels was motivated by a preliminary case study (Fries, 2015) in which the higher proficiency of students in the experimental group introduced a bias which made the findings difficult to interpret: were the results of the experimental group due to the way they were taught CNs, or to their better English level?

2. SELF (System of Evaluation for Languages with a Follow-up module for remediation). This adaptive test has been developed in Grenoble thanks to funds from the French national research agency.

The control group was taught [noun] + [noun] compounds according to the Minimum Competence in Scientific English textbook: “nouns can also be modified by other nouns, i.e. these nouns function as if they were adjectives. [...] This explains why they do not take an ‘s’ (with some exceptions), even after numerals” (Upjohn et al., 2013, pp. 138-139). In the experimental group, this was complemented with a cognitive-semantic approach focusing on the encyclopaedic meaning of words (students can draw on their specialised knowledge in order to understand CNs), the continuum between grammar and lexicon (CNs are also terms from specialised domains), and a graphic representation of [noun] + [noun] compounds as active zones within whole domains (see Figure 2 above, for example). This formal teaching was followed by practice exercises.

Then, during term time, both experimental and control groups followed a TBLT course which focused on note-taking and oral presentations. For both groups, the marked in-class assignments included written summaries of two videos dealing with energy transition in Denmark (‘Smart energy systems: 100% renewable energy at national level’³) and with pharmaceutical formulation (‘Fighting malaria with green chemistry: Artemisinin’⁴). For both groups, the final examination was an oral presentation on the internships they had done the previous year, in front of a jury comprising of a process engineering teacher and an English as a foreign language teacher. Although the teaching programme in both groups was exactly the same, the way the written assignments were corrected differed. In the control group, incorrect CNs were underlined and the letters ‘CN’ written in the margin (which meant there was a mistake to be corrected in the [noun] + [noun] construction), whereas students in the experimental group also had drawings with circles and arrows written in the margin to help them. Correct CNs were underlined in green in both groups.

The learner data used for this study are thus twofold. The first part includes the record of all the [noun] + [noun] constructions students used in the video-based summaries they wrote in class after the lesson they had on CNs, which

3. Podcast retrieved from <https://www.youtube.com/watch?v=eiBiB4DaYOM>

4. Podcast retrieved from <https://www.youtube.com/watch?v=FfAJdnKqRC0>

allows for a comparison of the performances of the two groups for the same tasks. The second part is a micro-corpus made up of the slideshows the students prepared for their final presentations, in which they were free to choose the words they wanted. In order to keep the two sets of data comparable, they have been restricted to written English, so the transcripts for the oral presentations themselves have not been included. The students were not asked to prepare a written version of their presentation, because it was felt counterproductive from a TBLT point of view: it would have encouraged them to read, instead of using public speaking skills.

4. Analysis and results

On the whole, both groups were able to grasp the CNs expressing the topic of each video and the key information given⁵. For the video on artemisinin, students in the control group as well as the experimental group identified the cause for the disease (malaria/plasmodium parasite), its target in the human body (blood cells, blood stream), and the name of the molecule which kills the parasite (hydrogen peroxide). However, students in the experimental group were much more precise in their use of CNs expressing a chemical reaction (extraction step, reaction step, solvent choices, water solvent...). In the second video, both groups were able to identify three key CNs: energy resources (wind turbines, wind energy/power), energy production (hydrogenation plants), and energy consumption (transport sector), but students in the control group were able to give a more detailed account of energy production (biogas plants, energy crops, fuel cells...). The tentative conclusions which can be drawn from these findings is that the textbook-based teaching given to all the students seems a sound basis to help them understand and reuse key CNs, with no clear added value coming from the cognitive perspective. In other words, it appears that the cognitive-semantic approach to teaching [noun] + [noun] constructions can at best complement, but in no way replace, a morphosyntactic perspective. In order to see more clearly what the benefit of the cognitive approach could be

5. See supplement, parts 1 and 2: <https://research-publishing.box.com/s/80f8vaff3ohlyxdw8gd9pqh1db6t4y5q>

in terms of implicit learning, appropriate style and word order, we now need to turn to the presentation slides. A concordance analysis of the slideshow corpus is shown in [Table 1](#).

Table 1. Concordance analysis of the slideshows

	Experimental group (Cognitive-semantic approach)	Control group (Morphosyntactic approach)
Total number of words (tokens)	4,258	4,252
Word types	2,370	1,686
[noun] + [noun] compounds	214	152
CNs quoted more than 10 times in the Web of Science (WOS)	73	67
Within-group variation		
Min	2	3
Max	19	16
SD	4.8	4.4

The two-gram function of the Antconc concordancer⁶ was used for the slideshow corpus and yielded 4,258 two-gram tokens and 2,370 two-gram types for the experimental group, versus 4,252 two-gram tokens and only 1,686 two-gram types in the control group, among which 214 were [noun] + [noun] constructions in the experimental group, versus 152 in the control group⁷. CNs were then checked in the WOS, a multi-disciplinary database of peer-reviewed journals, in order to compare the learners' writing with an expert corpus. All CNs quoted less than 10 times in the WOS were taken out. The results were 73 CNs for the experimental group and 67 in the control group, with wide variation across individuals. In the experimental group, one student produced only 2 CNs, while another produced 19, whereas in the control group, the range was 3 to 16, with standard deviations of 4.8 versus 4.4⁸.

6. Concordancer retrieved from <http://www.laurenceanthony.net/software/antconc/>

7. Each of these constructions had to be checked manually in its context, because of formatting issues related to slide decks: Antconc does not take bullet points into account in its two-gram function. For example, an introductory slide containing four bullet points (Introduction - Results - Implementations - Conclusion), yielded "introduction results, results implementations and implementations conclusion".

8. See supplement, parts 2 and 3: <https://research-publishing.box.com/s/80f8vaff3ohlyxdw8gd9pqh1db6t4y5q>

Considering the small number of students involved in this case study and the extent of individual variation among them, the analysis that follows will focus on three qualitative elements: evidence for implicit learning of CNs, stylistic appropriateness for the required task, and reliability of the cognitive explanation given for word order in CNs. Implicit learning can be inferred from the presence of highly specialised CNs, referring to a technical knowledge coming directly from the student's internship, rather than from the English class. In the experimental group, these highly specialised CNs are drawn from the domains of chemistry (sodium carbonate, calcium aluminates), physics (phase diagram), spectroscopy (absorbance spectrum, transmittance spectrum), and fluid mechanics (vortex street). A definition is even provided by Student 4 in his slides: "A Karman vortex street is a repeating pattern of swirling vortices caused by the unsteady separation of a fluid around blunt bodies". In the control group, on the other hand, all the highly specialised CNs are chemical compounds (ammonia water, sodium valproate, tungsten carbide). This seems to indicate that students in the experimental group were able to translate the knowledge gained during their internship into [noun] + [noun] compounds more easily than in the control group.

Secondly, the special place of CNs in the middle of the continuum between grammar and lexicon might be able to account for their potential for compressing the meaning of a whole phrase into a single [noun] + [noun] construction. This is particularly useful for powerpoint slides, where whole sentences should be avoided as a rule and replaced by key points only. In the experimental group, almost half of the CNs were used on their own in a bullet point, whereas roughly three-quarters of the CNs written on the control group's slides were included in whole sentences. Constructions such as "failure modes and effect analysis", "weight assessment calculation", or "membrane separation technique" made the slides look as if the students really knew what they were talking about, while providing them with visual help for their oral presentations at the same time. The use of CNs in bullet points therefore worked in some measure as a compensation strategy, allowing students to hide their weaknesses in written English. Student 1, for example, who was creative in reusing CNs adequately and even coining elaborate new ones, such as "fruit juice phase diagram", also continued to

make CN errors: “Works to comprehend the connection between food and its environment to develop generic tools for processes optimisation”.

Finally, the large thematic scope of the CNs used by process engineering students on their slides allows us to check if the conceptualisation of a [noun] + [noun] compound as an active zone within a domain can really account for CNs in a wide range of scientific and technical fields. On the whole, mistakes in word order are infrequent in the slideshow corpus: only two in the experimental group (“area electrolysis” and “energy household”) and three in the control group (“estimate energy losses”, “storage ammonia”, and “unit production”). All [noun] + [noun] compounds can be accounted for by the highlighting pattern, except a handful of figurative CNs, which are based either on a metaphor (cement plants, head office, key words) or on a metonymy (host organisation). The highlighting pattern therefore seems to be representative enough to be used as a teaching heuristic for CNs in S&T.

5. Conclusion

This exploratory case study of the use of CNs among French masters students in process engineering suggests that a cognitive-semantic approach to CNs could be beneficial to ESP teaching, as a complement to a morphosyntactic perspective. First of all, emphasis on the encyclopaedic meaning of words draws students’ attention to the terminology of their specialised field of study. It therefore allows students to draw on their expertise in their specialised fields in order to understand CNs better. It also makes them aware of the fact that CNs are a clear example of the continuum between lexis and grammar, so that learning key lexicalised NPs will also help them to use [noun] + [noun] constructions correctly. This terminological perspective can also be used as a compensation strategy for slideshows, if students use more CNs and fewer verbs, thus adapting their scientific and technical writing to the appropriate register. Finally, a graphic representation of CNs as circles and arrows, though failing to capture a small number of figurative CNs, seems representative enough to guide students in choosing the right word order in the compounding process, so it seems useful,

on the whole. These findings stand at the crossroads of didactics and ESP. Without drawing a distinction between explicit and implicit learning, it would be impossible to understand how students can use the terminology of their main fields of study correctly without studying it in their English classes. On the other hand, without taking into account specialised domains, it is quite difficult to understand why students should use CNs more accurately in fields of knowledge they are familiar with. However, this is only an exploratory case study, based on a very small learner corpus. It now needs to be followed by similar studies based on novice and expert corpora, for various fields.

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