Teaching English Language, Vol. 11, No. 2, Summer & Fall 2017, pp. 131-159

Exploring Nominalization in Physics and Applied Linguistics Textbooks with Different Levels of Difficulty: Implications for English for Specific Purposes

Alireza Jalilifar
Shahid Chamran University of Ahvaz, Iran
Mehran Memari[1]
Shahid Chamran University of Ahvaz, Iran

Abstract

This study sought to investigate the variational use of nominalization in Physics and Applied Linguistics textbooks representing the hard and soft ends of the continuum of sciences, respectively. The study also aimed to compare and contrast the functions of nominalization used in the respective textbooks. To do so, 16 textbooks, eight in each discipline, suggested by experts in each field were selected; four of the textbooks in each discipline were the representatives of a higher level of linguistic difficulty and the other four exemplified a lower level. Analysis involved extracting nominal expressions and estimating nominalization density. The results showed that besides minor variations, we could identify little appreciable difference in the way nominal expression types are rendered in Physics and Applied Linguistics textbooks. It can also be concluded that nominalization is not regarded as characteristic of all academic disciplines but it might be possible to arrange disciplines on a cline of nominalization. This being so, one argument raises doubts over the use of nominalization as a rhetorical strategy to increase density or technicality at least in some, if not in many, disciplines. The idea appears premature, and thus further research might reveal more disciplinary tendencies and inclinations.

Keywords: Nominalization, Textbook, Readability, Grammatical Metaphor

Received on January 11, 2017
Accepted on August 28, 2017

1. Introduction

As an integral part of everyone's academic life, writing is considered to be a language skill that every individual should go through. Though some of the

[1] Corresponding author: memari_english001@yahoo.com

writings throughout our lives are personal, in formal and technical situations our writings need specific characteristics (Hartley, Sotto & Fox, 2014). As a variety of language use, academic discourse is characterized by its own technical register (Halliday & Martin 1993), and it has affected almost all disciplines within which knowledge is generated.

The study of scientific discourse has garnered the attention of researchers interested in this area of enquiry, not only for the characterization of this register in particular but, more widely, for language as such (Halliday & Martin, 1993, p. 8). Research on language has focused on a verisimilitude of areas, including academic discourses (e.g., Banks, 2008; Halliday & Martin, 1993), analyses of specific discourse fields (e.g., O'Halloran, 2005), and the discourse of mathematics, and genres (e.g., Swales, 1990, 2004) to mention only a few. Although many works are based on small text samples, there is already a considerable amount of corpus-based research on scientific discourse. Studies on academic discourse from the lens of corpus-based linguistics either draw on a particular register or adopt a broader approach to analysing academic language (e.g., Bartsch, 2009; Conrad & Biber, 2001; Hyland, 2007, 2009).

The academic textbook is somewhat of a blurred genre (Parodi, 2009). It is the dominant genre of formal education, and its main communicative purpose, according to Bhatia (1998), is to "make accessible established knowledge in a particular discipline to those readers who are being initiated into a specific disciplinary culture" (p. 17). Textbooks are core learning materials or documents both in printed and in electronic forms (Klemencic, 2014).

Academic disciplines include specific types of texts with precise linguistic features (Conrad, 1996). The discipline of science involves a specialized grammar with several characteristic language features that have

been extensively studied (Derewianka, 1992; Fang, Lamme, & Pringle, 2010; Fang & Schleppegrell, 2008; Fang, Schleppegrell & Cox, 2006; Halliday, 1996a; Kazemian et al., 2013). It has been argued that scientific writing relies heavily on the language of science and that scientific texts cannot be written in another manner (Halliday, 1996a).

The language of science in general, and by association the language of textbooks in particular, is of highly abstract level (Christie, 2002; 2012; Derewianka, 1992; Fang, 2004; 2008; Fang, Lamme, & Pringle, 2010; Fang & Schleppegrell, 2008; Halliday & Martin, 1996). Abstractions occur when concrete processes are turned into abstract participants. Nominalization is a prevalent type of abstraction that is likely to create a participant. Research states that scientific writing contains large numbers of nominalizations because of their importance in the design of scientific texts (Halliday & Matthiessen, 2014; Kazemian et al., 2013).

The use of nominalization in scientific writing helps to condense information (Taverniers, 2004). Thus, in addition to saving the writer from repeating long descriptions, this linguistic device reduces longer phrasal constructions, making scientific language more compact, more functional. Nominalizations produce a greater concentration of the experiential meaning and a smaller incidence of interpersonal elements, such as personal pronouns and modal verbs, thus presenting information in a less personalized way (Taverniers, 2004). Furthermore, research has promulgated that nominalization influences the text formality and density (Ure & Ellis, 1977).

Parallel with lexical density, text difficulty (usually termed readability) is commonly associated with text readability which is per se dependent on text content. Accordingly, there is a relationship between readers' background knowledge and their ability to read and comprehend texts. It is commonly

known that complexity in scientific language is achieved mainly through specific terminology and nominalization, which is part of grammatical metaphor (GM). Surveys have shown that nominalizations, as the main manifestation of the Ideational Grammatical Metaphore (IdGM), feature frequently in the scientific discourse (e.g., Halliday & Martin, 1993; Halliday & Matthiessen, 2004).

Though a large body of research has been done on various types of nominalization and their application in business, political, and academic texts (Banks, 2003; Colombi, 2006; Farahani & Hadidi, 2008; Hadidi & Raghami, 2012), Jalilifar, Alipour, & Parsa, 2014; Saleh, 2016; Martin, 1993; Steiner, 2003; Sušinskienė, 2009; Tabrizi & Nabifar, 2013; Wenyan, 2012, further research on nominalization in textbooks, specifically with different levels of complexity in different disciplines, is warranted.

Given the argument made by Systemists that complexity in scientific language is achieved mainly through specific terminology and nominalization, the idea that "disciplines and professions are largely created and maintained through the distinctive ways", and that "members jointly construct a view of the world through their discourses" (Hyland, 2006, p. 114) makes it necessary to explain each discipline with respect to the difficulty level and nominalization density. To this end, this study seeks to investigate the variational use of nominalization from the perspective of grammatical metaphor in academic textbooks in Physics and Applied Linguistics as an example of hard and soft sciences, respectively. This study also tries to compare and contrast the functions of nominalization used in the respective textbooks. In the light of the above issues, the following research questions stand out:

1. To what extent is nominalization density reflected in the difficulty level of the sample of hard science textbooks?

2. To what extent is nominalization density reflected in the difficulty level of the sample of soft science textbooks?
3. Is there any significant difference between the nominal functions used in hard and soft science textbooks?
4. In classifying the different communicative functions served by nominalizations, is there any general trend in the rhetorical functions of nominalization in the samples of soft and hard science textbooks?
5. Is there any particular reason for the occurrence of any probable general trend or exceptions to that trend in the sample textbooks?

2. Methodology

This study addressed the question of whether the difficulty level and complexity of the textbooks are reflected in the density and variational use of nominalization. Likewise, the study compared and contrasted the functions of nominalizations used in the respective textbooks. To this end, the study adopted a top-down approach, applying a mixed-methods design for analysis.

2.1 Theoretical Frameworks

Systemic Functional Linguistics (SFL) (Halliday, 2004; Halliday & Martin, 1993) and register analysis (e.g., Biber 1988, 1995; Conrad & Biber, 2001) form the theoretical backgrounds of this research. The latter approach enables one to determine whether a particular linguistic feature is more frequent in one register than another in a more objective way, and encompasses a description of the functional characteristics (Biber & Conrad, 2009). In order to identify nominal expressions in the texts and to render them in congruent domains to identify their process types, it is necessary to select a model or models to analyze the data. Halliday and Matthiessen (1999) categorize grammatical metaphor into 13 types of which the first four types are classified as nominalization (Table 1). This model constitutes the main theoretical foundation of the research and for characterizing the discipline.

Table 1

Types of Nominalization (derived from Halliday & Matthiessen, 1999)

Type		Grammatical Shift		Semantic Shift	
		Grammatical Class	Grammatical Function	Congruent	Metaphoric
1		Adj. → N.	epithet/attribute → thing	quality	thing
2		V. → N.		process:	
	i		event → thing	event	
	ii		auxiliary → thing	tense modality	
	iii		attentive → thing	phase; contingency	
3		Prep.(phrase) →N.			
	i	Preposition	Minor →process thing	Minor process	
	ii	Prep. phrase	Location, extent →classifier	Minor process + thing	
4		Conjunction → N.	Conjunctive → thing	relator	

2.2 Textbook Selection

There are many classification schemes for scientific literature into appropriate subject fields. Among these various classifications, Glanzel and Schubert's (2003) is "one of the basic preconditions of valid scientometric analyses" (p. 357). Glanzel and Schubert's (2003) classification includes a two-level hierarchical classification scheme for three main discipline areas: *Sciences, Social Sciences, and Humanities*. By adding one more major area, that of *Applied Disciplines*, Coffin, Curry, Goodman, Hewings, Lillis, and Swann (2003) provided some representative examples for these four main discipline areas.

This analysis rests on the most convenient way of grouping disciplines into the above four main areas. As illustrated in Figure 1, these four main areas are viewed in a continuum from hard sciences to soft applied disciplines (Hyland, 2009).

SciencesSocial SciencesHumanities/ArtsApplied Disciplines

Hardest ⟸ ---------- ⟹

Fig. 1. Continuum of disciplines

The selected disciplines were Physics and Applied Linguistics representing the hard and soft ends of the continuum of sciences, respectively. Decision on the books was made by consulting six experts in each discipline. To this aim, the university professors in the related departments at three Universities in Iran were met, and they were requested to recommend the most key textbooks in their own disciplines suitable for undergraduate and graduate levels. Twenty four common textbooks, 12 in each discipline, suggested by the experts were selected. One of the major criteria was that the textbooks would have to be authored by English speaking researchers. The readability of the textbooks was determined statistically using The New Dale-Chall Formula. The formula is unique because this formula calculates the grade level of a text sample based on sentence length and the number of hard words. From among the seven grades above, four grade levels, grades, 13 – 15, are for undergraduate students, and grade 10 is for graduates. The Dale-Chall Adjusted Grade Level is shown in Table 3.

Table 3
Dale-Chall Adjusted Grade Level

Dale-Chall Adjusted Grade Level Table

Final Score	Grade Level
4.9 and Below	Grade 4 and Below
5.0 to 5.9	Grades 5 - 6
6.0 to 6.9	Grades 7 - 8
7.0 to 7.9	Grades 9 - 10
8.0 to 8.9	Grades 11 - 12
9.0 to 9.9	Grades 13 - 15 (College)
10 and Above	Grades 16 and Above (College Graduate)

Finally, from the 24 books suggested and based on the results from the New Dale-Chall Formula, 16 books representing the discipline were chosen, four with a low difficulty level and four with a high difficulty level, as shown

in Tables 4 and 5. Of each book, the chapters other than the first and the last ones were studied, because the first chapter usually sets the scene and introduces the preliminaries, and the last chapter oftentimes wraps up the topic.

Table 4
Selected Physics Textbooks and Their Readabilities

Books	Readability		Level
	Final Score	Grade	
1. Fundamentals of Physics	9	13 - 15	Low
2. Electricity and Magnetism	9.1	13 - 15	Low
3. Fluid Mechanics	8.6	11 - 12	Low
4. Physics for Engineers and Scientists	9.2	13 - 15	Low
1. Diffusion and Reactions in Fractals and Disordered Systems	10	16	High
2. Statistical Physics of Particles	10.2	16	High
3. Monte Carlo and Molecular Dynamics Simulations in Polymer Science	10	16	High
4. Complex Networks: Structure, Robustness and Function	10.1	16	High

Table 5
Selected Applied Linguistics Textbooks and Their Readabilities

Books	Readability		Level
	Final Score	Grade	
1. An Introduction to Language	9.1	13 - 15	Low
2. The Easy Writer: Formal writing for academic purposes	9.0	13 - 15	Low
3. An Introduction to Language and Linguistics	9.4	13- 15	Low
4. Testing for Language Teachers	9.2	13 - 15	Low
1. Understanding Language Acquisition : The Framework of Learning SUNY Series, Literacy, Culture, and Learning	10.1	16	High
2. Functional Grammar	10.5	16	High
3. Metadiscourse: Exploring Interaction in Writing	10.1	16	High
4. Genre Knowledge in Disciplinary Communication	10.3	16	High

2.3 Quantitative Analysis

In ideational grammatical metaphor, lexicogrammatical metaphor features are rearranged to put forth a certain view of reality in an incongruent way. They constitute an alternative way of constructing a picture of reality (Taverniers, 2004). The original forms, labeled congruent, occur when the elements of grammar are conforming to their characteristic functions (Christie, 2012). Accordingly, nouns behave as things and entities and verbs show actions, behaviors, and thoughts whereas circumstances communicate where, when, and why typically indicated by prepositional phrases, adverbs, or adverb clauses.

In light of Halliday's (1978, 1994) SFL theory and Halliday and Matthiessen's (1999) taxonomy of nominalizations, the first stage of the analysis was done as the pilot study. In this stage, about 10% of the data in each group was analyzed manually to recognize different types of nominalization. Among the nominals recognized in the pilot study, two kinds of nominals were problematic, namely technical words, and –ing ending nominals. Because technical words are fixed expressions and refer to phenomena that cannot be changed, and there was no trace of verb meaning in them, they were not regarded as nominal expressions. Still, expressions ending in -ing derived from verbs were not instances of nominalizations. These instances of the –ing ending fell outside the scope of our analysis because they could not be recognized as incongruent forms of words and their unpacking seemed injudicious. In addition to these two parts, all the footnotes and headings, and also the writings under the tables and figures were taken away from the study. To improve the reliability of our text analysis, intercoder and intracoder procedures were implemented to be sure that the instances of nominalizations are identified with a high degree of

accuracy. For inter-coder reliability, a second coder checked the data independently; and to control intra-coder reliability, the researcher re-analyzed 150 pages within an interval of about one month. Finally, among different 19 types of nominalization found in different studies, 15 types were found in this study. Since the data were nonparametric, and variables were categorical (nominal categories), phi-correlation was employed to calculate coding reliability. The Kappa coefficient was then applied to obtain the indices of inter-coder and intracoder reliabilities. Then, cases of disagreement were resolved or omitted from the data. When the list was compiled, the whole corpus was analyzed. The index of intercoder reliability was 0.812, and that of intra-coder reliability was 0.849 (Table 6).

Table 6
Inter/Intra Coder Reliability

	Symmetric Measures			
	Value	Asymp. Std. Error[a]	Approx. T[b]	Approx. Sig.
Measure of Agreement Kappa **Inter Coder**	.812	.071	7.264	.000
Measure of Agreement Kappa **Intra Coder**	.849	.068	7.681	.000
N of Valid Cases	98			

a. Not assuming the null hypothesis.
b. Using the asymptotic standard error assuming the null hypothesis.

Secondly, the analysis of the whole corpus began with the identification of the 15 types of nominalized expressions and continued until the diversity of the expressions was found to be clear and consistent. After establishing and extracting nominals, an effort was made to render metaphorical expressions in congruent expressions, because, according to Halliday (1985, 1994), each metaphorical wording must have its equivalent congruent wording. It is worth noting that unpacking metaphorical wordings into congruent forms was based on inventories represented by key researchers in

the field (e.g., Eggins, 2004; Halliday, 1985; Halliday & Matthiessen, 1999; Martin et al, 1997; Thompson, 2004).

In the third stage, by calculating the proportion of nominal expressions to the total words in each section of the textbooks, nominalization density was estimated. Afterwards, the mean frequency of nominal use was calculated for a thorough comparison between the nominals in the textbooks within each discipline separately. Once the frequencies and percentages of the use of nominals in the high and low subgroups were calculated, with the subgroups being related and the variables being categorical, McNemar test was exploited to calculate possible differences between the high and low groups.

2.4 Qualitative Analysis

Nominals, found in our corpus, were to be checked and analyzed in their contexts to find and recognize their functions. Therefore, in the qualitative phase of the study, the data were scrutinized with the aim of finding any general trend in the rhetorical functions of nominalization in the sample textbooks. In recognizing any general trend in the rhetorical functions of nominalizations, we tried to justify any reason behind the occurrence of any probable general trend or exceptions to that trend in the sample textbooks. The following section presents samples from the patterns or rhetorical functions we identified in the data.

3. Results and Discussion

The 15 patterns of nominalization emerging from our analysis along with the illustrative examples extracted from the data are presented below. This will be followed by explaining the findings emerging from each discipline in focus.

Table 7

Nominal Patterns and Related Examples

No.	Patterns and related examples
1	*(Preposition) + Nominal + Infinitive* There is the possibility to derive the behavior of a macroscopic body from the knowledge of its components. (*Ph. 1. H*)
2	*Preposition + Nominal + Preposition* Without knowledge of the language, one can't tell how many words are in an utterance. (*AL. 2. H*)
3	*(Premodifier) + Premodifier + Nominal + Preposition* The absence of loops in the Cayley tree allows one to solve the percolation model (and other physics models) exactly. (*Ph. 2, L*)
4	*(Premodifier) + Nominal + Adjective as post modifier* The dictionaries that one buys in a bookstore contain some of the information found in our mental dictionaries. (*AL. 3. L*)
5	*Preposition + Nominal + Deictic* In closing this chapter, we would like to mention that … (*Ph. 4, H*)
6	*Nominal + Noun (Phrase)* This is in contrast to the broad bright fringes characteristic of the two-slit interference pattern (see Fig. 37.6). (*Ph. 1, L*)
7	*Nominal + Nominal* About one in a thousand babies is born deaf or with a severe hearing deficiency. (*AL. 2. L*)
8	*Noun + Nominal + (Prepositional Phrase)* That is, one obtains the same logarithmic time dependence for any direction of the bias field! (*Ph. 4, L*)
9	*Nominal + Preposition* Inflectional morphemes represent relationships between different parts of a sentence. (*AL. 3. L*)
10	*Premodifier + Nominal* Beginning with the latter we guess 7} = *ai*, and, on plugging this into (9.1), we find *a* =— *l/E*. (*Ph. 4, L*)
11	*(Premodifier) + Nominal + Verb Phrase* A case of special importance is one where there is rotational symmetry about an axis, which we call the z axis. (*Ph. 3, H*)
12	*Deictic + (Epithet) + Nominal* The *r*-less dialect still spoken today in Boston, New York, and Savannah maintains this characteristic. (*AL. 3. H*)
13	*Preposition + (Premodifier) + Nominal* The failure was felt in all areas of learning and perception, the core of behaviorism. (*AL. 4. L*)
14	*Premodifier + Nominal + Relative Clause* Similar behavior is observed in the vicinity of line charges. It is clear from the above discussion that the charge density corresponding to a point charge can be represented by a Dirac delta function (see Example 1.4). (*Ph. 2, H*)
15	*Numerative + Nominal* The point of view of these studies is slightly different than the one expounded above. (*Ph. 4, H*)

3.1 Physics

This section illustrates the tokens and types of nominalization in the discipline of physics at the two aforesaid levels of difficulty. The nominal frequencies and patterns are also presented. Half of the dataset in this discipline includes four Physics books with a high level of difficulty. The number of pages and words and also nominal expressions helped us find out the nominal frequencies and density.

Table 8
Nominalization Frequencies in Books with a High Level of Difficulty

Field	Books	Pages	Words	Nominals	%
Physics	High 1	55	28050	78	0.278
	High 2	81	41115	143	0.347
	High 3	158	75122	223	0.296
	High 4	48	26140	99	0.378
Total		342	170427	543	0.319

Of the total corpus investigated (170427 words), irrespective of the slight variation involved in the four studied books, only 543 nominal expressions were located. That means Physics texts with a high level of difficulty are not overly dense in terms of nominalization, and therefore any decision on the results obtained should be very cautiously interpreted.

Results indicated that all the identified nominal expressions are dispersed in the dataset, partially meaning that the occurrence of the nominal expressions is hardly stylistic. The most frequent pattern used in the four textbooks is pattern 3 (19.35) and the least frequent pattern is 10 (1.84). The order of patterns in terms of their frequency of occurrence in high level Physic books is also presented in Table 9.

Table 9
Patterns in Books with a High Level of Difficulty in Order of Occurrence

No.	Pat.	Raw	%	No.	Pat.	Raw	%
1	**3**	105	19.35	9	**14**	26	4.71
2	**6**	79	14.51	10	**15**	25	4.66
3	**9**	55	10.50	11	**12**	17	3012
4	**2**	49	8.95	12	**13**	15	2.69
5	**11**	43	7.84	13	**4**	14	2.57
6	**5**	35	6.55	14	**7**	10	1.84
7	**1**	31	5.64	15	**10**	10	1.84
8	**8**	31	5.69				

Another part of the dataset in this discipline includes four books with a low level of difficulty. To find out the nominal frequencies and density, the number of pages and words as well as nominal expressions is presented here.

Table 10
Nominal Frequency in Books with a Low Level of Difficulty

Field	Books	Pages	Words	Nominals	%
Physics	Low 1	106	53770	172	0.319
	Low 2	130	66302	144	0.217
	Low 3	224	94610	204	0.215
	Low 4	658	129720	195	0.150
Total		342	344402	715	0.207

Table 10 displays that, overall, the nominalization density in Physics books with a low level of difficulty is 0.207. These results witness the lower density of nominal structures in linguistically more manageable texts compared to this characteristic in linguistically less manageable texts.

Surprisingly, patterns 1 and 15 have not been implemented in Physics books with a low level of difficulty. The most frequent pattern used in the books that correspond to this level is pattern 3 (18.64) and the least used pattern, other than types 1 and 15, is pattern 5 (1.30). The other patterns fall somewhere in between. Table 11 displays the order of the patterns in terms of their frequency of occurrence.

Table 11
Patterns in Physics Books with a Low Level of Difficulty in Order of Occurrence

No.	Pat.	Raw	%	No.	Pat.	Raw	%
1	**3**	134	18.64	9	**14**	26	3.57
2	**6**	89	12.37	10	**11**	24	3.39
3	**8**	86	11.96	11	**4**	24	3.31
4	**10**	82	11.44	12	**7**	13	1.96
5	**2**	71	9.86	13	**5**	9	1.30
6	**12**	64	9.39	14	**1**	0	0
7	**13**	61	8.47	15	**15**	0	0
8	**9**	32	4.50				

Given the argument made by Systemists that complexity in scientific language is achieved mainly through specific terminology and nominalization, this study addressed the question of whether the difficulty level and complexity of the textbooks are reflected in nominalization density.

Comparing nominalization density and readability or complexity has proved the claim by systemists (SFL) about the direct relation between nominalization density and readability or complexity (See Tables 8 & 10).

Nominal expressions in Physics books with a high level of difficulty are more frequent than the nominal expressions in Physics books with a low level of difficulty. This result shows the correspondence between nominalization density and text complexity claimed in the literature. Thus, nominalization density is reflected in the difficulty level of the sample of hard science textbooks.

In comparing the order of occurrence of nominal expression types (Tables 9 & 11), results revealed variations in Physics textbooks with high and low levels of difficulty. The most frequent types of nominal expressions in the two sets of books are patterns 3 and 6. This result might lead us to conclude that these latter patterns represent disciplinary specificity without considering complexity or readability. Besides minor variations, we could identify little appreciable difference in the way nominal expression types are rendered in the Physics textbooks. The results driven from the comparison by the Chi-Square are displayed in Table 12.

Table 12
Nominal Patterns Frequency Comparison in Physics Books

P	Chi-square	df	Nominal patterns
0.000*	29.03	1	1
0.000	2.82	1	2
0.009	3.01	1	3
0.013	2.70	1	4
0.003*	14.21	1	5
0.542	0.48	1	6
0.469	0.17	1	7
0.000*	24.92	1	8
0.011	2.78	1	9
0.000*	54.79	1	10
0.004*	4.84	1	11
0.000*	28.58	1	12
0.000*	26.65	1	13
0.849	0	1	14
0.000*	23.04	1	15

What stands out from the statistics shown in Table 12 marks a statistically significant difference in patterns 1, 5, 8, 10, 11, 12, 13 and 15 between the books with high and low levels of difficulty.

Pattern 1 ((Preposition) + Nominal + Infinitive)

The distribution of this pattern with the core obligatory syntactic structure of Nominal + Infinitive (5.64%) only in the Physics books with a high level of difficulty illustrates complexity distinction. Distributed in all the Physics books with a high level of difficulty, this pattern can hardly be considered as an individual stylistic preference. In general, pattern 1, which serves the textual function of purpose and possibility, is shown in the examples presented below:

There is, however, a **possibility** to start with energies larger than N_/2, which correspond to *negative temperatures* from Eq. (4.20). (*Ph. 2. H*)

1)The first **step** to find the equilibrium positions is, __q ∗ 1_, , , __q ∗ n_, by minimizing the potential. (*Ph. 4. H*)

Pattern 5 (Preposition + Nominal + Deictic)

The different distributions of pattern 5 (the nominal group followed by deictic expressions as postmodifiers) in the two datasets can elucidate peculiarities of each set of data: the occurrence rate of 35 (6.55) in the books with a high level of difficulty and 9 (1.30) in the books with a low level of difficulty. Findings from this study illustrated the function of particularity realized through deploying deictic expressions following the nominal. The tokens for pattern 5 are presented below.

2) Canonical ensemble: a fixed temperature T = 1/kB_ can be achieved by **putting** the system in contact with a reservoir. (*Ph. 4. H*)

Pattern 8 (Noun + Nominal + (Prepositional Phrase)

Pattern 8 with the syntactic structure of noun as premodifier and prepositional phrase as postmodifier of the nominal as the head demonstrated different distributions in the two dataset. This diversity can clear up the

property of each set of data: the occurrence rate of 31 (5.69) in the books with a high level of difficulty and 86 (11.96) in the books with a low level of difficulty. This pattern serves the function of particularity through using classifiers (noun) in nominal groups. The classifiers in nominal groups are powerful assets in elaborating the concepts more particularly. The tokens for pattern 8 are presented below.

3) The standard **construction** (Fig. 20.14) consists of a double walled Pyrex glass vessel with silvered walls. (*Ph. 2. H*)

Pattern 10 (Premodifier + Nominal)

The varied distribution of pattern 10 (the nominal group proceeding premodifier) in the two datasets can elucidate peculiarities of each set of data: the occurrence rate of 10 (1.83) in the books with a high level of difficulty and 82 (11.44) in the books with a low level of difficulty. Findings from this study again illustrated the function of particularity realized through deploying premodifying expressions preceding the nominal. The tokens for pattern 10 are presented below.

4) We can treat the Earth as a particle and obtain reasonably accurate data about its **orbit**. (*Ph. 1. L*)

Pattern 11 ((Premodifier) + Nominal + Verb Phrase)

The distribution of pattern 10 (with the core obligatory elements of nominal group followed by verb phrase, and the optional premodifier) in the two datasets can elucidate specificities of each set of data: the occurrence rate of 43 (7.84) in the books with a high level of difficulty and 24 (3.39) in the books with a low level of difficulty. Such compound nominal groups increase the lexical density of the text as a result of carrying more content words than functional words. The tokens for pattern 11 are presented below.

5) A schematic diagram of Joule's most famous **experiment** is shown in Figure 20.1. (*Ph. 2. L*)

Pattern 12 (Deictic + (Epithet) + Nominal)

Pattern 8 with the syntactic structure of the core obligatory elements of nominal groups proceeding deictic expressions, and the optional epithet in between was differently treated in the two datasets. This distribution can clear up the property of each set of data: the occurrence rate of 17 (3.12) in the books with a high level of difficulty and 64 (9.39) in the books with a low level of difficulty. The epithet indicates some quality of the term it modifies. The epithets representing the objective property of the thing itself are potentially defining and experiential in function, and the ones expressing the speaker's subjective attitude towards it represent an interpersonal element in the meaning of the nominal group (Halliday & Matthiessen, 2004). The tokens for pattern 12 are presented like this:

6) Keep in mind that these **relationships** were derived from the definitions of velocity and acceleration, ... (*Ph. 1. L*)

Pattern 13 (Preposition + (Premodifier) + Nominal)

Pattern 13 (the nominal group preceded by preposition as obligatory core premodifier and more optional premodifier) in the two datasets can indicate the quality of each set of data: the occurrence rate of 15 (2.69) in the books with a high level of difficulty and 61 (8.47) in the books with a low level of difficulty. The tokens for pattern 13 are presented as follows:

7) In certain cases, the point <u>of</u> **observation** may be enclosed by the charge distribution. (*Ph. 4. L*)

Pattern 15 (Numerative + (Premodifier) +Nominal)

The distribution of this pattern with the core obligatory syntactic structure of nominal followed by numerative and the optional premodifier with the occurrence rate of 25 (4.66) only in the books with a high level of difficulty illustrates complexity distinction. Distributed in all the Physics books with a high level of difficulty, this pattern can hardly be considered as a personal stylistic preference. In general, pattern 15 is shown in the examples presented below.

8) In other words, while the exchange of distinct particles leads to two **configurations**. (*Ph. 1. H*)

4.4 Applied Linguistics

The four Applied Linguistics books in this study, with a high level of difficulty, were searched for the frequency and density of nominal expressions as displayed in Table 13.

Table 13
Nominalization Frequency in Books with a High Level of Difficulty

Field	Books	Pages	Words	Nominals	%
Applied Linguistics	High 1	90	48325	79	0.163
	High 2	181	97045	123	0.126
	High 3	68	36250	169	0.466
	High 4	140	74200	108	0.145
Total		360	255820	479	0.187

Of the total data investigated (255820 words), irrespective of the slight variation involved in the four studied books, only 360 nominal expressions were located; That is, these books were not overly dense in terms of nominalization, and therefore any decision on the results obtained should be very cautiously interpreted. The most frequently used pattern in the four textbooks is pattern 3 (20.20) and the least frequently used is 1(0.20). Table 14 illustrates the order of patterns in terms of their frequency of occurrence in high level Applied Linguistics books.

Table 14
Nominal Patterns in Books with a High Level of Difficulty in Order of Occurrence

No.	Pat.	Raw	%	No.	Pat.	Raw	%
1	**3**	97	20.20	9	**15**	19	3.95
2	**6**	76	15.83	10	**12**	19	3.95
3	**9**	56	11.66	11	**10**	13	2.70
4	**2**	51	10.62	12	**13**	11	2.29
5	**5**	36	7.50	13	**4**	10	2.08
6	**11**	34	7.08	14	**7**	5	1.04
7	**8**	30	6.25	15	**1**	1	0.20
8	**14**	21	4.37				

Applied linguistics was also represented by four books with a low level of difficulty. The basic frequencies and density of nominal expressions are shown in Table 15.

Table 15
Nominal Frequency in Books with a Low Level of Difficulty

Field	Books	Pages	Words	Nominals	%
Applied Linguistics	Low 1	141	75395	130	0.172
	Low 2	61	32594	109	0.334
	Low 3	110	58892	175	0.297
	Low 4	658	56816	182	0.320
Total		418	223697	596	0.266

Overall, the nominalization density in these books is 0.266, implying the lower density of nominal structures in these linguistically more manageable texts compared to this characteristic in linguistically less manageable texts.

As to the distribution of nominal expressions, types 1 and 15 are used only once in one of the sample texts. Pattern 3 is regarded as the most frequently used (17.11) and the least employed patterns are 15 (0.16) and 1 (0.16).

Table 16
Nominal Patterns in Books with a Low Level of Difficulty in Order of Occurrence

No.	Pat.	Raw	%	No.	Pat.	Raw	%
1	**3**	102	17.11	9	**14**	33	5.53
2	**8**	67	11.24	10	**11**	31	5.20
3	**6**	60	10.06	11	**7**	21	3.52
4	**12**	56	9.39	12	**4**	21	3.52
5	**13**	52	8.72	13	**5**	17	2.85
6	**10**	51	8055	14	**1**	1	0.16
7	**9**	47	7.88	15	**15**	1	0.16
8	**2**	36	6.06				

In relation to density and complexity, results have rejected the claim by systemists (SFL) about the direct relation between nominalization density and complexity in applied linguistics. Thus, as the first question of this study raised, nominalization density is not reflected in the difficulty level of the sample of soft science textbooks.

In comparing the order of occurrence of nominal expression types (Tables 13 & 15), results revealed variations in Applied Linguistics textbooks with high and low levels of difficulty. The most frequent type of nominal expressions in the two sets of books is the third pattern in order. That is, this pattern is used irrespective of text complexity. Besides minor variations, we could identify little appreciable difference in the way nominal expression types are rendered in Applied Linguistics textbooks. The results of the Chi-square test indicated a statistically significant difference in using patterns 5, 6, 7, 8, 10, 12, 13 and 15 in Applied Linguistics books with high and low levels of difficulty (see Table 17). In the following, these patterns are explained in more detail.

Table 17
Comparison of Nominal Patterns in Applied Linguistics Books

P	Chi-square	df	Nominal patterns
0.849	29.03	1	1
0.681	2.82	1	2
0.531	3.01	1	3
0.136	3.70	1	4
0.004*	14.21	1	**5**
0.005*	0.48	1	**6**
0.003*	0.17	1	**7**
0.000*	24.92	1	**8**
0.645	2.78	1	9
0.000*	54.79	1	**10**
0.539	4.84	1	11
0.000*	28.58	1	**12**
0.000*	26.65	1	**13**
0.012	0	1	14
0.000*	23.04	1	**15**

Pattern 5 (Preposition + Nominal + Deictic)

The different distribution of pattern five in the two datasets can elucidate peculiarities of each set of data: the occurrence rate of 36 (7.50) in the books

with a high level of difficulty and 17 (2.85) in the books with a low level of difficulty. The tokens for pattern 5 are presented below.

9) He has done this not through a conceptual analysis of "learning" but by **exploring** the limits of language. (*AL. 4. L*)

Pattern 6 (Nominal + Noun Phrase)

Pattern six with the syntactic structure of noun phrase as postmodifier of the nominal as the head demonstrated different distributions in the two datasets. This dispersion can clear up the property of each set of data: the occurrence rate of 76 (15.83) in the books with a high level of difficulty and 60 (10.06) in the books with a low level of difficulty. The postmodifiers in nominal groups are powerful assets in elaborating the concepts more particularly. The tokens for pattern six are presented below.

10) It will become clear from all this that Wittgenstein is not **providing** a new theory of language acquisition, … (*AL. 1. H*)

Pattern 7 (Nominal + Nominal)

Pattern seven with the syntactic structure of nominal expressions as premodifiers of the nominal as the head, or nominal expressions as postmodifiers of the nominal as the head has been variously treated in the two datasets. This different distribution can clear up the property of each set of data: the occurrence rate of 5 (1.04) in the books with a high level of difficulty and 21 (3.52) in the books with a low level of difficulty. The postmodifiers/postmodifiers in nominal groups are powerful assets in elaborating the concepts more particularly. The tokens for pattern seven are presented below.

11) Deaf children have **difficulty learning** a spoken language because normal speech depends largely on auditory feedback. (*AL. 2. L*)

Pattern 8 (Noun + Nominal + (Prepositional Phrase))

The different distributions of pattern eight (the nominal group proceeded by noun as premodifiers, and also followed by the optional prepositional phrase) in the two datasets can elucidate peculiarities of each set of data: the

occurrence rate of 30 (6.25) in the books with a high level of difficulty and 67 (11.24) in the books with a low level of difficulty. The tokens for this pattern are presented below.

12) There is also evidence for this distinction from language **acquisition** (discussed in chapter 7). (*AL. 4. L*)

Pattern 10 (Premodifier + Nominal)

The tendency to overuse/underuse this pattern (the nominal group proceeding premodifier) in the two datasets appears to mark peculiarities of each set of data: the occurrence rate of 13 (2.70) in the books with a high level of difficulty and 51 (8.55) in the books with a low level of difficulty. The tokens for pattern 10 are presented below.

13) Knowing a word means knowing that a particular **sequence** of sounds is associated with a particular **meaning**. (*AL. 3. L*)

Pattern 12 (Deictic + (Epithet) + Nominal)

Results indicated that the inclination among writers to use this pattern with the syntactic structure of the core obligatory elements of nominal groups proceeding deictic expressions and the optional epithet in between varies in the two datasets. This different distribution can clear up the property of each set of data: the occurrence rate of 19 (3.95) in the books with a high level of difficulty and 56 (9.39) in the books with a low level of difficulty. The epithet indicates some quality of the term it modifies. The epithets representing the objective property of the thing itself are potentially defining and experiential in function, and the ones expressing the speaker's subjective attitude towards it represent an interpersonal element in the meaning of the nominal group (Halliday & Matthiessen, 2004). The tokens for pattern 12 are presented below.

14) There is also evidence for this **distinction** from language acquisition (discussed in chapter 7). (*AL. 4. L*)

Pattern 13 (Deictic + (Epithet) + Nominal)

The occurrence rate of this pattern in the books with a high level of difficulty, 11 (2.29), and in the books with a low level of difficulty, 52 (8.72), illustrated the function of particularity realized through deploying preposition preceding the nominal. The tokens for pattern thirteen are presented below.

15) After **discussing** the consequences of this I will tie it to what Wittgenstein takes to be the framework of **learning**, … (*AL. 2. H*)

Pattern 15 (Numerative + Nominal)

The distribution of this pattern with the core obligatory syntactic structure of nominal followed by numerative in the two datasets is indicative of the different tendencies of the two groups in using this pattern: the occurrence rate of 19 (3.95) in the books with a high level of difficulty and 1 (0.16) in the books with a low level of difficulty. The tokens for this pattern are presented below.

16) This **discussion** will also point to the problems and issues the Domestication Model of learning has to solve. (*AL. 3. H*)

4. Conclusion

Among the difficulties that academic genres represent both to learners and researchers are technicality, lexical density and grammatical metaphor. Nominalization is one of the structures causing a higher degree of lexical density and ambiguity in scientific texts. To Halliday and Matthiessen (2004), nominalization is developed first in scientific register, because of its massive potentiality and tendency for creating, devising, discovering and inventing new knowledge. For this reason, nominalization is regarded as a proper linguistic feature for characterizing academic textbooks.

The results of this research have showed that the two disciplines are not marked characteristically by the use of nominalization, and nominalization should thus not be regarded as characteristic of all academic disciplines but it might be possible to arrange disciplines on a cline of nominalization. This being so, one argument raises doubts over the use of nominalization as a

rhetorical strategy to increase density or technicality at least in some, if not in many, disciplines.

Though this study has endorsed the claim by systemists about the direct relation between nominalization density and complexity in Physics textbooks as examples of hard science, this relationship is not held in Applied Linguistics books as the representative of soft science. Contrary to the claim made by the systemists, the current study suggests that more text complexity does not necessarily tie with more nominal density. This means that there should not be a one to one correspondence between linguistic complexity, on the one hand, and a specific rhetorical strategy use, on the other, but in fact a bundle of strategies might account for linguistic complexity of texts which have not been the concern of this study.

Essentially, one of the main pedagogical implications of this research and studies of the same nature is to smooth the path and supply a tool and outlook for scientific writing and those who tend to pursue IGM in their careers as scientific writers, students and researchers. Next, many students need the opportunity to learn how to read or probably how to write the scientific genres, so that they may effectively participate in scientific processes that this discourse is used for.

There are certainly limitations to this study which might be eschewed in future investigations. The way nominalization is metaphorically expressed in different genres is likely to vary, and the present study has confined itself to a fairly small scope, textbook, and thus it can scarcely be a good representative of the disciplines. Another limitation of this study is that, in order to achieve more in the domain of nominalization, the same study can be replicated using larger and more representative data because the corpus used in this study is hardly enough to make valid generalizations about the nominalized features of academic discourse. Studying other disciplines as representatives of other

parts of the continuum of sciences like Social Sciences and Humanities/Arts can help us safely generalize the results.

References

Banks, D. (2003). The evolution of grammatical metaphor in scientific writing. In A. Vandenbergen, M. Taverniers & L. Ravelli (Eds.), *Grammatical metaphor: Views from systemic functional linguistics* (pp. 37–65). Amsterdam: John Benjamins Publishing Co.

Banks, D. (2008). *The development of scientific writing*: *Linguistic features and historical context.*London: Equinox.

Bartsch, S. (2009). Corpus-studies of register variation: An exploration of academic registers. *Anglistik: International Journal of English Studies. Focus on Corpus Linguistics*, *20*(1), 105–124.

Bazerman, C. (1994). Systems of genres and the enactment of social intentions, In A. Freedman & P. Meadway (Eds.), *Genre and the new rhetoric.* (pp. 79–104). New York: Taylor & Francis.

Biber, D. (1988). *Variation across speech and writing.* Cambridge: Cambridge University Press.

Biber, D. (1995). *Dimensions of register variation. A cross linguistic comparison.* Cambridge: Cambridge University Press.

Biber, D., & Conrad, S. (2009). *Register, genre and style*. Cambridge: Cambridge University Press.

Bhatia, V. K. (1998). Generic conflicts in academic discourse. In I. Fortanet, S. Posteguillo, J. C. Palmer & J. F. Coll (Eds.), *Genre studies in English for academic purposes* (pp. 15-28). Castello: Universitet Jaume.

Biber, D. (1988). *Variation across speech and writing.* Cambridge: Cambridge University Press.

Biber, D. (1995). *Dimensions of register variation. A cross linguistic comparison.* Cambridge: Cambridge University Press.

Biber, D., & Conrad, S. (2009). *Register, genre and style*. Cambridge: Cambridge University Press.

Christie, F. (2002). *Classroom discourse analysis: A functional perspective*. London: Continuum.

Christie, F. (2012). *Language education throughout the school years: A functional perspective.* West Sussex, United Kingdom: Wiley-Blackwell.

Coffin, C., Curry, M., Goodman, S., Hewings, A., Lillis, T., & Swann, J. (2003). *Teaching academic writing: A tool kit for higher education.* London: Routledge.

Colombi, M. C. (2006). Grammatical metaphor: Academic language development in Latino students in Spanish. In H. Byrnes (Ed.), *Advanced language learning: The contribution of Halliday and Vygotsky* (pp. 147-163). London: Continuum.

Conrad, S. (1996). Investigating academic texts with corpus-based techniques: An example from biology. *Linguistics and Education, 8*, 299-326.

Conrad, S., & Biber, D. (Eds.) (2001). *Variation in English: Multidimensional studies*. London: Continuum.

Derewianka, B. (1992). *Reading secondary science textbooks.* In J. Scott (Ed.), *Science and language links: Classroom implications* (pp. 67-80). Portsmouth, NH: Heinemann.

Eggins, S. (2004). *An introduction to systemic functional linguistics.* London: Continuum.

Fang, Z., Lamme, L., & Pringle, R. (2010). *Language and literacy in inquiry-based science classrooms*, grades 3-8. Thousand Oaks, CA: Corwin.

Fang, Z., & Schleppegrell, M. J. (2008). *Reading in secondary content areas: A language-based pedagogy*. Ann Arbor, MI: The University of Michigan Press.

Fang, Z., Schleppegrell, M. J., & Cox, B. E. (2006). Understanding the language demands of schooling: Nouns in academic registers. *Journal of Literacy Research, 38*(3), 247-273.

Farahani, A. A., & Hadidi, Y. (2008). Semogenesis under scrutiny: Grammatical metaphor in science & modern prose fiction. *Iranian Journal of Applied Linguistics, 11*(2), 51-82.

Glanzel, W., & Schubert, A. (2003). A new classification scheme of science fields and subfields designed for scientometric evaluation purposes. *Scientometrics, 56*(3), 357–367.

Hadidi, Y., & Raghami, A. (2012). A comparative study of ideational grammatical metaphor in business and political texts. *International Journal of Linguistics, 4*(2), 348-365.

Halliday, M. A. K. (1978). *Language as a social semiotic: The social interpretation of language and meaning*. London: Edward Arnold.

Halliday, M. A. K. (1985). *Introduction to functional grammar*. London: Arnold.

Halliday, M. A. K. (1994). *An introduction to functional grammar* (2nd ed.) London: Edward Arnold.

Halliday, M. A. K. (1996). Language and knowledge: The unpacking of text (pp. 24-46). In M. A. K. Halliday (Ed.), *The language of science*. Beijing: Peking University Press.

Halliday, M. A. K. (2004). Some grammatical problems in scientific English (pp. 159-180). *In M. A. K. Halliday, The language of science*. London: Continuum.

Halliday, M. A. K., & Martin, J. R. (1993). *Writing science. Literacy and discourse power*. London: Flamer press.

Halliday, M. A. K., & Martin, J. R. (1996). *Writing science: Literacy and discourse power.* London: Falmer Press.

Halliday, M. A. K., & Matthiessen, C. M. I. M. (1999). *Construing experience through meaning: A language-based approach to cognition.* London: Cassell.

Halliday, M. A. K., Matthiessen, C. (2004). *An introduction to functional grammar* (3rd ed.), London: Arnold.

Halliday, M. A. K., & Matthiessen, C. M. I. M. (2014). *Halliday's introduction to functional grammar*. Milton Park, Abingdon, Oxon: Routledge.

Hartley, J., Sotto, E., & Fox, C. (2014). Clarity across the disciplines. *Science Communication*, *26*(2), 188-210.

Hyland, K. (2006). *English for academic purposes: An advanced resource book.* New York: Routledge.

Hyland, K. (2007). Applying a gloss: Exemplifying and reformulating in academic discourse. *Applied Linguistics, 28*(2), 266–285.

Hyland, K. (2009). *Academic discourse: English in a global context*. London: Continuum.

Jalilifar, A. R., Alipour, M., & Parsa, S. (2014). Comparative study of nominalization in applied linguistics and biology books. *RALs, 5*(1), 24-43.

Kazemian, B., Behnam, B., Ghafoori, N. (2013). Ideational grammatical metaphor in scientific texts: A Hallidayan perspective. *International Journal of Linguistics, 5*(4), 146-168.

Kazemian, B., Hashemi, S. (2014). Nominalizations in scientific and political genres: A systemic functional linguistics perspective. *International Journal of Humanities and Social Sciences, 3*(2), 211-228.

Klemenčič, E., & Čepič Vogrinčič, M. (2014). Analysis of texts in the field of education: A regulation on textbook approval and a history textbook. *SAGE Open, 4*(3), 1-9.

Martin, J.R. (1993). A contextual theory of language. In B. Cope & M. Kalantzis (Eds.), *The powers of literacy: A genre approach to teaching writing* (pp. 116-136). Pittsburgh: University of Pittsburgh Press.

Martin, J. R., Matthiessen, C. M. I. M., & Painter, C. (1997). *Working with functional grammar*. London: Edward Arnold.

O'Halloran, K. (2005). *Mathematical discourse: Language, Symbolism and Visual Images*. London: Continuum.

Parodi, G. (2004). Textos de especialidad y comunidades discursivas técnico-profesionales: Una aproximación basada en corpus computarizado. *Estudios Filológicos* 39, 7–36.

Parodi, G. (Ed.) (2005). *Discurso especializado e instituciones formadoras.* Valparaíso: EUV.

Parodi, G., & Gramajo, A. (2007). Technical-professional discourses: Specialized and dissemination text types. In G. Parodi (Ed.), *Working with Spanish corpora* (pp. 145–172). London: Continuum.

Parodi, G. (2008). Lingüística de corpus: Una introducción al ámbito. *Revista de Lingüística Teóricay Aplicada, RLAs 46*(1), 93–119.

Parodi, G. (2009). University genres in disciplinary domains: Social sciences and humanities and basic sciences and engineering, *Delta, 25*(1), 401-426.

Parodi, G. (2012). ¿Qué se lee en los estudios doctorales? Estudio empírico basado en géneros a través del discurso de seis disciplinas. *Revista de Lingüística Teórica y Aplicada, RLA* 50(2): 89–119.

Saleh, E. (2016). *A comparative study of nominalization in introduction and method sections of applied linguistics research articles: A qualitative study* (Unpublished M.A. Thesis). Shahid Chamran University of Ahvaz, Iran.

Steiner, E. (2003). Ideational grammatical metaphor: Exploring some implications for the overall model. *Language in contrast*, *4*(1), 137-164.

Swales, J. (1980). ESP: The textbook problem. *English for Specific Purposes* 1, 11–23.

Swales, J. M. (1990). *Genre analysis. English in academic and research settings*. Cambridge: Cambridge University Press.

Swales, J. (1995). The role of textbooks in AEP writing research. *English for Specific Purposes, 14*(1), 3–18.

Swales, J. M. (2004). *Research genres. Exploration and applications.* Cambridge: Cambridge University Press.

Tabrizi, F., & Nabifar, N. (2013). A comparative study of ideational grammatical metaphor in health and political texts of English newspaper. Journal of Academic and Applied Studies, *3*(1), 32-51.

Thompson, G. (2004). *Introducing functional grammar*. London: Arnold.

Tardy, C. (2003). A genre system view of the funding of academic research, *Written Communication 20*(1), 7–36.

Taverniers, M. (2004). *Grammatical metaphors in English*. Moderna Sprak *98*(1), 17-26.

Ure, J., & Ellis, J. (1977). Register in descriptive linguistics and linguistic sociology. In O. Uribe-Villas (Ed.). *Issues in sociolinguistics.* The Hague: Mouton, 197-243.

Wenyan, G. (2012). Nominalization in medical papers: A comparative study. *Studies in Literature and Language*, *4*(1), 86-93.