

## **Nominalization, abstraction and technicality in History and Physical Science: some evidence from Greek primary school textbooks**

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### **ABSTRACT**

*The aim of this paper is to analyse Greek primary school textbooks of History and Physical Science in terms of their abstraction and technicality, which - following Systemic Functional Linguistics - characterize educational knowledge, mainly based on written language. Written texts reconstruct experience into specialized knowledge through the grammatical metaphor of nominalization, which is considered to be strongly related to the recontextualization of oral mode to written mode. Moreover, research on secondary education school texts has shown relevant variety between Physical Science and History texts by means of lexicogrammatical choices employed. But, since relevant research stresses the importance of grammatical metaphor in secondary education, our attempt in this paper is to illustrate some facets of the same phenomenon in Greek primary education textbooks. More specifically, our aim is to analyse some Greek textbooks of History and Physical Science in terms of nominalization in order to account for its ways to pattern specialized fields, according both to grades (A' to F') and to different school disciplines.*

### **KEY WORDS**

*Abstraction, technicality, grammatical metaphor, nominalization, Systemic Functional Linguistics, History, Physical Science, Greek textbooks*

### **ABSTRACT**

*Le but de cet article est d'analyser les manuels de l'école primaire grecque d'Histoire et de Sciences Physiques en ce qui concerne leur abstraction et technicalité, qui, suivant Linguistique Fonctionnelle Systémique (SFL), caractériser les connaissances pédagogiques, principalement basée sur la langue écrite. Textes écrits reconstruire expérience en connaissance spécialisée par la métaphore grammaticale de nominalisation, qui est considéré comme fortement lié à la contextualisation du mode orale en mode écrite. Par ailleurs, des recherches sur les manuels scolaires de l'enseignement secondaire a montré pertinente variété entre les textes scolaires de Sciences Physiques et Histoire au moyen de lexicogrammatical choix employés. Mais, étant donné que les recherches pertinentes souligne l'importance de la métaphore grammaticale dans l'enseignement secondaire, notre tentative est d'illustrer certaines facettes du même phénomène en éducation primaire grecque. Plus précisément, notre objectif est d'analyser certains Grecs manuels d'Histoire et de la Science*

*Physique en termes de nominalisation pour tenir compte de ses moyens à des domaines spécialisés, selon les deux classes (A' à F') et aux disciplines scolaires différents.*

## MOTS-CLÉS

*Abstraction, technicalité, métaphore grammaticale, nominalization, Linguistique Fonctionnelle Systémique, Sciences Physiques, Histoire, textes scolaires*

## THEORETICAL FRAMEWORK

The ways by which school textbooks systematically re-shape students' experience lies at the center of Systemic Functional Linguistics' (SFL) theoretical and analytical interest (Halliday 1999; Hasan, 2006). Specifically, emphasis is put on the question of what 'sets of meanings' are constructed in different school disciplines' textbooks, that is, how the young speakers' experience of social and natural world is (re)construed towards different scientific disciplines (Halliday, 2000; Halliday & Martin, 2004).

According to this approach, school literacy's general endeavor is the transition from commonsense to educational knowledge, which implies the transition from the spoken to written language, forced by education's literacy practices. This transition co-occurs with the reconstruction of experience through non observable, distant from everyday knowledge, taxonomic and universally recognized entities, facts, relations and qualities (Christie, 1999; Halliday, 1999; Painter, 1999; Hasan, 2005, 2006).

This grammatical re-shaping of experience emerges through successive "waves" (Christie, 1999; Halliday, 1999, 2000): the entrance to primary school concerns the familiarization with written language and the ability of *abstraction*, while the transition to secondary education involves students' systematic engagement with *technical* knowledge, that is, with the discourse of the individual scientific fields and the mechanism of *grammatical metaphor*.

By these means, grammatical metaphor allows the whole rewording between meaning and grammar as it reconstructs semantic categories through non congruent grammatical classes (Halliday 1994, 1999; Halliday & Mathiessen 1999; Simon-Vandenberg Taverniers & Ravelli, 2003; Halliday & Martin, 2004). In this case, metaphor regards diverse realizations of meanings, as their typical grammatical structure (e.g., process as verb) is replaced by another (e.g., process as thing).

Specifically, the most important grammatical metaphor, that is *nominalization*, reconstructs acts (congruently realized as verbs), qualities (congruently realized as adjectives), circumstances (congruently realized as prepositions and prepositional phrases) and conjunction (congruently realized as conjunctives), in pseudo-objects, that are realized as nouns (Halliday & Mathiessen, 1999). Some examples are shown in the following table:

**TABLE 1**  
*Nominalization as grammatical metaphor*

<b>Congruent wording</b>	<b>Metaphorical wording/Nominalization</b>
(verb) <i>move</i>	(noun) <i>movement</i>
(adjective) <i>weak</i>	(noun) <i>weakness</i>
(preposition) <i>with</i>	(noun) <i>accompaniment</i>
(conjunctive) <i>if</i>	(noun) <i>condition</i>

So, during the first re-shaping of experience at primary school, grammatical metaphor is expected to concern mostly abstract or technical terms; on the other hand, the wide use of

grammatical metaphor throughout secondary education allows the development of a science-like reasoning based on an inclusive rewording of social and natural phenomena by the mechanism of nominalizing of acts, qualities, circumstances, etc.

Therefore, the school textbooks' linguistic investigation has been focused on secondary education's texts, highlighting the semantic and lexicogrammatical choices featuring the different school disciplines. In all relevant research, nominalization has been emerged as crucial resource for the construction of History's abstractive interpretation, as well as, Physical Science's technical taxonomies (Veel & Coffin, 1996; Wignell, 1998; Macken-Horarik, 2000; Halliday & Martin, 2004; Schleppegrell, 2004; Coffin, 2006; for Greek data, Paizi & Kondyli, 2011; Papagiannopoulos & Kondyli, 2014).

Following the above framework, our present research concerns the semantic and lexicogrammatical features that construe the disciplines of Physical Science and History in Greek primary education, in order to explore the ways in which discourse in primary school forwards the - above mentioned - transition to the more scientific-like knowledge of the secondary school.

Out of a broader investigation that concerned both the ideational and textual 'syndromes' of primary school's texts (i.e. transitivity, grammatical metaphor, conjunction, theme/rheme, lexical density, school genres) (Maniou, 2016), this paper focuses on the ways by which nominalization construes specialized historical and scientific knowledge already in primary education.

In particular, the aim is to highlight aspects of nominalization's ideational and textual role in the construction of scientific technical and abstract historical texts throughout primary school (A' - F' class), since students are not yet expected to have entirely comprehended written language lexicogrammar (Halliday, 1999). On the other hand, our endeavor, regards the "recontextualization" of the English grammar's semantic and lexicogrammatical classes into the Greek linguistic system for the aim of the study.

In the following part, we will attempt a further elucidation of the mechanism of grammatical metaphor and its role in the construction of specialized school knowledge.

### ***Abstraction and technicality in school disciplines: grammatical metaphor***

According to the analysis of secondary school disciplines, especially Physical Science and History, different semantic and lexicogrammatical choices of respectively different school genres allow specialized kinds of knowledge (Schleppegrell, 2004).

Such research argues that humanities and Physical Science exploits linguistic resources both to explain the world (in History) and to reconstruct it through taxonomic systems (in Physical Science). That is to say, historical texts aim to explain acts and events between specific or generic participants so as to reach general conclusions, through semiotic processes of *abstraction*, while scientific texts, taking the semantic organization of the field one step further, reconstruct physical phenomena as sets of systematically related entities (*technicality*) (Martin, 2004b).

The term "abstraction" mainly refers to non-specific, generic entities, acts and circumstances, thus distant from the material context of their realization (Painter, 1999). According to Martin (2004b), the text is able to abstract experience from its material base through certain lexicogrammatical resources, such as sets of relations (relational processes) between generic participants or objectified processes (nominalizations). More specifically, History effectively accounts for the past human and social reality though a wider –distant from specific events – point of view, being able, in this way, to draw comprehensive conclusions (Martin, 2004b).

*The numerical superiority of the Greeks in the region and the existence of many members of the Filiki Etairia, were some of the main reasons that helped the rebellious Greeks to make their first successes.*

History F' Class

In Physical Science, where physical entities and phenomena are identified and categorized through systematic sets of taxonomies, abstraction acquires the additional feature of technicality (Wignell, 1998; Martin, 2004a, b); that is, moving one step further than History's nominal interpretation of social world, Physical Science reconstructs commonsense physical world as stable systems of taxonomic technical terms (Martin, 2004a, b; Wignell, Martin & Eggins, 2004). This technical reconstruction is based on the account and explanation of physical phenomena through scientific jargon and taxonomies of scientific – not observable – criteria. At the same time, these new, elaborated, semantic categories are constructed through process types that construe relations (attributions, taxonomies and identifications), complex nominal groups and nominalizations (Martin, 2004b; Wignell et al., 2004). The use of nominalizations - instead of congruent clause sequences' - enables physical processes' explanation as if they were physical objects, facilitating, in this way, their classification as grammatical technical terms.

*Light is energy. During its transition through a translucent body, through its reflection or diffusion, but mainly through its absorption by a body causes an increase in the body's energy.*

Physics F' Class

In these ways, therefore, the use of nominalization allows an alternative, more nominal organization of the clause, increasing text's metaphor, abstraction and technicality, through the whole rewording between grammar and semantics (Halliday & Mathiessen, 1999; Halliday & Martin, 2004).

## METHODOLOGICAL FRAMEWORK

In order to investigate the overall semantic and lexicogrammatical syndromes of grammatical metaphor as a structural component of History's and Physical Science's discourse throughout Greek primary school (classes A' to F'), in this section we will present nominalization's semantic and lexicogrammatical features, as well as an indicative lexicogrammatical "mapping" of some of its ideational (*transitivity*) and textual (*lexical density*) syndromes.

### *The lexicogrammatical tools of the study*

Starting from nominalization, as the significant version of grammatical metaphor in school's discourse, we schematize its special metaphorical features in semantics and lexicogrammar, in order to establish a valid analytical basis for metaphorical realizations in Greek (Maniou, Kondyli & Paizi, 2014).

Additionally to the investigation of nominalization, the school texts are analyzed on the basis of the *transitivity* system, which linguistically realizes the ideational metafunction in the lexicogrammar of the clause. In this way, we expect that the nominalization of the distinct semantic areas of experience, as they are realized by the different kinds of clauses, will show the ideational effect of grammatical metaphor.

Moreover, the analysis of lexical density as an important textual consequence of nominalization will illustrate lexicogrammar's ability to assemble a high number of lexical items into a single clause.

### *The lexicogrammar of nominalization*

Grammatical metaphor's principal potential concerns the lexicogrammatical realization of a meaning category through an alternative, typically incongruent grammatical class through the mechanism of *class-shift*<sup>1</sup> (Halliday & Mathiessen, 1999).

As we have already discussed, in school's written language, grammatical metaphors mainly regards nominalizations, as nouns often realize semantic categories which are prototypically realized through other grammatical classes (e.g. verbs and adverbs). So, through nominalization, processes (typically realized through verbs) and qualities (typically realized through adverbs) are metaphorically re-worded as things – which congruently construe entities.

The significant feature of nominalization, thus, lies in its grammatical ability to *conjoin* or *fuse* two classes of meaning into one wording; contrary to *transcategorization*<sup>2</sup> that regards the common transfer of some etymons to another class through syntactic and morphological means (ex. analyze – analyst, analytical, etc), a metaphoric realization maintains a word's semantic content (event or quality) while it is, at the same time, construed as thing (Halliday & Mathiessen, 1999). The following nominalizations exemplify fusion of acts and qualities into metaphorical pseudo – objects, that is in the form of nouns:

**TABLE 2**  
*Semantic fusion in grammatical metaphor*

<b>Congruent realization</b>	<b>Metaphorical realization</b>	<b>Semantic fusion</b>
(to) develop	development	process + thing (verb + noun)
weak	weakness	quality + thing (adjective + noun)
(to) burn	burning	process + thing (verb + noun)

At the same time, nominalization tends to *downgrade* congruent wordings into lower grammatical ranks through the – parallel to class-shift – mechanism of *rank – shift* (Halliday & Mathiessen, 1999). Congruently,

- a) a *sequence* is realized through a clause complex,
- b) a *figure* is realized through a simple clause,
- c) an *element* is realized through a nominal group, as shown in the following table (in brackets the realization in Greek):

**TABLE 3**  
*Congruent rank wording*

<b>Meaning</b>	<b>Grammar</b>	
Sequence	Clause complex	<i>When we burn [καίμε] wood (1) heat is produced [παράγεται](2)</i>
Figure	Clause	<i>We burn [καίμε] wood (1)</i>
Element	Nominal group	<i>Wood[ξύλο]</i>

<sup>1</sup>*Grammatical class* refers to a word's syntactic role in the clause level - in the sense of its semantic load -, while *grammatical rank* refers to the syntax above clause and, in particular, to the organization of semantics in the text level.

<sup>2</sup>According to Halliday & Mathiessen (1999), the significant criterion for the recognition of a metaphorical - and not merely transcategorized - element is semantic fusion. Thus, the feature of fusion, and, at the same time, the analysis of semiohistory (logogenesis, ontogenesis, phylogenesis) (Halliday & Mathiessen, 1999), the consequent rank shift as well as morphology, establish the basic criteria for the analysis of grammatical metaphor in Greek (Maniou et al., 2014).

The above categories of meaning can be realized through incongruent, metaphorical grammatical ranks, that is, a sequence through a single clause, a figure through a nominal group, etc. as we can see in the downgrading of the following sequence *when we use electric power we produce heat*:

**TABLE 4**  
*From congruent to metaphorical rank wording*

	<b>Congruent wording</b>	<b>Metaphorical wording</b>
Meaning	Grammatical realization	Grammatical realization
Sequence	<u>clause complex</u> : <i>when we use electric power, (1)</i> <i>we produce heat (2)</i>	<u>Clause figure</u> : <i>With the <u>use</u> [χρήση] of electric power we produce heat</i>
Figure	<u>clause</u> <i>we use electric power (1)</i> <i>we produce heat (2)</i>	<u>Element</u> <i><u>use</u> [χρήση] of electric power</i> <i><u>production</u> [παραγωγή] of heat</i>
Element	<u>nominal group</u> <i>heat</i>	<u>Classifier</u> <i>Heat production</i> <i>[παραγωγή θερμότητας]</i>

#### *Nominalization and transitivity*

According to SFL, the analysis of ideational metaphors<sup>3</sup> falls within the *transitivity* structure, that is, the lexicogrammatical choices that realize ideational metafunction in the clause, construing inner and outer world's experience (Halliday & Mathiessen, 2004). Namely,

- a) The verb construes a certain process
- b) The nominal groups construe participant entities, and
- c) Phrasal and adverbial groups define the relevant circumstances.

Moreover, clauses are classified into six different *process types*, according to the kind of meaning expressed by the process (*material, mental, relative, verbal, behavioral, existential*), as well as, the kinds of entities participating in it (Halliday & Mathiessen, 2004).

Through the following clauses we will attempt a synoptic description of the basic process (marked with bold) types with both congruent and nominalized (which are underlined) participants and circumstances, as they are found in our data:

- a) *Material processes* construe acts and events of outer world as movement and physical change, with basic participants the *actor* – the acting entity – and the goal - action's object.

*We also **use** [αξιοποιούμε] it for the heating [θέρμανση] of water and for domestic use [χρήση].*

*In order **to reduce** [για να μειώσουμε] the heat transfer [μετάδοση] (...)*

*The exploitation of oil energy **is done** [γίνεται] as it **is being burnt** [καίγεται].*

- b) *Mental clauses* construe inner world's actions, including processes of perception, emotion, and cognition. Mental processes' participants are the conscious entity *senser and process's content phenomenon*.

<sup>3</sup>Grammatical metaphors can be generally distinguished in ideational and interpersonal in accordance with the respective lexicogrammatical system of their realization (Halliday & Mathiessen, 2004).

However, Constantine **knew** [γνώριζε] well the difficulties [δυσκολίες] waiting for him.

c) Relative clauses, which altogether construe *intensive*, *possession* and *circumstantial* relations, are divided into clauses of attribution and identification. In relative attributive clauses, participant *attribute* describes or classifies participant *carrier*, while in relative identifying clauses, participant *value* identifies/defines participant *token*:

The stability [σταθερότητα] of oil price **is** [είναι] important for economy.

This fact **has** [έχει] its explanation [εξήγηση].

(...) because its use **causes** [προκαλεί] less pollution [ρύπανση]

However, the most important moment of its history **was** [ήταν] its liberation [απελευθέρωση]

Respiration [αναπνοή] **is** [είναι] the opposite procedure of photosynthesis [φωτοσύνθεση]

The feminine reproduction organs [όργανα αναπαραγωγής] **are** [είναι] vagina (...)

d) Verbal clauses construe processes of speech, with basic participants the *sayer* and the *verbiage*:

He communicated with Pope and **asked** [ζήτησε] for the help he **had promised** [είχε υποσχεθεί].

e) Behavioral clauses, respectively, construe the behavior of a conscious *behavior*:

Ioustinianos **listened** [άκουσε] to them with caution [προσοχή].

f) Existential clauses construe an existent's being:

With this research are detected locations, where **there is** [υπάρχει] a high possibility [πιθανότητα] to find oil.

Circumstances, finally, realized through prepositional phrases and adverbial qualifiers, are used in all six process types in order to report relevant to process circumstances of time (e.g. for many years), space (e.g. in high temperatures), cause (e.g. due to this fact), means (e.g. without light), aim (e.g. for the heating), etc.

Thus, different lexicogrammatical choices of transitivity are expected to have a significant role in the construction of school written language. Material, mental, verbal and behavioral clauses are expected to construe every day, full of action experience of younger students. On the other hand, the gradual re-construction of this commonsense kind of knowledge into the systematically organized educational context is expected to “recruit” semantic areas of description, classification and definition, as realized through relative clauses (Halliday & Martin, 2004).

#### *Lexical density*

According to Halliday & Mathiessen (2004) lexical density, that is the number of *lexical elements* or *content words* per clause (i.e. verbs, nouns, adverbs and adjectives), consists a significant differentiating mark between everyday spoken language and educational/ academic written discourse.

In that sense, spoken language is *grammatically intricate*, as it is organized through successive clause complexes/sequences – joined with hypotaxis and parataxis, while it is not lexically dense (approximately two content words per clause, marked with bold):

***Be quiet, the baby is slipping!*** = 2 lexical words per clause  
(*Κάνε ησυχία, κοιμάται το μωρό!*)

On the other hand, abstract and rather de-contextualized written discourse is lexically denser, concentrating a large number of content words in one clause (Halliday & Mathiessen, 2004). Clauses' high lexical density is interlaced with their overall organization around nominal group, and in that sense, constitutes grammatical metaphor's significant textual "product":

***Normally, fertilization, i.e. the compound of the egg by the sperm, is in the woman's body*** = 9 lexical words per clause

(*Φυσιολογικά, η γονιμοποίηση, δηλαδή η ένωση του ωαρίου με το σπερματοζώαριο, γίνεται μέσα στο σώμα της γυναίκας.*)

Thus, high lexical density allows the concentration of a large amount of information into a limited number of clauses, while meaning is re-organized through metaphorical experiential elements, as processes are established - through nominalization - as constant objects.

### ***The data***

The data of the study were drawn from the primary school's textbooks of Environmental Study (grades A to D), Physics (grades E and F) and History (grades C to F)<sup>4</sup>. Specifically, we analyzed 201 chapters with a total of 6.253 clauses with regard to their process types, the use of nominalization and their lexical density.

In order to reach quantitative conclusions, the analysis of our corpus was based on descriptive statistics; in particular, we researched lexicogrammatical data's percentage occurrence (relative frequency) and then presented these findings through graphs (tables, diagrams, etc.). Nevertheless, it is through the parallel exposition of the textbooks' indicative realizations that we will endeavor the close reading of our analysis' findings.

## **RESULTS**

### ***Transitivity, nominalization and lexical density in Environmental Study's, History's and Physics' textbooks***

According to the analysis of our data, physical and historical world in primary school textbooks is mainly represented through material and relative processes, that is, as physical and historical events among actors, goals, etc, as well as relations of description, classification and definition among – congruent or metaphorical – entities. The less occurring mental, verbal, behavioral and existential clauses realize the text's participants' respective processes as well as they ask for the students' mental, verbal, etc 'intervention'.

More specifically, as it concerns scientific texts we observed the gradual reduce of material processes in Environmental Study (henceforth *E.S.*) (49%) and the simultaneous

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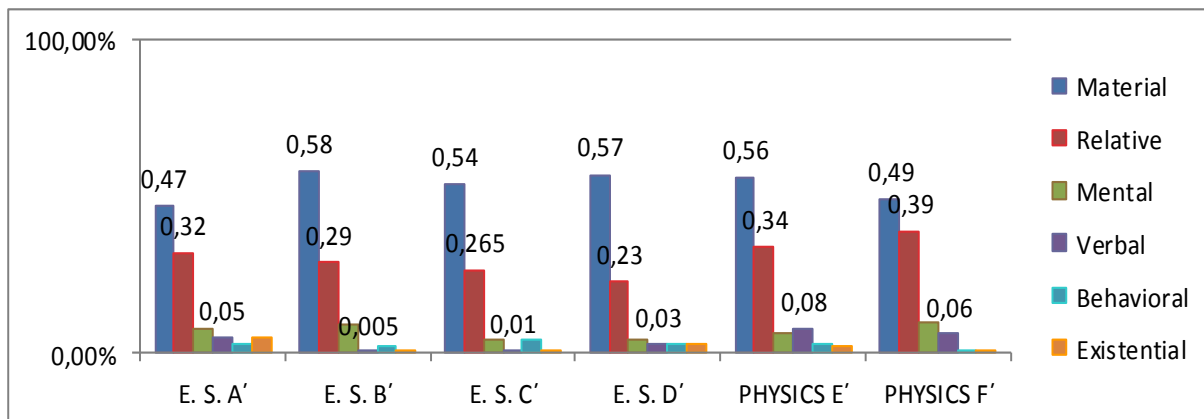
<sup>4</sup>In order to investigate early historical and scientific uses of language in the first two primary school classes, were Physical Science and History do not constitute separate disciplines, we analyzed Environmental Study's relative chapters, such as Animals, Plants, Energy, Time, Culture, etc.



increase of the relational processes (39%) up to F' class's Physics (Diagram 1). This reduce of material representation, in correlation to the significant relational increase, confirms the expected re-construction of commonsense knowledge through the systematization of classification and definition during the last two classes of primary school. The least found mental, verbal, bahavioral and existential clauses' presence, however, does not differ among the six textbooks.

**DIAGRAM 1**

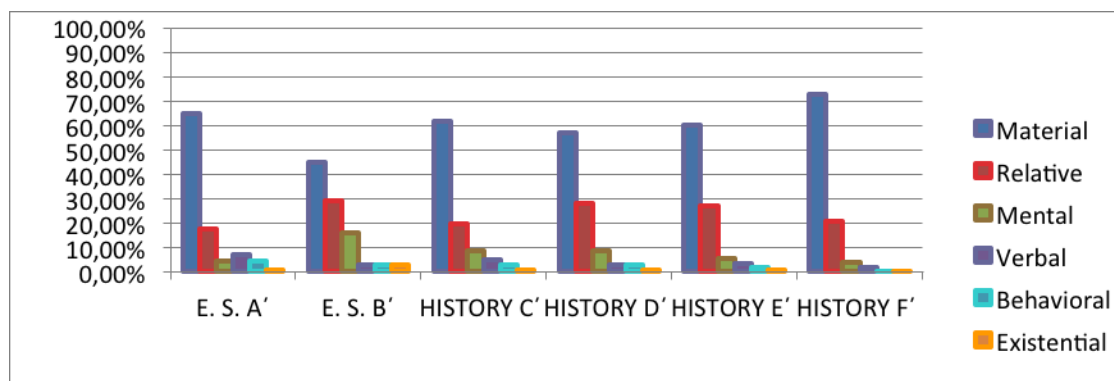
*Transitivity in Environmental Study (A' - D') and Physics (E' -F')*



In historical texts, on the other hand, material clauses are generally increased throughout the six classes, as their highest percentage was found in F' class's historical textbook (73%) (Diagram 2); this “material” increase can be correlated with the reduce of relational processes of the particular textbook (21%). Last, the few mental, verbal, bahavioral and existential clauses' processes are steadily reduced up to the last class' s History textbooks.

**DIAGRAM 2**

*Transitivity in Environmental Study (A' - B') and History (C' -F')*



Therefore, in the upper primary school classes, we see the diverse representation of both pedagogical discourses: the material reality of the Environment Study (A' to D') is reconstructed through classificaton and symbolic relationships in Physics (E' to F'), once the historical events are firmly construed as material interactions.

On the other hand, the analysis of grammatical metaphor showed the differentiated use of nominalization among the primary school's texts, as we located 801 nominalizations in the

whole of 6.253 countered clauses, however lopsided at the textbooks throughout the six school grades.

According to Table 5, the suspended use of nominalization during classes A' to D' (2,5% - 11,4%)<sup>5</sup> is significantly increased at E' and F' History's and Physics' textbooks (28% - 43%); thus, the parallel increase of nominalization both in historical and scientific texts indicates an equivalent gradual reconstruction of the different disciplines:

**TABLE 5**

*Nominalization in Environmental Study's, History's and Physics' textbooks*

	<b>Textbooks</b>	<b>NOMINALIZATIONS</b>	<b>%</b>	<b>TOTAL OF CLAUSES</b>
1.	E.S. A'	14(Ph. Sc.)+8 (History)	4,7% / 3 %	557
2.	E.S. B'	15(Ph. Sc..)+7 (History)	4,5% / 3 %	538
3.	E.S. C'	35	6%	582
4.	E.S. D'	59	8,5%	691
5.	History C'	16	2,5%	646
6.	History D'	74	11,4%	649
7.	History E'	144	28%	514
8.	History F'	228	44%	518
9.	Physics E'	158	21% (20,8)	758
10	Physics F'	199	25% (24,8)	801

In particular, as it concerns scientific texts, the few nominalizations found in the Environmental Studies' A' - B' (4,5% - 4,7%) and C' - D' (6% - 8,5%) textbooks come mainly from everyday processes and participate mainly in material and attributive clauses, which are lexically non dense (henceforth *l.d.*). However, in some cases a commonsense and a technical nominalization "co-operate" in order to construe scientific field's primary technical re-contextualization (as seen in example 3):

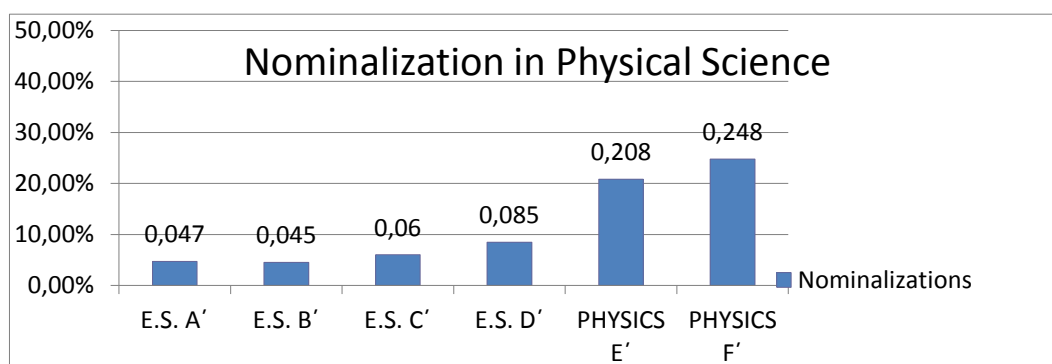
- (1) E. S. A': *We observe the changes [(αλλαγές)] of the plants {Mental, l.d.: 3} and we talk about them. {Verbal, l.d.: 2}*
- (2) E. S. B': *Animals find ways of accommodation (προσαρμογής) in their environment. {Material, l.d.: 5}*
- (3) E. S. C': *How is the harvest (συγκομιδή) of olive's crop being made, that is the gathering (μάζωμα) of olives? {Material, l.d.: 6}*
- (4) E. S. D': *Atmospheric pollution (μόλυνση) causes problems to the environment {Relational, l.d.: 5}*

However, a rather significant metaphorical rise is observed in E' (21%) and F' (25%) class's Physics' textbooks, as the extended use of nominalization has a substantial contribution in the technical reconstruction of physical world (Diagram 3). In these textbooks, nominalization allows the overall re-construing of the field, as physical phenomena participate in new figures of condensed meanings, as actor/goal (material processes) and most importantly, as carrier/attribute (attributive processes) and token/value (identifying processes) in lexically dense clauses (over 4 lexical words per clause). In this way the constantly changing physical world becomes stable in order to induce other material changes, to classify and be classified, to define and be defined:

<sup>5</sup>The percentages refer to the ratio of the registered nominalizations to the total number of clauses.

- (5) Physics E': *Despite its importance (σημασία) for planet's stability (σταθερότητα), the planet's exploitation (εκμετάλλευση) is uncontrollable* {Relational, l.d.: 7}
- (6) *The light's refraction (διάχυση) is explained by the photon waves' interaction (αλληλεπίδραση) [...]* {Material, l.d.: 6 +}
- (7) Physics F': *This simple method of separation (διαχωρισμού) is called grading (διαλογή).* {Material, l.d.: 5}
- (8) *Insulation (μόνωση) has particular importance (σημασία) for the canal's support (υποστήριξη) [...]* {Relational, l.d.: 6 +}

**DIAGRAM 3**  
Nominalizations in Physical Science



The nominalizations found in historical texts, on the other hand, are similarly few in E.S. (A' and B') and History of C' class (2,5%-3%), as they participate in material, lexically non dense clauses:

- (9) E. S. A': *What preparations (ετοιμασίες) do we make for Easter?* {Material, l.d.: 2}
- (10) E. S. B': *Our jobs, our celebrations (εορτασμοί), our music, they all show our culture* {Relational, l.d.: 5}
- (11) History C': *After Hector's burial (ταφή), the war begun again outside Troy.* {Material, l.d.: 6}

Nominalization relatively rises in History of class D' (11,4%); however, in E' and F' historical textbooks metaphorical realizations are increased up to 28% and 44% respectively (Diagram 4), increasing lexical density and abstraction and thus allowing historical world's nominal reconstruction into historical terminology. More specifically, in History E' nominalized historical acts and abstract terms establish the necessary linguistic distance from the individual context, construing generic and abstract sets of meanings through sequences of lexically dense processes:

- (12) History D': *Iliada refers to the struggle of Greeks for the conquest (κατάληψη) of Troy* {verbal, l.d.:3}
- (13) *Alliance's intention (πρόθεση) was to protect the freedom (ελευθερία) of citizens who belonged to it* {material: l.d.3,5}
- (14) History E': *Since the first years of its conquest (κατάκτησης), they faced difficulties (δυσκολίες) in the governing (διακυβέρνηση) of the conquered cities.* {relational, l.d.: 8}
- (15) *The disestablishment (κατάργηση) of tetrarchy brought calmness (ηρεμία) and unity (ενότητα) into the empire.* {material, l.d.: 6}

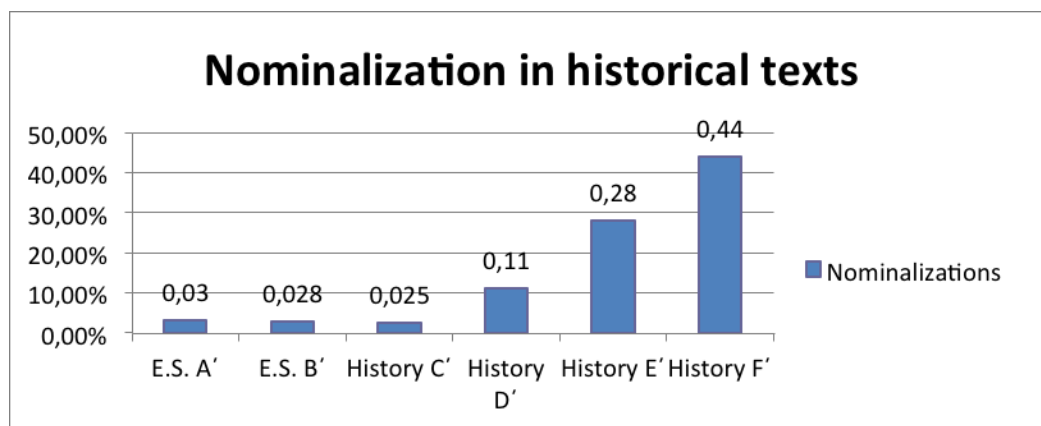
Moreover, and above text's grammar, grammatical metaphor allows the construction of specialized historical concepts of universal status which result from overall procedures of historical abstraction expressing wider semantic configurations. In that sense, students become acquainted already in primary school with a historical world of "packaged" events, as well as "packed" eras, movements, ideologies, etc. (as seen in example 16). Thus, History's numerous nominalizations not only pack specific acts and qualities, but most importantly, forward the objectified and de-contextualized interpretation of wider categories of meaning.

(16) History F': *At the end o 18<sup>th</sup> century, due to the dissemination [διάδοση] of the French Revolution's [Επανάστασης] liberal ideas, Greeks' hopes for liberation [απελευθέρωση] turn to Napoleon's French.* {material, l.d.:8}

(17): *The revolutionaries with their coup asked for the kingdom's abolishment [κατάργηση] or the replacement [αντικατάσταση] of the king, the constitution's improvement [βελτίωση] as well as several changes [αλλαγές] in the army* {verbal, l.d.:12}.

#### DIAGRAM 4

##### Nominalizations in historical texts

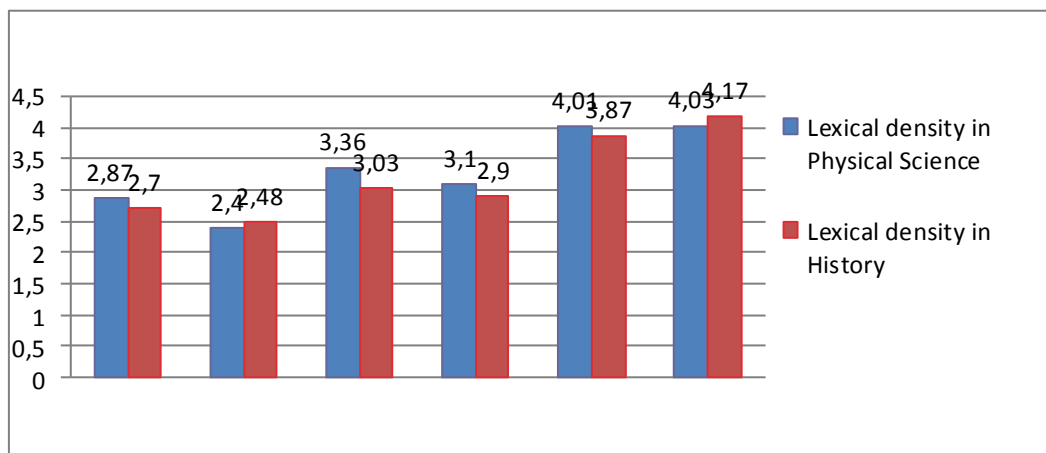


It should be, therefore, generally noted that the nominalizations found in our analysis differ considerably in their semantic origin throughout the six primary grades. For example, *habits, preparations, change, adaptation, squinting, calm, range, attack, difficulties, changes* resulting from processes and qualities of everyday speech, are found in the textbooks of the first three grades of elementary school. Conversely, metaphors like *alliance, seizure, freedom, unity, repeal, revolution, conquest, improvement, release*, etc. recorded in the history textbooks from the D' to the F' class, construe abstract concepts of historical writing. Moreover, nominalizations as *processing, pollution, screening, isolation, separation, refraction, interaction, dissemination*, and so on, participate in technical definitions and classifications of Physical Science's texts.

At the same time, the raising lexical density throughout the six school levels (Diagram 5), appears to be associated with the corresponding increase in the grammatical metaphor, as Physical Science's and History's texts become regularly denser during the transition from the middle to the upper classes, and from congruent to nominalized representation of the physical (examples 5, 6, 8) and historical world (examples 14, 16, 17).

**DIAGRAM 5**

*Lexical density in Environmental Study's, History's and Physics' textbooks*

**DISSCUSION**

The socio-semiotic approach to the discourses of different secondary school disciplines as proposed by the Systemic Functional Linguistics (Halliday & Martin, 2004; Schleppegrell, 2004; Coffin, 2006) allowed us to highlight typical grammatical and semantic aspects of Greek primary school's Physical Science's and History's texts, expanding in this way the analysis field into the least explored educational level.

We focused in the use of nominalization in Greek school's textbooks as a crucial lexicogrammatical resource by which Physical Science and History are re-constructed into the respective primary school's disciplines. In these endeavor, a strong challenge was the ways by which grammatical categories of English are realized in the Greek lexicogrammatical system.

By these means, in our corpus, comprised of 201 chapters drawn from Environmental Studies', Physics' and History's textbooks throughout the six grades of primary school (A' to F'), ideational and textual nominalizations were examined in relation to the basic process types (transitivity system) and lexical density.

Our data showed that, even in the senior classes of primary school, nominalization has a significant contribution both to the reconstruction of experience of human and natural world and in the reorganization of the text towards a new, de-contextualized scientific perspective. To that extend, SFL's theoretical framework applies to primary education, confirming young readers' early engagement to specialized configurations of meanings, largely based on grammatical metaphor.

According to our findings, the critical differentiation between Physical Science and History school texts regards the new semantic systems allowed by the use of nominalization: Physical Science's texts mainly represent physical entities' material interactions, which are progressively classified and identified as nominalized physical phenomena, mainly through lexically dense relative clauses (E' - F' classes); in History texts, on the other hand, specific and generic entities' acts, as well as nominalized events and broader historical phases (E' - F' classes) participate mostly in – likewise lexically dense – material clauses, while relative clauses' role is rather complementary.

Thus, nominalization in school Physical Science urges the technical reconstruction of physical processes and qualities into scientific stable categories (*heat, inhalation, variation, diffusion*, etc). Respectively, nominalization in History forwards the dissociation from the

specific historical occasion through historical abstractions (*Conquest, Revolution, Renaissance, Declaration*, etc). Despite its equivalent use in physical and historical texts throughout primary school, nominalization constitute a significant lexicogrammatical resource for the construction of different kinds of meanings, urging scientific language's technicality and historical discourse's abstraction, respectively.

At the same time, the extended use of grammatical metaphor in E' and F' classes' textbooks raises significantly texts' lexical density (over 4 lexical words per clause), systematizing, this way, the nominal representation of the events, distancing them from their specific context. Therefore, in all process types, nominalizations do allow further levels of semantic organization towards written school discourse.

To this extend, the metaphorical progression constitutes a continuum alongside the school texts, from A' to F' grade. Moreover, metaphoric lexicogrammatical syndromes at the F' elementary education's grade seem to reach the same range of complexity compared to the early secondary education.

By these means, both the continuity between elementary and secondary education and the specialized disciplinary knowledge look safeguarded. But, according to theoretical and empirical evidence, the effects of high technicality and abstraction eventually result semantically non appropriate for elementary students' linguistic potential.

This paper certainly cannot be considered exhaustive for the analysis of school texts and their metaphorical content. After all, for further investigation remain various issues concerning overall metaphorical packaging such as the *logical relations* construed through logical metaphor, and the *informational progress* in constructed in the texts by the system of *theme/rheme* (Halliday & Matthiessen, 2004). The investigation of such could allow, by its turn, the researching of the treatment and/or 'de-packing' of these metaphorical syndromes through the actual teaching in class, that is, a research which exceeds the possibilities of the present paper.

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