

Study on Subject Knowledge Building Based on Discipline Discourse Corpus: From the Perspective of Grammatical Metaphor

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doi:10.56397/JLCS.2023.06.07

Abstract

The purpose of this paper is to explore the distribution characteristics of different grammatical metaphor types in different types of knowledge. Six textbooks of geophysics, writing, geography, management, biochemistry, and history were selected as samples to build their own electronic textbook corpus, and by means of word suffix search and related word form search, it was found that: (1) there are certain distribution characteristics of grammatical metaphor usage types in subject textbooks of different knowledge types. Experiential grammatical metaphors are all used most frequently; interpersonal grammatical metaphors are used more than logical grammatical metaphors in the process of constructing technical knowledge; logical grammatical metaphors are used more than interpersonal grammatical metaphors in the process of constructing educational or daily knowledge. (2) The hierarchical nature of the representation, presentation, and organization of knowledge differs among knowledge types and it is inferred that technical knowledge is highest hierarchy knowledge type. This study also has some implications for the development and evaluation of teaching materials.

Keywords: grammatical metaphor, knowledge building, discipline discourse corpus

1. Introduction

1.1 Review of Related Literature

Grammatical metaphor is an important theoretical innovation in systemic functional linguistics, arising from the cross-coupling of semantic and lexico-grammatical categories (Halliday, Matthiessen 1999: 227-238). The theory was first proposed by Halliday in 1985 in *Introduction to Functional Grammar*, and has gradually matured and become a research hotspot after nearly three decades of

development. There are many related studies on grammatical metaphors, which are widely used in education, society, discourse building, translation and other fields. In the field of sociology of education, the lack of knowledge perception and separatism are two major problems that need to be solved (Maton, 2013). In order to solve these two major problems, a higher awareness of disciplinary knowledge building is required. There are very few studies on disciplinary knowledge building in China. Wu Geqi and Zhu Yongsheng (2016) analyzed

the “power triad” of university English textbooks; Shi Xiaolei (2020) combined logical-grammatical metaphor and legitimation code theory to explore the knowledge building of different disciplines; Gao Yanmei and Zhou Jiangping (2023) analyzed disciplinary knowledge building from semantic density and syntactic complexity to analyze disciplinary knowledge coding and disciplinary cultural features. In view of the fact that most of the previous studies focus on a certain grammatical metaphor, the present study starts from the grammatical metaphor theory of systemic functional linguistics and compares and analyzes different kinds of grammatical metaphors among different disciplines to investigate the problem of knowledge building in different disciplines, focusing on systemic functional linguistics itself, while involving knowledge related to the field of sociology of education. And in terms of research subject, few study chose textbooks as research subjects. The textbook is the main material on which students acquire systematic knowledge for their studies at school. It helps them to master the content of the teacher’s lectures; it also facilitates their preparation, revision and homework. It is the basis for further expanding the field of knowledge and is the main basis for the teacher’s teaching, providing the basic materials for lesson planning, teaching, assigning homework and assessing students’ academic performance. Therefore, textbooks are the natural and significant evidence for exploring the knowledge building of different disciplines and different knowledge structures.

1.2 Grammatical Metaphor

It is generally believed that Halliday introduced the concept of grammatical metaphor in 1985 when he discussed functional grammar. Halliday (1994) argues that there are grammatical metaphors between multiple linguistic variants that express a particular semantic meaning. As a core concept of systemic functional linguistics, grammatical metaphor reveals the building of meaning and is important for understanding the nature of language.

In systemic functional linguistics, language is an evolving system, and the architecture of language contains five dimensions: structure, system, hierarchy, instantiation, and metafunction. Language has three main metafunctions, namely conceptual, interpersonal,

and discourse functions. And the functions of language are the different meanings (Halliday, 1976/1978). Therefore, changes in meaning are changes in metafunction, and there is a systematic change in each pattern of meaning. Language is a hierarchical system in which the context is above the language, and the language system itself is divided into 3 levels: semantic, lexico-grammatical, and phonological or writing system; phonology (or characters) is the material carrier of linguistic expression. A grammatical metaphor arises when there is a misalignment between the semantic and lexico-grammatical layers of embodiment. Semantics is embodied by a specific lexico-grammatical system and is governed by the context. It is necessary to examine semantic changes both “from above” (from context to meaning) and “from below” (from lexico-grammatical to meaning), and to find the basis for changes in meaning from both lexico-grammatical forms and contextual motives.

Grammatical metaphor is not only a special way of expressing meaning, but also an important resource for the latent expansion of meaning in the language system. Grammatical metaphors provide different ways of expressing the same “core meaning” (consistent and metaphorical). Consistent means that the semantic layer of the language system has a natural coherent realization with the lexico-grammatical layer, where the semantic units sequence, figure and element are realized by the lexico-grammatical units clause complex, clause, phrase or phrase, respectively. Metaphor, on the other hand, breaks this consistent relationship and changes in the linguistic hierarchy and semantic sphere, thus occurring as a grammatical metaphor.

Conceptual-grammar metaphors focus on the relationship between different linguistic expressions expressing the same conceptual structure, and are an important mechanism for people to understand experience. It can be specifically divided into experiential-grammar metaphors and logical-grammar metaphors. This article adopts Yang Bo’s (2018) three criteria for determining whether conceptual grammar metaphor has occurred: consistent and metaphorical forms have the same conceptual meaning basis; comparable lexico-grammatical embodied forms, i.e., the linguistic expression to be determined needs to have a reference object; and there is morphological similarity between consistent and metaphorical forms.

Nominalization is an important phenomenon of conceptual-grammatical metaphor. For example:

- (1) a. The police **investigated** the matter.
- (1) b. The police conducted an **investigation** into the matter.

Experiential grammatical metaphors refer to the fact that the relevant grammatical metaphors are concerned with experiential semantic contents that are misaligned with their daily representations in a way that results in the intersection or coupling of dual semantic contents. The experiential function of language can be manifested through a system of relevance semantics. In this system, people's experiences of the real world (both external and internal) are understood as six operational "processes" (Halliday & Matthiessen 2004/2008: 172), namely, happening, doing, being, sensing, saying, having. Words are the most basic semantic unit of experience, consisting of processes, participants, contexts, and connecting components; participants include things and traits. Experience-grammar metaphors can occur at the word, phrase, and clause levels, and this article will focus only on experience-grammar metaphors at the word level.

Logical grammar metaphors can be divided into environment (e.g., "if" to "in the event of"), process (e.g., "if...then" to "lead to"), and thing (e.g., "because" to "reason") according to their semantic components, things (e.g., "because" to "reason"), and attributes (e.g., "if...then" to "reason"; "so" is reflected by "the resulting effects"). Among them, the things category includes time (e.g., "before" to "the first time"), means (e.g., "by" to (e.g., "by" to "means"), result (e.g., "so" to "result"), and condition (e.g., "if" to "condition"). Attribute classes include thing attributes (such as "by" to "enabling action") and process attributes (such as "then" to "subsequently shown"). "subsequently shown"). For example:

- (2) a. They shredded the documents **before** they departed for the airport.
- (2) b. Their shredding of the documents **preceded** their departure for the airport.

Interpersonal grammatical metaphor refers to the remapping of the meaning of interpersonal experience to the lexico-grammatical layer, including the modal metaphor system and the tone metaphor system, which is one of the important parts of Halliday's grammatical

metaphor theory.

Tone metaphor is a phenomenon of tone variation, i.e., a transfer from one tone domain to another tone domain. In tone metaphor, grammatical categories and semantic features are no longer in a one-to-one relationship; one tone embodies two or more verbal functions at the same time. Halliday classifies the interpersonal functions of language into four categories: statement, question, command, and offer. These four interpersonal functions of language are represented at the lexico-grammatical level by the declarative, interrogative, imperative, and modulated interrogative tones, respectively. If the linguistic function is embodied with the corresponding tone of voice appears to be the consistent form of language. Conversely, if the interpersonal function is not embodied by the corresponding tone, it is a tone metaphor. The following three examples use different tones, but all convey the same experiential meaning, as the speaker tries to get the listener to approach him/her immediately:

- (3) a. **You should** come here at once.
- (3) b. **Could you** come here at once?

The discourse function, as one of the three major linguistic metafunctions, also generates grammatical metaphors due to the transfer of level orders or categories. First proposed by Martin, the initial focus was on discourse articulation. Martin argues that among the discourse articulatory devices, if they are not used to refer specifically to or organize the external world and social reality, they constitute the internal articulation of the discourse, and this intra-discourse articulatory relation produces logical metaphorical devices that belong to discourse grammatical metaphors.

Since the definition of discourse grammatical metaphors is vague, difficult to retrieve directly in the corpus, and relevant studies show that their actual use is relatively rare, this study does not include discourse grammatical metaphors in its scope.

1.3 Types of Knowledge and Subject Classification

Knowledge is a meaning (Halliday & Matthiessen, 1999). The classification of knowledge proposed by modern psychology is generally divided into three categories: declarative knowledge, which is knowledge about "what" the world is; procedural

knowledge, which is knowledge about “how”; and strategic knowledge, which is knowledge about “how” to learn. How to learn” knowledge. Procedural knowledge deals with objective things, while strategic knowledge deals with learners’ own cognitive activities. In different disciplines, the knowledge involved can be divided into common knowledge, educational knowledge, and technical knowledge, which correspond to declarative knowledge, strategic knowledge, and procedural knowledge in psychology, respectively.

According to the Fields of Disciplines of Conferring Academic degrees, the National Standard Classification and Code of Disciplines of the People’s Republic of China contains 5 academic disciplines (Natural Sciences; Agricultural Sciences; Medical Sciences; Engineering and Technical Sciences; Humanities and Social Sciences). In addition, human knowledge can be divided into 5 major systems according to disciplines: Humanities, Social sciences, Natural sciences, Formal sciences and Applied sciences. In this paper, three of these subject systems will be selected for study: Humanities, Social Sciences, and Natural

Sciences, with specific subjects of Geophysics, Psychology, and Writing Tutorials, and knowledge types of daily knowledge, educational knowledge, and technical knowledge, respectively.

2. Theoretical Framework

Based on the fact that different types of grammatical metaphors in systemic functional linguistics focus on different objects, it is assumed that different types of grammatical metaphors correspond to different ways of constructing knowledge. The object of experiential grammatical metaphor is the experiential semantic content, and the corresponding knowledge building method is the representation of knowledge; the object of interpersonal grammatical metaphor is the meaning of interpersonal experience, and the corresponding knowledge building method is the organization of knowledge; the object of logical grammatical metaphor is the connection between clauses, so the corresponding knowledge building method is the presentation of knowledge. Accordingly, the following (Figure 1) is the theoretical analysis framework of this article:

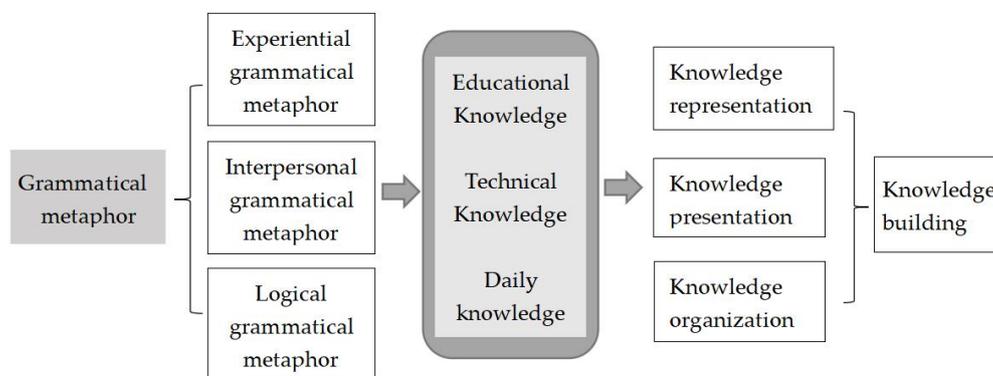


Figure 1. Theoretical framework

This study takes the subject material knowledge as the research object, by quantitatively analyzing the distribution of grammatical metaphor categories inside different knowledge types, according to the correspondence between grammatical metaphor types and knowledge building types, so as to get the similarities and differences of building methods of different knowledge types.

3. Method

3.1 Research Questions

This paper quantitatively analyzes the

distribution of three kinds of grammatical metaphors in textbooks of different disciplines through a self-constructed electronic textbook corpus in an attempt to address the following two questions:

- (1) Does the use of grammatical metaphors in textbooks of different disciplines have certain different distributional characteristics?
- (2) Are the differences in the distribution of grammatical metaphors in the textbooks related to the way knowledge is constructed?

3.2 Textbook Corpus Building

This study of self-constructed electronic corpus will be conducted in the following steps:

(1) Selecting disciplinary textbooks: In this paper, according to the three major fields of science (natural sciences, social sciences, and thinking sciences) and the tri-disciplinary classification of natural sciences, humanities, and social sciences originating from the United States, foreign electronic textbooks of three types of disciplines are selected, which belong to the fields of psychology, biochemistry, writing tutorials, management, history and geophysics; the textbook titles are *The Sourcebook of Nonverbal Measures—Goes Beyond Words*; *The Organic*

Codes—An Introduction to Semantic Biology; *The Wave in the Mind—Talks and Essays on the Writer, the Reader, and the Imagination*; *Financial Management and Real Options*; *Green Giants?—Environmental Policies of the United States and the European Union*; *Field Geophysics—the Geological Field Guide Series*, where the subject types are social sciences, humanities, and natural sciences, respectively; and the knowledge categories covered: educational knowledge, technical knowledge, and daily knowledge. Download the pdf version on the Library Genesis website. Table 1 provides specific information about the three books:

Table 1. The basic information of six textbooks

Info. Title	<i>The Sourcebook of Nonverbal Measures — Goes Beyond Words</i>	<i>The Wave in the Mind — Talks and Essays on the Writer, the Reader, and the Imagination</i>	<i>Field Geophysics — the Geological Field Guide Series</i>
Publish time	2004	2004	2002
Subject title	Psychology	Writing	Geophysics
Discipline type	Social science	Humanity	Natural science
Knowledge type	Educational knowledge	Technical knowledge	Daily knowledge
Info. Title	<i>The Organic Codes — An Introduction to Semantic Biology</i>	<i>Financial Management and Real Options</i>	<i>Green Giants? — Environmental Policies of the United States and the European Union</i>
Publish time	2003	2003	2004
Subject title	Biochemistry	Management	History
Discipline type	Social science	Humanity	Natural science
Knowledge type	Educational knowledge	Technical knowledge	Daily knowledge

(2) Sampling and cleaning process: The pdf versions of the six electronic textbooks were converted to txt. format, and the preface, acknowledgments, table of contents, and references at the end of the textbook were deleted, while the tables, pictures, questionnaires, scales, figures, quotes, and notes in the textbook were deleted, leaving only the

textbook chapters. Then, different chapters were randomly selected from each of the three textbooks according to the number of words. The random sampling tool was the Concordance Sampler to ensure that the number of words in the text was as close as possible to each other at the end of the sampling. Table 2 shows the data statistics of the corpus sample sampling process:

Table 2. The data statistics

Knowledge	Educational knowledge		Technical knowledge		Daily knowledge	
Disciplines	Psychology	Biochemistry	Management	Writing	History	Geophysics
Words	50000	50000	50000	50000	50000	50000

Total	100000	100000	100000
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The final corpus obtained after sampling has total tokens of 300000 with 16867 types.

3.3 Data Processing

In this step, the author will use the AntConc.3.4.4.0 corpus search tool for the search. The retrieved words or suffixes were selected from the example sentences on Halliday & Messithen (1994).

(1) Use of experiential-grammar metaphors: -ment, -ation, -age were selected as suffixes to retrieve vocabulary use in textbooks of three disciplines at once.

(2) Use of interpersonal-grammar metaphors: -ity, -ness were selected as suffixes to retrieve, followed by a process of manual screening.

(3) Use of logical-grammar metaphors: We retrieved various tense forms of “follow” and “cause”, and retrieved the use of these metaphors in each of the three subjects at once.

After all the data were retrieved, a manual screening was performed to ensure the accuracy of the data, and those that did not belong to grammatical metaphors were removed. The final data results were obtained by a thick screening.

4. Results

4.1 Experiential Grammatical Metaphor

4.1.1 Use in Educational Knowledge

The type of knowledge involved in psychology textbooks is educational knowledge, and the search was conducted with -ment, -age, -ation as the search item. 1481 items were searched, specifically including the use of percentage, usage, marriage, illustration, approximation, differentiation, development, acknowledgement, puzzlement and so on. According to Halliday’s (1999) 13 categories of experiential grammar metaphors, the results can be summarized as trait-thing (such as approximation, differentiation), process-thing (such as marriage, illustration). Look at the following two sentences:

(6) Once gathered from several sources, professionals may use the EDI-C data to isolate areas of expressive or receptive nonverbal **usage** that need remediation.

(7) ... in his structure of intellect model and in the **development** of measures of multiple intelligence ...

In example (6), the word “usage” is converted from “use” and belongs to the process-thing category. Similarly, the “development” in example (7) is converted from the verb –develop, which also belongs to the process-thing category. It is the metaphorical form is “measures of multiple intelligence are developing”.

4.1.2 Use in Technical Knowledge

The type of knowledge involved in the textbook on writing tutorials and management is technical knowledge, with -ment, -ation, -age as the search item. 3700 items were searched. For example, storage, reportage, linkage, indication, imagination, motivation, rearrangement, agreement, and so on. Two examples are given below:

(8) No part of this book may be reproduced in any form or by any means, electronic or mechanical, including photocopying, recording, or by any information **storage** and retrieval system, without permission in writing from the publisher.

(9) Nevertheless, **motivation** for using mathematical programming arises from several real needs.

In example (8), “storage” is a grammatical metaphor of the process-thing type, which is derived from the phrasal type “...or by any stored information...”. Example (9) use “motivation” to express the meaning: “Nevertheless, (people) increasingly motivated to use mathematical programming for several real needs.”

4.1.3 Use in Daily Knowledge

The type of knowledge covered in the geophysics and history textbook is daily knowledge (i.e., declarative knowledge), with -ment, -ation, -age as search terms. The final 1901 items were researched out. For example, automation, isolation, assessment, enforcement, advantage, and so on. Here are two examples:

(10) Much else has remained unchanged, and advances in airborne techniques have actually inhibited research into improving ground-based instrumentation for mineral **exploration**.

(11) While precaution as a risk **assessment** and risk management principle arose in Europe, ...

Example (10) is a grammatical metaphor for the

process-thing class, where “exploration” is converted from “for exploring mineral”. In example (11), “assessment” is converted from the verb “assess”, which belongs to the process-thing category.

4.2 Interpersonal Grammatical Metaphor

4.2.1 Use in Educational Knowledge

This study uses psychology as a representative subject of educational knowledge, conducted with -ness, -ity as the suffix of the word. The specific usage data of interpersonal grammatical metaphors were obtained after manual screening. The search yielded a total of 20 results in the psychology e-textbook, of which two items was suffixed with -ness and occurred as an interpersonal grammatical metaphor, specifically in the form of willingness, and 18 items were suffixed with -ity and occurred as a form of possibility, namely, possibility and probability. These forms resulted in sentences that form an explicit objective modal orientation. The following two examples were chosen to illustrate this:

(12) ...he immediacy factor of the NVPS reflects openness, a **willingness** to reveal oneself to another, and a certain amount of vulnerability.

(13) Fourth, the large number of statistical analyses for the various combinations of behaviors raises the **probability** of experiment-wise error.

In example (12), “willingness” is the interpersonal grammatical metaphor converted from the phrase “be willing to”. It is a modal metaphor. The sentence can be restored into “...he immediacy factor of the NVPS reflects openness, and he is willing to reveal oneself to another, and he is a little bit vulnerable”. And the (13) sentence contains one grammatical metaphor usage — probability. The whole sentence can be transferred into “Fourth, experiment-wise error is more probable because of the large number of statistical analyses for the various combinations of behaviors.”

4.2.2 Use in Technical Knowledge

The textbook about how to write can be used as a representative subject for technical knowledge, the researcher still researches the corpus with -ness, -ity as word suffixes and manually screened to obtain data on the specific use of interpersonal grammatical metaphors. The search yielded 165 results in the writing tutorial e-textbook, including 7 items with the suffix

-ness and the occurrence of an interpersonal grammatical metaphor, specifically in the form of willingness, and 158 items with the suffix -ity and the occurrence of an interpersonal grammatical metaphor, respectively possibility and liability. These sentences retrieved all ended up forming an explicitly objective modal orientation (Halliday & Matthiessen, 1999). The following two examples were selected to illustrate this:

(14) Whether this extension has been an advantage or a **liability** to our genetic survival is certainly arguable, probably unprovable.

(15) The “interaction of heredity with environment” in this case has just begun to be tested, since only in the last hundred years has there been a **possibility** of unlimited dominance by any subset of humanity, along with unlimited, uncontrollable aggressivity.

In example (14), “liability” is the metaphorical usage of the phrasal form “be liable for”. Therefore, the whole sentence can be transferred into “Whether this extension has been advanced or liable for our genetic survival is certainly arguable, probably unprovable.” And in example (15), “possibility” is the grammatical metaphorical form converting from “possible” to convey a sort of possibility. Therefore, the whole sentence can be transferred into “... since only in the last hundred years, unlimited dominance by any subset of humanity, along with unlimited, uncontrollable aggressivity has been possible”.

4.2.3 Use in Daily Knowledge

Geophysics, a representative discipline of daily knowledge (i.e., declarative knowledge) for this study, was also searched with AntConc using -ness, -ity as word suffixes, and the specific usage data for interpersonal grammatical metaphors were obtained after manual screening. The search yields a total of 15 data results in the geophysics textbook. Among them, 5 results are with the suffix of -ness and 10 results are with the suffix of -ity, respectively expressing the modal of willingness and possibility. The following sentences can demonstrate clearly their modal orientation:

(16) ... [The state] has a legitimate interest in guarding against imperfectly understood environmental risks, despite the **possibility** that they may ultimately prove to be negligible.

(17) ... and the likely **willingness** of courts to

challenge the actions of both federal and state executives...

Just like the analysis above, in example (16), “possibility” is used to express “it is possible that they may ultimately prove to be negligible”. The whole sentence can be transferred into “[The state] has a legitimate interest in guiding against imperfectly understood environment risks, though it is possible that they may ultimately prove to be negligible.” And the example (17) is the grammatical metaphorical form as “be willing to”. The whole sentence can be transferred into “... courts are likely willing to challenge the actions of both federal and state executives...”.

And it is worth mentioning that the small number of usage of interpersonal grammatical metaphors indicates that in the presentation of declarative knowledge, grammatical metaphors are rarely used by objective or subjective modal words such as “possible” or “willing”. Instead, they are expressed in their conventional form.

4.3 Logical Grammatical Metaphor

4.3.1 Use in Educational Knowledge

This section will explore the ways in which educational knowledge is organized, and the discipline used as educational knowledge in this study is psychology. The search results were obtained by typing “follow|follows|followed” and “cause|causes|caused” respectively into AntConc. There were 23 entries, 8 of which were related to the form “follow”, and the other were related to the form of “cause”. Two of the examples were selected for analysis:

(18) This **follows** Burgoon and her associates’ (Burgoon, Buller, Hale, & DeTurk, 1984; Burgoon & Hale, 1987; Burgoon, Kelley, Newton, & Keeley-Dyreson, 1989) method of using numerous experimental studies conducted within the laboratory setting to provide tests for comparison.

(19) A brief report of a study using this assessment of interactional sensitivity to demonstrate its connection to conversational supportiveness (Trees, 2000) **follows** the description of the measure.

The word “follow” here is equivalent to “be caused”, with the preceding and following items forming a cause-and-effect relationship. In the first example, the subject “this” is the result because of the latter part of the sentence. The verb — predicate, follows, can be transferred

into the prepositional phrase—is because / is for. And the next example, as the same, the latter part is the reason, so the whole sentence can be transferred into “The description of the measure is the reason for a brief report of a study using this assessment of interactional sensitivity to demonstrate its connection to conversational supportiveness.” The “follows” is a metaphor as a noun phrase—the reason for.

4.3.2 Use in Technical Knowledge

Technical knowledge was searched using the textbook sampling corpus of writing tutorials, still typing “follow|follows|followed” “cause|causes|caused” respectively in AntConc, and the search results were obtained after screening. A total of 82 search results were obtained, of which 66 were related to the form “follow” and 16 to the form “cause”. Two of the examples were selected for analysis:

(20) When scientists come out and state that they cannot achieve objectivity, and historians follow suit, a certain demoralisation may **follow**.

(21) And when in reading a memoir I suspect or identify such elements, they **cause** me intense discomfort.

Similar to the previous subsection, “follow” is equivalent to “be caused”. Example (20) verbalizes cause, producing a logical-grammatical metaphor. That to say, the whole sentence can be restructured as “When scientists come out and state that they cannot achieve objectivity, and historians follow suit, a certain demoralisation may be caused.”. As for the next example, “cause” is original as a noun—a reason. However, in sentence (21), it is used as verb—a predicate. In this situation, the rank increases and the meaning is similar so that the grammatical metaphor occurs. The whole sentence can be restructured as “I am intensely discomfort for the cause of such elements I suspect or identify when in reading a memoir.”.

4.3.3 Use in Daily Knowledge

Daily knowledge was searched using the textbook sampling corpus of history and geophysics, still typing “follow|follows|followed” “cause|causes|caused” respectively in AntConc, and the search results were obtained after screening. A total of 64 search results were obtained, of which 21 were related to the form of “follow” and the other “cause”. Two of the examples were selected for analysis:

(22) Similar instruments with similar crystals should read roughly the same in the same places, but even this needs to be checked carefully since radioactive contaminants near, and within, the crystals can **cause** readings to differ.

(23) This is tiring under any circumstances and can **cause** serious medical problems if the instrument has to be levelled by bracing it against the strap.

As mentioned before, “cause” is original as a noun, expressing the meaning of reasons. That’s to say, the thing — readings to differ is because of the crystals. The whole sentence can be converted into “Similar instruments with similar crystals should read roughly the same in the same places, but even this needs to be checked carefully since radioactive contaminants near,

and within, the crystals can be the reason for differentiating readings.” And the (23) sentence can also be restructured into “This is tiring under any circumstances and can be the reason for serious medical problems if the instrument has to be levelled by bracing it against the strap.”

4.4 Tendencies of Knowledge Building in Different Subject Materials

In order to explore the second research question of this study, a parallel comparison of the use of grammatical metaphors for the three different types of subject knowledge is also required. Based on the results of the first three subsections, the use of grammatical metaphors for the different types of knowledge can be obtained as shown in the following figure (Figure 2):

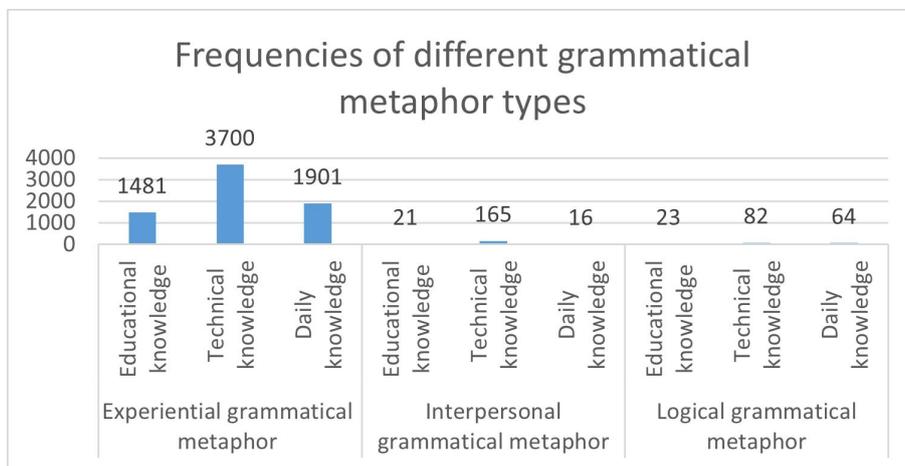


Figure 2. Frequencies of different grammatical metaphor types

Adjusting the rows and columns gives further insight into how different types of knowledge

are constructed, as shown in Figure 3:

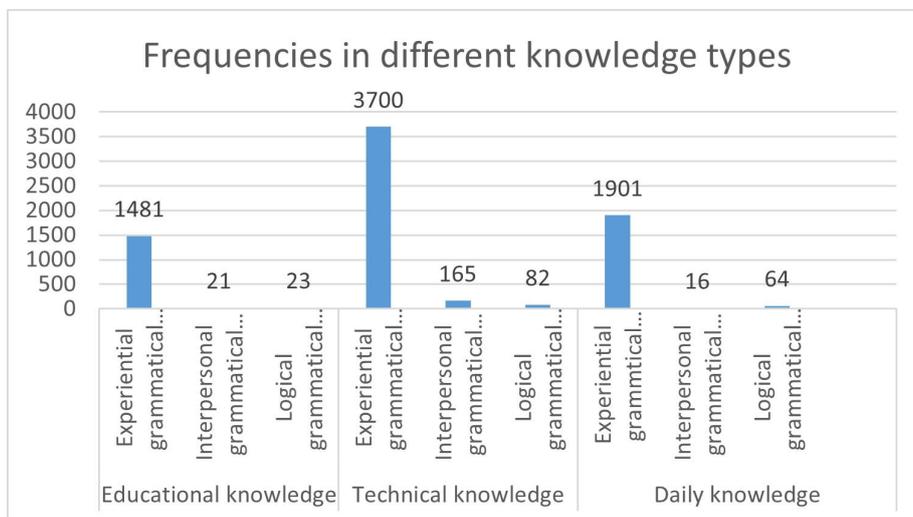


Figure 3. Frequencies in different knowledge types

From Figure 2 and Figure 3, it can be seen that, on the whole, experiential grammatical metaphors are the most frequently used grammatical metaphors in the building of educational, technical and daily knowledge. The experiential grammatical metaphors are used in descending order of frequency as technical knowledge, daily knowledge and educational knowledge; and the interpersonal grammatical metaphors are used in descending order of frequency as technical knowledge, educational knowledge and daily knowledge; and the logical grammatical metaphors are used in descending order of frequency as technical knowledge, daily knowledge and educational knowledge. In addition, it can be found that in the process of constructing educational knowledge, experiential grammatical metaphors are used most frequently, followed by logical grammatical metaphors, and finally interpersonal grammatical metaphors; in the process of constructing technical knowledge, experiential grammatical metaphors are used most frequently, followed by interpersonal grammatical metaphors, and finally logical grammatical metaphors; in the process of constructing daily knowledge (i.e., declarative knowledge), the most frequently used experiential grammatical metaphors, followed by logical grammatical metaphors, and finally interpersonal grammatical metaphors.

5. Discussion

As mentioned earlier, the experiential grammatical metaphor corresponds to how knowledge is represented; the interpersonal grammatical metaphor corresponds to how knowledge is presented; and the logical grammatical metaphor corresponds to how knowledge is organized. The different frequency of use of the three different grammatical metaphors in the three different subject materials, then, indicates that the three different subject materials have different ways of building knowledge, and that the hierarchical nature of the different types of knowledge is different. In no matter type of knowledge, the prior thing is to convey new content for readers or learners, therefore, the experiential grammatical metaphor is always the most important and primary. In the building of educational knowledge, the most important thing for the editor to do in order to successfully 'educate' or 'inspire' learners is to be able to engage in a 'discursive interaction' with them. At the same

time, making the author's instruments clear and acceptable is also important. Therefore, the presentation of knowledge reflects a kind of interactivity, and interpersonal grammatical metaphors are used just roughly as frequently as logical grammatical metaphors, reflecting a kind of organization. In the building of technical knowledge, the organization of knowledge is not much important because the "new information" are likely series of instructions. Learners can understand the latter instruction even without the former one. Therefore, when building technical knowledge, the way of presentation is more significant than the organization. In the building of daily knowledge, the editor's main aim is to explain things clearly, to make clear the 'what' of the 'what', so there is little requirement for interactivity, but the clear organization of knowledge increases the probability that the editor will explain or explain clearly and that learners will understand more easily. The organization of knowledge increases the probability that the editor will explain or clarify it and that the learner will understand it more easily. Thus, it can be argued that the hierarchical nature of different types of knowledge varies. In terms of knowledge representation, technical knowledge is the most hierarchical, followed by daily knowledge and finally educational knowledge; in terms of knowledge presentation, the hierarchy is ranked from highest to lowest as technical knowledge, education knowledge and daily knowledge; and in terms of knowledge organization, the hierarchy is ranked from highest to lowest as technical knowledge, daily knowledge and educational knowledge. According to Maton (2009), discourses can be divided into two kinds: vertical discourse and horizontal discourse. And vertical discourse can further be divided into two types with different knowledge structure: hierarchical knowledge structure and horizontal knowledge structure. The results of this study verify the building of different textbook discourse in different disciplines depend on different degree on hierarchical knowledge and horizontal knowledge. And Shi (2020) found that within the continuum of hierarchical and horizontal knowledge structures, the structural tendencies of different disciplines of knowledge show there is some variation in this variation and a consistent relationship with the proportion of logico-grammatical metaphors used. Specifically, from chemistry to linguistics

to sociology, the tendency towards a hierarchical knowledge structure becomes weaker and weaker. His findings have parallels with this study.

When knowledge is of a technical nature, the types of grammatical metaphors used in its building are, from high to low, experiential grammatical metaphors, interpersonal grammatical metaphors and logical grammatical metaphors; when knowledge is of an educational or daily nature, the types of grammatical metaphors used in its building are, from high to low, experiential grammatical metaphors, logical grammatical metaphors and interpersonal grammatical metaphors. This distribution is related to the different hierarchical nature of the different knowledge types in terms of their representation, presentation and organization of knowledge. Therefore, it can be inferred that technical knowledge is highest hierarchy knowledge type. The language is always condensed and terse in technical knowledge. In terms of the use of specific experiential grammatical metaphors, the phenomenon of grammatical metaphors in the trait-thing category is the most significant, reflecting semantic variation.

In terms of research methodology, this study employed the corpus and combined it with a keyword search to creatively explore the characteristics of the discourse used in different subject materials. Therefore, it provides a new research idea for the relative study. In terms of teaching practice, this study provides reference and implications for the development and evaluation of teaching materials for different types of knowledge. The discourses used in the teaching materials for different disciplines should follow the corresponding characteristics of the disciplinary knowledge structure. However, there are still some major limitations in this study. The corpus sample is not large enough, including the number of textbooks selected and the number of chapters sampled, which is not sufficient to provide a more comprehensive reference; the search terms are a little bit small and do not fully reflect the use of different types of grammatical metaphors in actual textbooks; and finally there is a certain degree of subjectivity in the process of determining the types of grammatical metaphors if the data washing is completed only by the author herself.

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