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Grammatical Metaphor in Chinese: A Corpus Based Study

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Abstract

This paper investigates Grammatical Metaphor (GM) in Chinese by analyzing the use of GM instances in a data set formed by 37 texts from scientific textbooks. This paper first explores the distribution of GM categories and GM syndromes in Chinese. For this aim, the GM instances in data are recognized and quantified in terms of the thirteen elemental GM categories and the seven types of GM syndromes in Chinese. This paper also investigates the impacts of contextual and developmental factors on the deployment of GM in Chinese. The relationship between GM deployment and the context of culture is explored by comparing the degree of GM in texts drawn from different genres. The effect of language development on GM deployment is detected by comparing the extent of metaphor in texts representing different levels of writing. It is found that GM distribution in Chinese is not random but determined jointly by the general tendency of GM construction and the typological properties of Chinese. Moreover, this study shows that the deployment of GM in Chinese is affected by context of culture and language development.

1 Introduction

The concept of Grammatical Metaphor (GM) is introduced by comparing the phenomenon with lexical metaphor in the first edition of *An Introduction to Functional Grammar* (Halliday 1985). The most important contribution in this initial GM exploration is the differentiation between *congruent* and *metaphorical* realizations. According to this differentiation, Ravelli (1985:55) defines GM as "an alternative lexicogrammatical realization of a semantic choice". Halliday (personal communication with Ravelli, 1985) enhances the definition by explaining GM as the result of a *semantic compounding* rather than a simple semantic choice. In the more recent exploration of GM nature, the understanding of GM is further developed by explaining it as a phenomenon arising from the *stratal tension* between semantics and lexicogrammar (Halliday 1998). In this study, GM refers to "the phenomenon whereby a set of agnate (related) forms is present in the language having different mappings between the semantic and the grammatical categories" (Halliday and Matthiessen 1999:7).

In the last 20 years, there has been much GM research (e.g. Halliday 1985, 1998; Halliday and Matthiessen 1999, 2004; Ravelli 1985, 2003; Taverniers 2003; Simon-Vandenbergen 2003) in Systemic Functional Linguistics (SFL). The research enriches the theoretical framework of language description within SFL and contributes to the contextual understanding of language. As Ravelli (2003:48) states, GM "is central to an understanding of language, and to an understanding of the relationship between language and context". However, all systemic studies of GM focus on the identification, categorization and deployment of GM in English. This paper investigates GM in

Chinese by quantitatively analyzing the use of GM instances in a data set formed by 37 texts from scientific textbooks. The investigation is limited to the ideational GM in Chinese due to space constraints.

This paper first explores the distribution of various types of ideational GM and the interdependence between these types of GM in Chinese. The GM instances in data are recognized and quantified in terms of the thirteen elemental GM categories and the seven types of GM syndromes in Chinese. This study also investigates the impacts of contextual and developmental factors on the deployment of GM in Chinese. The correlation between GM deployment and the context of culture is revealed by comparing the degree of GM in texts drawn from different genres. The effect of language development on GM deployment is detected by comparing the extent of metaphor in texts representing different levels of writing.

In order to classify the metaphorical expressions in ideational dimension, two methods have been used in GM research. Firstly, they are categorized according to the downranking grammatical movement involved. In particular, there are three types of ideational GM which metaphorically realize the meaning of sequence, figure and element (Halliday and Matthiessen, 2004). Secondly, ideational GM is classified on the basis of the metaphoric shifts from one semantic element to another. From this perspective, two models of ideational GM categorization are developed by Ravelli (1985) and Halliday and Matthiessen (1999). This paper categorizes the ideational GM in Chinese from the second perspective, employing a framework developed on the basis of the taxonomy of Halliday and Matthiessen (1999). The categorization of ideational GM in Chinese is discussed at greater length in Section 3.

The investigation of GM deployment in different genres of texts sets out to contribute to the growing body of contextual research of GM. Earlier studies in this aspect are concerned with the relationship between GM, register variables and metafunctions. Ravelli (1985) demonstrates the correlation between the register variable of mode and GM on the basis of a measurement of lexical density, grammatical intricacy and GM in eight English texts. Ravelli (1985) also notes that GM is the resource for the management of the Theme and Information system, which is "one of the factors that contributes most to the overall effectiveness of a text" (Halliday 1998: 203). The contextual studies of GM also reveal that GM is a field oriented source for constructing texts. Halliday (1993) demonstrates that GM is central to the construction of scientific knowledge by analyzing the grammatical features of scientific English. Martin's (1993a) analysis of the semantic features of the language in science and history shows that GM in the two fields displays different features. GM in science discourse is used as a primary lexicogrammatical resource for building technical taxonomies, while GM in history discourse is used for carrying forward reasoned argument. As far as the interaction between GM, tenor and interpersonal metafunction is concerned, it is argued that the employment of GM changes interpersonal meanings and tenor and gives rise to the realignment of social relationship (Halliday and Matthiessen 1999; Ravelli 2003).

The preceding discussion indicates that GM is an essential lexicogrammatical resource for constructing discourses in certain registers. Moreover, GM is a linguistic phenomenon which should be explained in broader social and cultural contexts (Thibault 1991; Ravelli 2003). In this aspect, relatively less research has been conducted. This study makes an attempt to reveal the correlation between GM deployment and the context of culture. For this purpose, this study statistically

compares the GM degree in two groups of texts belonging to report and explanation genres respectively. The focus on GM deployment in report and explanation genres is determined by the real genre distribution in the Chinese scientific textbooks from which the data for analysis is collected.

The investigation of the effect of language development on GM deployment in Chinese extends the previous research of GM from the perspective of ontogenesis. Halliday (1994:xviii) argues that "GM is a dominant feature of adult language, and it is learned rather late". Torr and Simpson (2003) explore the precursors of GM in early childhood and argue that metaphorical expressions originate during the preschool years. Derewianka (1995) conducts a quantitative analysis of the use of GM from the age of 5 to 13 and confirms Halliday's (1994) suggestion that the language of children develops through the phases of handling *general concept*, *abstract concept* and *grammatical metaphor*. The research also supports the claim that "it is not until around nine or ten that a child can usually handle grammatical metaphor" (Halliday 1994:xviii). This brief review of ontogenetic GM research illustrates that the use of GM is closely associated with language development. This paper investigates the impact of language development on GM deployment in Chinese by examining GM in university and secondary school textbooks which use different levels of writing. In practical analysis, this study compares the degree of GM in two groups of texts drawn respectively from secondary school and university textbooks.

In next section, the corpus for the GM investigation and the way it is collected are described. Section 3 presents the procedure of GM identification and quantification. Section 4 discusses the distribution of GM in Chinese by examining how frequently certain GM categories, subcategories and syndromes are used in the data. The

relationship between GM deployment in Chinese and external environment is explored in Sections 5 and 6. Finally, Section 7 provides the conclusion of this study.

2 Language materials and data collection

2.1 Language materials: The scientific writing in Chinese textbooks

Given the focus on the exploration of ideational GM, the analysis in this paper needs a special form of language materials in which ideational GM instances are widely deployed. On the other hand, the language materials should be as typical as possible of Chinese to increase the confidence of applying the findings in this study to the language. With these considerations, the language materials chosen for this study must satisfy the requirements of relevance and typicality. This study uses the scientific writings in Chinese textbooks as the large corpus from which the texts to be analyzed are drawn to balance these requirements.

The scientific writings in Chinese are characterized by their register variables of mode and field which are closely tied up with the use of GM. As far as the mode of language is concerned, the contextual research of GM shows that GM, especially ideational GM, "is indeed very much at the heart of written language" (Ravelli 2003:49). Halliday (1985:95) also points out that "written language is associated with the use of GM". With respect to the close relationship between GM and written language, this paper presents the analysis of written texts in Chinese for the purpose of GM investigation. The field of language is another significant consideration in choosing the language materials. The purpose of this study determines that the data for analysis must

be selected from a language field in which the instances of ideational GM are a critical resource for text building. As shown in Section 1, the use of GM is one of the most important linguistic features of scientific writing. Writing in the field of science generally involves a large amount of GM instances for the reason that taxonomizing and reasoning are the two main functions of metaphorical expressions (Halliday 1998). This feature of extensive distribution of GM instances explains why writing in the field of science is chosen as the language materials in this paper.

From the perspective of typicality, the language of textbooks is distinctive in that it serves as the model of writing for students. This is first because the textbook bears unique and significant social function of representing a sanctioned version of human knowledge and culture to each generation of students. This social function requires that textbooks must be designed and written carefully to transmit objective and factual information. Moreover, the written texts in textbooks are not just a vehicle of transmitting knowledge, but are also instruments in forming ways of writing. As far as the writings in scientific textbook are concerned, they are typical writing model for students because "most extended writing in science is in fact copied more or less directly from such books" (Martin 1993b:167).

Taking all these factors into consideration, the writings in scientific textbooks are chosen as the language materials for GM analysis in Chinese. In particular, the language materials are the writings in the latest edition of Chinese scientific textbooks which are used for the teaching of physics and chemistry in secondary schools and universities. The latest edition of textbook is adopted to show the linguistic feature of Chinese presently in use. The written Chinese from physics and chemistry textbooks are selected for the purpose of balancing possible differences in the distribution of GM

in the textbooks concerning various scientific subjects. It is worth noting that the main subjects of the science teaching in China are physics, chemistry and mathematics. The mathematics textbooks are not chosen for this study because the mathematical language shows particular features in ideational, interpersonal and textual dimensions (O'Halloran, 2005).

The level of scientific textbook is taken into consideration in choosing the language materials for the purpose of investigating the impact of language development on the use of GM in Chinese. In mainland China, the systemic learning of scientific knowledge starts from secondary school and continues in university. Thus, there are two levels of scientific textbooks which are used by the students in secondary schools and universities respectively. The texts in university textbook are in effect the adult form of scientific writing. The texts in secondary school textbooks, however, are deliberately controlled in terms of complexity and abstraction to apprentice students to the formal scientific writing. In other words, the writings in university and secondary school textbooks are different in the level of language development. To examine the GM deployment in different levels of writing, the language materials include both secondary school textbooks and university textbooks. The secondary school textbooks are used by the fourth year students in secondary school (six years in total) at the ages of fifteen. The university textbooks are the learning material of the first year undergraduate students, who are generally eighteen years old.

2.2 Data collection

The texts selected for this study must form a manageable data set for the purpose of conducting a quantitative investigation of GM. More importantly, this data set must be representative of the language materials and corresponding to the language materials in the distribution of GM. These purposes are achieved in this paper by selecting texts from different genres of writing in the scientific textbooks.

From the perspective of genre, texts in the scientific textbooks fall into several types of writing which are distinctive in social purpose and generic structure. This study selects various numbers of texts from each genre of writing in the scientific textbooks to collect a representative data. The actual numbers of texts in different genres are determined in accordance with the real distribution of genres in the textbooks. In other words, the data is collected on the basis of the genre distributions in the writings of scientific textbooks. In this case, it becomes necessary to define the genres in Chinese scientific textbooks involved in this study and find out how these genres are proportionally distributed in the language materials.

Yang (in press) sets up a framework of genre classification in Chinese by making reference to the genre research of English textbooks in Martin (1993b) and Veel (1997). Using this framework, this study identifies the genre type of a sample of writings from the textbooks to explore the distribution of genres in the language materials. The genre distribution ascertained by examining the sample is applicable to the rest of the language materials as long as the sample texts are large in number. In order to employ a sample which is large enough, five chapters of writing are randomly selected, respectively, from the textbooks of physics and chemistry used in secondary school and

university. In total, 20 chapters of writing which contain as many as 438 texts are involved in the exploration of genre distribution in the language materials. The numbers of texts in all types of genre are listed in Table 1.

Text / Genre	Secondary school			University		
	Phys.	Chem.	Total	Phys.	Chem.	Total
1. Report/Defining	20	6	**26**	19	6	**25**
2. Report/Classifying	10	11	**21**	8	15	**23**
3. Report/Describing	16	30	**46**	19	38	**57**
4. Report/Decomposing	7	4	**11**	6	4	**10**
5. Explanation/Sequential	12	8	**20**	13	21	**34**
6. Explanation/Causal	7	5	**12**	7	10	**17**
7. Explanation/Theoretical	7	4	**11**	25	9	**34**
8. Explanation/Consequential	8	11	**19**	5	7	**12**
9. Experiment/Procedural	8	12	**20**	2	1	3
10.Experiment/Reconunt	4	8	**12**	7	3	**10**
11.Exposition	2	3	5	2	1	3
12.Narrative	3	1	4	2	1	3
Total	104	103	207	115	116	231

Table 1. Numbers of all genres of texts in sample

As shown in Table 1, the sampled texts are drawn from secondary school and university textbooks. The comparison of the numbers of the same genre reveals that secondary school and university textbooks give different priorities on genre deployment. Table 1 also shows that the textbooks concerning different subjects are distinctive in genre distribution. The variation of genre distribution in the textbooks of different subjects may reflect the relationship between content and generic structure of written discourses. Finally, Table 1 reveals that the quantity of the texts belonging to exposition and biography is strikingly small compared with the quantity of texts in the genres of report, explanation and experiment. This observation supports Martin's (1993b) claim that the genres of exposition and biography are used less commonly in scientific textbooks. Because the texts in these two genres appear in a very low

frequency, they are not taken into account in the further measurement of genre distribution.

The quantification of texts in different genres is designed with the purpose of estimating the proportional genre distribution in the language materials. For example, each text of report/classifying genre is accompanied by about two texts of report/describing genre in the secondary school textbooks. Thus the approximate proportion between these two genres in the sample is 1:2. The proportions between other types of genres could be measured in the same method. Taking all the proportions between the genres with more than 10 texts (printed in bold) into consideration, the distribution of various types of genres in the language materials are represented in Table 2.

Types of Genre		Secondary school	University
Report	Defining	2	2
	Classifying	2	2
	Describing	4	5
	Decomposing	1	1
Explanation	Sequential	2	3
	Causal	1	1
	Theoretical	1	3
	Consequential	2	1
Experiment	Procedural	2	
	Recount	1	1

Table 2. Proportional genre distribution in language materials

It should be noted that although the proportions between different genres are illustrated in Table 2 with exact figures, they are the results of approximate calculation. In other words, the genre distribution in the language materials is calculated by estimating the proportions of each type of genre in the sample texts. It is possible that the real genre distribution in the language materials is slightly different from the findings in Table 2. However, the distortion of calculation is reduced because the genre

distribution is estimated with a large sample of texts. In this sense, the effect of this distortion on the ascertaining of proportional genre distribution is lessened.

According to the genre distribution ascertained above, this study proportionally collects texts from the ten types of genres concerned. The numbers of the texts collected from these genres are similar to the figures in Table 2. Thus, the numbers of texts in each type of genre vary from one to five, reflecting the proportions of various genres of writings in the language materials.

With this method of data collection, 37 texts comprise the data to be analyzed in the study. More exactly, 18 texts represent the writings in the secondary school textbooks, while other 19 texts in the data come from the university textbooks. The texts from secondary school textbooks cover the ten genre types in Table 2. The texts in university textbooks, on the other hand, involve nine types of genre in Table 2 due to the fact that the genre of experiment/procedural occurs with a very low frequency in university textbooks.

The 19 texts in the genre of report and the 14 texts in the genre of explanation constitute the principal part of data. In contrast, the 4 texts from experiment genre are less important in the sense of quantity. With respect to the leading role of report and explanation genres, the relationship between genre and GM deployment in Chinese are explored by comparing the GM degree of texts from these two genres.

In addition to the genre distribution of data, the length of the 37 texts is another factor which affects the deployment of GM instances in data. This study applies the GM degree of a text to the statistical comparison of GM deployment to reduce the impact of text length on the use of GM. Because the GM degree refers to the ratio of the total number of GM instances to the total number of clauses in a text, the length of

text has a lessened impact on the result of relevant analysis. The process of calculating GM degree is discussed at greater length in Section 3.

3 Identification and quantification of GM in Chinese

According to the general purpose of investigating GM in Chinese, the data which consists of 37 texts is treated in two steps: 1) the identification of GM instances and 2) the quantification of GM instances.

3.1 Identification of GM instances

The identification of GM instances begins with the division of Chinese texts into clauses which serve as the basic unit of functional analysis. Following this, the clauses in a text are further divided into grammatical units on the basis of the framework for functional analysis of Chinese developed by Halliday and McDonald (2004). Then the individual GM instances in a clause are identified in terms of their categories and subcategories.

This study classifies the GM in Chinese according to the metaphoric shifts from one semantic element to another. According to Halliday (1998), there are eleven major GM categories which correspond with eleven possible shifts between five semantic elements and two minor categories which have no corresponding congruent domains. A framework for GM categorization in Chinese is developed in this study using this categorizing approach.

Halliday and Matthiessen (1999) further divide several categories of ideational GM in English into subcategories in terms of shift between various grammatical functions. The categories of ideational GM in Chinese are differentiated in the same method. For instance, the semantic element of process functions as the grammatical roles of Event and Auxiliary in Chinese. Thus, there are two subcategories of the semantic shift from process to thing: 1) the shift from Event to Thing and 2) the shift from Auxiliary to Thing. This example also gives rise to the consideration of the distinction between English and Chinese in the division of GM categories. To be more specific, one subcategory of the category 2 ideational GM in English is concerned with the shift from Catenative to Thing which could be illustrated by expressing the meaning of 'try to' with 'attempting' or 'want to' with 'desiring' (Halliday and Matthiessen 1999). This subtype of ideational GM does not exist in Chinese on account of the absence of catenative expressions in the language. This sort of distinction is also observed in the subtypes of other categories of ideational GM in the two languages. This problem is not discussed in detail here as this paper's object of investigation is GM in Chinese.

In Table 3, all the thirteen types of ideational GM in Chinese and their subtypes are illustrated respectively in terms of semantic shift and grammatical movement. The examples are GM instances recognized in data, which are simplified to suit the space of Table 3.

Semantic shift (GM category)	Grammatical movement (Subcategory)	Example
1 quality - thing	i) Epithet - Thing	*jingzhi - jingzhi* static rest
	ii) Attribute - Thing	*wanqu - wanqu* curved curvature
2 process -thing	i) Event - Thing	*biaoshi - biaoda* represent representation
	ii) Auxiliary - Thing	*keneng - nengli* can ability

3 circ.- thing	Cause, Source, etc - Thing	*genju* - *genju* depending on foundation
4 relator - thing	Conjunctive - Thing	*yinwei* - *yuanyin* since reason
5 process-quality	i) Event - Epithet ii) Auxiliary - Epithet	*paichi* - *paichi* *de* repel repulsive Particle *yao* - *yuding* will intending
6 circ. - quality	i) Location (place/time) - Epithet/Classifier ii) Cause, Source, etc. - Epithet/Classifier iii) Manner - Epithet	*zai shui zhong* - *shui zhong* in water inside water inside *genju* - *tichu* *de* according to claimed Particle *guangfan* - *guangfan* widely wide
7 realtor -quality	i) Conjunctive - Attribute ii) Conjunctive - Epithet	*tongshi* - *duiying* and corresponding *dang* - *shengcheng de* when produced Particle
8 circ. - process	Cause, Source - Process	*yizhao* - *yaoqiu* depending on require
9 relator -process	Conjunctive - Process	*yinwei* - *daozhi* because lead to
10 relator -circ.	i) Conjunctive - Accompaniment ii) Conjunctive - Location(place/time) iii) Conjunctive - Cause, Source	*tongshi* - *sui* and with *dang* - *zai* when in *yinwei* - *youyu* because because of
11 + thing	+ Thing	*paichi* - *paichi* *xianxiang* repel repulsion phenomenon
12 + process	+ Process	*yingxiang* - *you* *yingxiang* affect have effect
13 thing -quality	i) Thing - Epithet ii) Thing - Classifier iii) Thing - Deictic	*fangxiang* - *fangxiang de* direction direction Particle *sudu* - *sudu* velocity velocity *kaipule* - *kaipule* Kepler Kepler

Table 3. Categories of ideational GM in Chinese

Halliday and Matthiessen (1999) claim that the GM instances belonging to different categories generally present in the form of GM syndromes. In order to investigate the actual use of GM in Chinese, this study also identifies GM syndromes by observing the clusters of individual GM instances in the data. The GM syndromes appeared in the

data are categorized in terms of the ranks where the metaphoric reconstrual takes place. More specifically, the GM clusters are recognized as higher and lower rank syndromes, each of which is further divided into several syndrome types centered on certain categories of GM. The identification of GM syndromes in this study provides an empirical basis for understanding the interdependence between different categories of GM in Chinese.

3.2 Quantification of GM instances

The task of quantifying GM instances directly depends on the identification of metaphorical expressions in the data. The GM instances recognized are first counted according to their categories in individual texts of the data. The GM instances in different texts are then added up in terms of category to measure the numbers of each category of GM in the data. In the light of the quantifying work, this study defines the distribution of each elemental GM category in the general formation of metaphorical expressions in Chinese.

In order to show the distribution of GM syndromes in Chinese, the clusters of GM instances in data are quantified in terms of the seven types of GM syndromes recognized in the identifying work. The clusters of individual GM instances centered on the same GM category are counted as the same type of syndromes although they may differ in pattern. For example, the GM syndromes with the patterns of '13 + 6 + 2' and '6 + 2' are treated as the subtypes of syndrome centered on GM category 2. It is also worth noting that higher rank syndromes are constructed by lower rank syndromes. In

this case, the lower rank syndromes functioning as the components of higher rank syndromes are not counted as independent GM syndromes.

The last part of GM quantification is the measure of GM degree in the texts under discussion. To measure the extent to which GM instances are deployed in a text, this study follows the method developed by Ravelli (1985). This method demonstrates the degree of GM by calculating the ratio of the number of GM instances in a given text in relation to the number of the clauses in that text. As described in Section 2, the data in this study is deliberately chosen to form various groups of texts different in genre and ontogenetic level. Such a way of data collection offers the possibility to compare the degree of GM in different groups of data. The comparison is based on the results of calculating GM degree in individual texts.

In the quantification of GM instances, there are two issues must be clarified: 1) the exclusion of certain types of GM and 2) the treatment of GM recursion. Ravelli (1985) excludes certain types of GM instances in her analysis of GM in English texts, namely, the *frozen*, the *taxonomized*, the *abstract* and the *technical* GM. This study also excludes the latter three types of GM from the quantification of metaphorical expressions in the texts. However, the *frozen* GM in Chinese has been recognized as a special category of GM with reference to the framework developed by Halliday and Matthiessen (1999). For that reason, this type of GM is taken into account in the detailed counting of GM instances. The recursion of GM means a metaphorical realization is realized metaphorically again (Ravelli 1985). As one of the important aspects in the construction of metaphorical expressions, the phenomenon of recursion is also observed in the data. Following Ravelli (1985), this study treats the metaphorical expression engendered by GM recursion as a single instance of GM.

4 GM distribution in Chinese

According to the process of data treatment outlined in the preceding section, this study first obtains the quantity of GM instances in each category listed in Table 3. This section describes and interprets the distribution of GM categories in Chinese on the basis of the quantifying work. Following this, the GM syndromes in Chinese are identified and quantified to show the syntagmatic relation between GM categories. Finally, the distribution of GM subcategories is discussed to reveal the deployment of certain grammatical functions in GM construction.

4.1 Distribution of GM categories

The distribution of the thirteen GM categories in Chinese is explored by counting the number of GM instances in each category. In Figure 1, the distribution of GM categories in Chinese is illustrated with the number of each choice in data added.

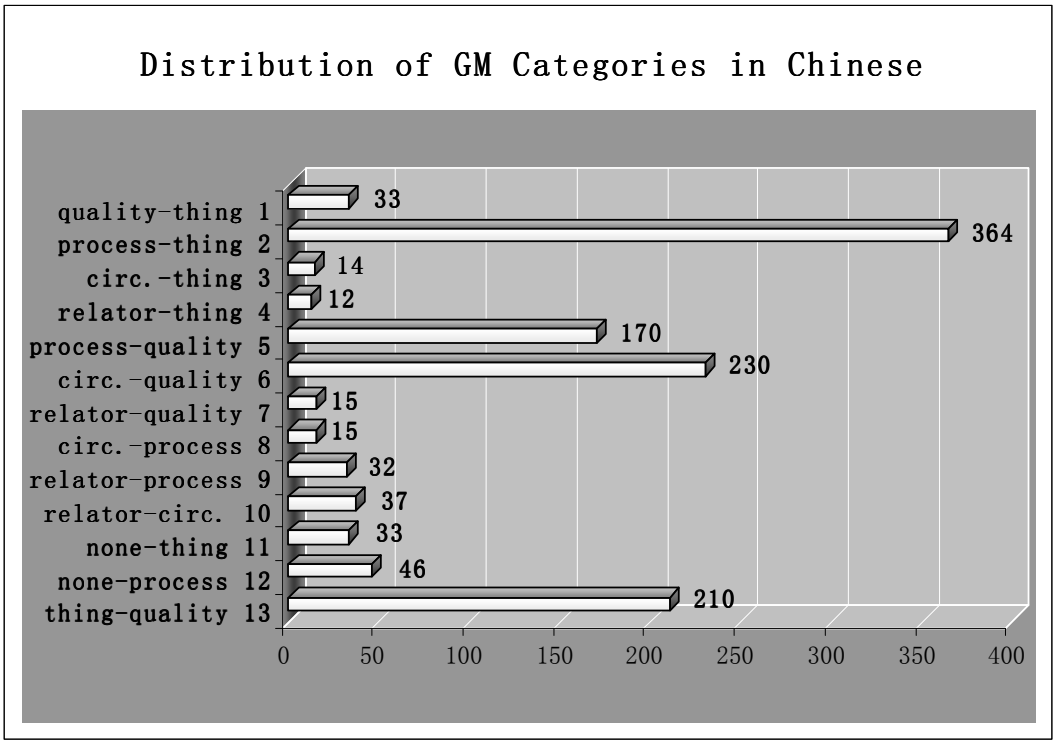

Figure 1. Distribution of GM categories in Chinese

According to the numbers of GM instances in different categories, the frequencies of thirteen GM categories are displayed in Table 4.

Incidence	Elemental GM categories	Frequencies (%)
High incidence	2. process-thing	30.06
	6. circ.- quality	18.99
	13. thing-quality	17.34
	5. process-quality	14.04
Low incidence	12. none-process	3.80
	10. relator-circ.	3.06
	1. quality-thing	2.73
	11. none-thing	2.73
	9. relator-process	2.64
	7. relator-quality	1.24
	8. circ.-process	1.24
	3. circ.- thing	1.16
	4. relator-thing	0.99

Table 4. Frequency of GM category in Chinese

As shown in Figure 1 and Table 4, the numbers of GM instances in various categories vary from 364 to 12, correspondingly, the relative frequencies of these categories in the form of percentage range from 30.06% to 0.99%. It is also observed that some categories of GM instance occur with considerably higher frequency than other categories. More specifically, there are four GM categories which are quantitatively predominant in the general deployment of metaphorical expressions in Chinese. By contrast, the other nine categories are strikingly low in frequency. This distinction in incidence is accountable to the inherent properties of particular GM category in Chinese.

4.1.1 GM categories with high incidence

In the four categories of GM instances with high incidence, the most frequently chosen one is the semantic shift from process to thing (category 2) which occurs 364 times or in 30.06 % of all the GM instances in the data. The next most frequently occurring type is the shift from circumstance to quality (category 6): 18.99% or 230 of the entire 1211 GM instances in the corpus. In the order of frequency, these two GM categories are followed by the GM category concerning the shift from thing to quality (category 13) with the number of 210. The least frequent of these GM categories with high incidence is the shift from process to quality (category 5) which accounts for 14.04% of the entire instances with 170 occurrences. The proportion of these four categories of GM instances to all the metaphors in data is about 80%.

According to the quantitative evidence described above, the semantic shift from process to thing is the most pervasive GM category in Chinese. The other three GM categories quantitatively important in Chinese involve the semantic shifts with the

destination of quality. Thus, all the GM categories with high incidence involve the semantic shifts with the destinations of thing and quality, two main elements of nominal group. The direct implication of this observation is that these GM categories with high incidences are motivated by the grammatical movement towards nominal group. More exactly, a close examination of the grammatical movement from clause to nominal group in Chinese shows that GM categories with high incidence occur in the movement from clause to nominal group.

In Chinese, the metaphorical movement from clause to group occurs in two patterns which give rise to different types of semantic shift. These patterns of movement and the GM categories involved are illustrated by Figure 2.

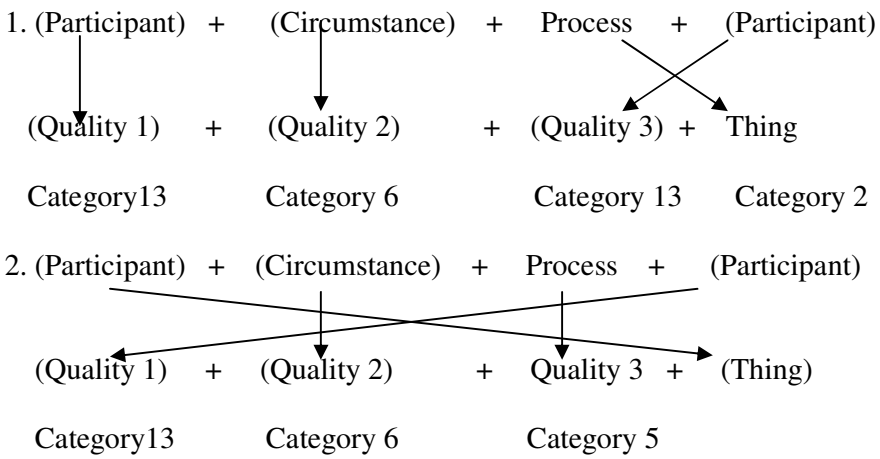

Figure 2. Two patterns of movement from clause to group in Chinese

Figure 2 indicates that all the semantic shifts arising from the two patterns of movement are the GM categories with high incidence, namely GM categories of 2, 5, 6 and 13. Therefore, the high incidence of the four GM categories illustrates that most GM instances in Chinese occur in the grammatical movement from clause to nominal group.

The two patterns of movement in Figure 2 also reveal that the shift from process to thing and the shift from process to quality are more critical in the reconstrual of Chinese clauses since only these two shifts are compulsory in the process of metaphorical realization. In other words, the GM instances in categories 2 and 5 are the leading roles in the relevant metaphorical expressions. This problem is further explored in the discussion of interdependence between these GM categories.

4.1.2 GM categories with low incidence

Table 4 illustrates that the proportions of GM categories with low incidence range from 3.80% to 0.99%. This finding is interpreted and discussed in relation to the properties of these categories of GM.

First, the categories of 11 and 12 which include the GM instances without congruent form are investigated. These two types of ideational GM are used as the attachments of nominalization belonging to other GM categories. As a kind of reinforcing expression, the GM instances of the two categories are not compulsory for the relevant metaphorical rewordings. In this sense, the low frequency of the metaphorical expressions without congruent form is determined by their optional nature in constructing GM.

Two GM categories with low incidence take circumstance as the starting point of semantic shift. The very low frequency of the shift from circumstance to thing is largely determined by the typological features of circumstance in Chinese. As illustrated in Table 3, only one subtype of circumstance in Chinese can be transferred into thing, while the other two subtypes are metaphorically realized as quality (Yang, in press). The low frequency of the shift from circumstance to process is tied up with the etymological relation between prepositions and verbs in Chinese. Many prepositions in

Chinese have characteristics of verbs and can be used as verbs that have similar meanings. This specific feature of Chinese determines that the circumstance of a clause is frequently transferred into an isolated process and the original clause is simultaneously extended into a clause complex. This kind of transfer from circumstance to process is apparently not a metaphorical reconstrual. With this background, the probability of realizing circumstance metaphorically as process is greatly reduced.

The GM category concerning the shift from quality to thing needs special attention in the assessment of GM in Chinese for the reason that its incidence is unexpectedly low. The low frequency of this category of GM instances is related to the unique "Carrier + Attribute" structure of ascriptive figure in Chinese. In regard to this structure, the consideration of the shift from quality to thing is focused on how the ascriptive figures are reconstrued as nominal groups. There are two patterns in transferring an ascriptive figure into a nominal group in Chinese, which are illustrated by Figure 3.

Figure 3. Two transferring patterns of ascriptive figure

According to the categorization of ideational GM in Chinese, only the transfer in the pattern b) is regarded as the metaphorical realization of ascriptive figure. The transfer from clause to nominal group in pattern a) is not identified as metaphorical reconstrual in the present research.

The existence of the two transferring patterns of ascriptive figure gives rise to the possibility that only part of the quality in Chinese is reconstrued as thing. In other words, the low frequency of shift from quality to thing is possibly engendered by the

high incidence of pattern a) transformation. To verify this hypothesis, the number of the transfers in pattern a) is quantified in the study. The result of quantification shows that this pattern of transfers appears 69 times in the data, which is about twice as much as the GM instances involving the shift from quality to thing. Thus, the low incidence of GM category of quality to thing attributes to the transferring preference of ascriptive figure in Chinese.

The last four GM categories with low incidence are concerned with the semantic shifts sharing the same starting point of relator. While all the categories appear in data with low incidence, it is rather difficult to ignore that the categories ending with circumstance and process are used more frequently. These two types of GM instances are observed twice as many as those in the categories with the destination of thing and quality. In terms of the 'distance' of metaphoric movement, the shifts with a shorter 'distance' are used more frequently than those with a longer 'distance', which are illustrated in Figure 4.

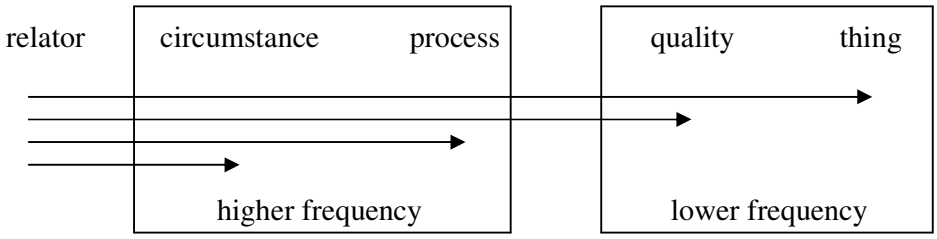

Figure 4. Frequency of GM categories starting from relator

Figure 4 shows that the categories with higher frequency are involved in the grammatical movement from clause complex to clause, while those with lower frequency are concerned with the movement from clause complex to group. It appears that the clause complex in Chinese is tended to be reconstrued metaphorically as clause instead of group.

The distribution of GM instances in different categories shows that there is a polarization of incidence in these GM categories. The discussion above reveals that this polarization is obviously not a random phenomenon in Chinese. On the contrary, the low incidence of certain GM categories is accountable to the special properties of GM construction in the language. Additionally, it is worth noting that the significance of a certain GM category is not quantitatively determined. A GM category with low incidence could be more crucial in the metaphorical reconstrual of meanings. When a semantic shift from process to thing occurs in the movement from clause complex to clause, it is in effect motivated by the semantic shift starting from relator. That is, GM categories with low incidence may be the driving force of those with high incidence. The discussion of GM syndromes in Section 4.2 explores this problem in more detail.

4.1.3 GM categories in groups

The GM instances in various categories are further classified in various groups in which the semantic shifts involved share similar destinations or starting points. This study classifies eleven major categories of ideational GM into five groups in terms of the destination of semantic shift: 1) shift to thing; 2) shift to quality; 3) shift to process; 4) shift to circumstance and 5) shift to modifier. Two minor GM categories which have no corresponding congruent domains are included in Group 6. This kind of classification is proposed because the semantic shifts in one group generally share similar purpose of expression. Thus, the discussion of GM categories in groups is more revealing to the understanding of the motivation of metaphorical expressions. The numbers and percentages of GM instances in the six groups are presented in Table 5.

	Group 1 (shift to thing)	Group 2 (shift to quality)	Group 3 (shift to process)	Group 4 (shift to circ.)	Group 5 (shift to modifier)	Group 6 (no cong. form)
Number	423	415	47	37	210	79
Percentage	34.93%	34.27%	3.88%	3.06%	17.34%	6.52%

Table 5. GM instances in six groups

The percentage of GM instances in Group 1 illustrates the proportion of nominalization in Chinese, which is about 35%. This result of calculation indicates that one third of the GM instances in Chinese are realized in the form of nominalization. Coincidently, it is found that the nominalization in English also accounts for about 35% of all GM instances in the texts analyzed (Ravelli 1985). However, it is worth noting that the proportions of nominalization in English and Chinese are calculated on the basis of different methods of GM quantification. In this case, the likeness in the percentage of nominalization does not imply that Chinese and English deploy same degree of nominalization.

It is also noted that the percentage of GM instances in Group 2 is relatively high if compared to other groups of GM instance. This high proportion is closely related to the fact that the Head of a Chinese nominal group is typically preceded by its modifiers which can be realized by nominal elements, verbal elements and embedded clauses (Halliday and McDonald 2004). Although the Head of Chinese nominal group can be modified by embedded clause, the pressure of limiting the length of modifying elements greatly reduces the number of modifiers in the form of clause. In this case, the quality realized by defining relative clause in an English nominal group is frequently construed by a verbal or nominal premodifier in its Chinese equivalence. The comparison of GM

in English and Chinese also reveals that the GM instances in Group 2 occur more frequently in Chinese than in English (Yang, in press).

4.2 Distribution of GM syndromes

The GM instances in Chinese have been discussed in Section 4.1 as individual linguistic phenomenon. However, "instances of GM typically occur not in isolation but in organic clusters or 'syndromes'" (Halliday and Matthiessen 1999:249). In this section, the syndromes of GM in Chinese are identified and quantified to explore the syntagmatic relation of GM instances. This study identifies seven types of GM syndromes which center on certain GM categories by observing the clusters of GM instances in data. These GM syndromes occur in two ranks of metaphoric movement: I) from sequence to figure or element and II) from figure to element. All the GM syndromes and their structures are shown in Table 6.

GM syndromes		Structure
Lower rank	Syndromes centered on category 1	13 + 1
	Syndromes centered on category 2	(13) + 6 + 2
	Syndromes centered on category 5	(13) + 6 + 5
Higher rank	Syndromes centered on category 4	(13) + 6 + 2 (13) + 6 + 2 (13) + 6 + 5 + (13) + 6 + 5 + 4 13 + 1 13 + 1
	Syndromes centered on category 7	(13) + 6 + 2 7 + (13) + 6 + 5 13 + 1
	Syndromes centered on category 9	(13) + 6 + 2 (13) + 6 + 2 (13) + 6 + 5 + 9 + (13) + 6 + 5 13 + 1 13 + 1
	Syndromes centered on category 10	(13) + 6 + 2 10) + (13) + 6 + 5 13 + 1

Table 6. Syndromes of GM in Chinese

Table 6 shows that the higher rank GM syndromes are constructed by the lower rank GM syndromes. Thus, the analysis of higher rank syndromes is, in a certain degree, based on the discussion of lower rank syndromes. However, it must be pointed out that the lower rank syndromes involved in higher rank clusters do not exist in their own right because they arise from the encapsulation of logical-semantic relation in sequence. The lower rank syndromes occurring alone are named here as 'independent syndromes', while those functioning as the components of higher rank syndromes are referred to 'dependent syndromes'. Only the 'independent' lower rank syndromes are taken into account in the quantification of GM syndromes. The numbers of each type of GM syndromes across the whole data set are shown in Table 7 together with their frequencies of occurrence.

GM syndromes types		Number	Percentage (%)
Low rank	Syndromes centered on category 1	23	8.36
	Syndromes centered on category 2	137	49.82
	Syndromes centered on category 5	19	6.91
High rank	Syndromes centered on category 4	12	4.36
	Syndromes centered on category 7	15	5.45
	Syndromes centered on category 9	32	11.64
	Syndromes centered on category 10	37	13.45

Table 7. Distribution of GM syndromes in Chinese

Table 7 demonstrates that the GM syndromes controlled by category 2 occur with the highest incidence in data. The syndromes with categories 9 and 10 are used less frequently, which account for about 25 % of the metaphorical clusters in the data. This observation indicates that the most pervasive lower rank syndromes in Chinese are the clusters of GM instances in which the shift from process to thing acts as controlling metaphor. The most pervasive higher rank syndromes, on the other hand, are metaphorical clusters centered on the shifts from relator to circumstance and process.

Regarding the fact that normally one GM syndrome consists of two or three GM instances, there is no question that most metaphorical expressions in the data are deployed in the form of GM syndrome. However, it is also possible that some GM instances do not function in association within particular linguistic environments. For instance, Table 7 illustrates that GM syndromes with category 5 occur in a very low incidence. This is because most of the GM instances in category 5 are not involved in the construction of GM syndromes.

The identification of GM syndromes shows that all the seven types of syndromes are controlled by GM instances in certain categories. It is found that only GM categories 2 and 5 occur with high incidence in the data. The GM instances in categories 4, 7, 9 and 10, which act as the key metaphors in higher rank syndromes are used in a relatively smaller frequency. This finding indicates that the GM categories with high incidence can be driven by the GM categories occurring in a low frequency. This study also observes that as many as 165 lower rank GM syndromes occur in the form of 'dependent syndrome', which is the constitutional component of a GM syndrome higher in rank. This means the lower rank GM syndromes driven by the reconstrual of sequence actually occur more frequently than the independent ones. To sum up, the contribution of certain GM category to the construction of Chinese texts is not simply determined by its quantity.

4.3 Distribution of GM subcategories

This study divides some GM categories into subtypes for the reason that the semantic elements involved in these categories are realized by more than one grammatical

function. For example, the element of quality may alternatively be realized by the grammatical functions of Epithet and Attribute. The investigation of GM instances in subtype reveals the deployment of relevant grammatical functions in the construction of GM in Chinese.

To begin with, this section measures the numbers of two subtypes of shift from quality to thing, namely, the grammatical movements from Epithet and Attribute to Thing. It is observed that in the 33 occurrences of the shift, 25 instances are concerned with the movement from Attribute to Thing, while the other 8 instances belong to the movement from Epithet to Thing. This finding supports the suggestion that Chinese prefers to introduce qualities in a clause as the structure of Carrier + Attribute (Halliday and Matthiessen 1999).

As far as the semantic element of process is concerned, its realization involves two grammatical forms: Event and Auxiliary. This study predicts that most metaphorical shifts starting out as process should be concerned with the grammatical function of Event since it is the main element of verbal group in any language. This predication is tested by calculating the numbers of the two movements starting from Event and Auxiliary. The calculation shows that 320 GM instances in category 2 (process-thing) are grammatical movements from Event to Thing. The movement from Auxiliary to Thing, in contrast, occurs 44 times in the category. Of all the 170 GM instances in category 5 (process-quality), 167 occurrences are concerned with the grammatical movement from Event. These results of measurement justify the hypothesis that the grammatical movements which take Event as starting point are predominant in the shifts starting from process.

Compared with quality and process, the semantic element of circumstance is more complex in grammatical realization since it involves as many as eight grammatical functions, which fall into three groups according to their grammatical structures (Halliday and McDonald 2004; Yang, in press). Significantly, some grammatical classes functioning as circumstance are incapable of reconstruing particular semantic elements metaphorically. For instance, the circumstance of Manner never appears in the shift from circumstance to thing. To show this feature of circumstance in Chinese more clearly, the match of relevant grammatical functions and GM categories are presented in Table 8.

cir. types / Category	1. Location (directional)	2.Cause, Source, Matter Instrument, Comparison Accompaniment	3.Location (static) Manner
	Prep. phrase	Preposition	Adverb
Category 3 (cir. – thing)		+	
Category 6 (cir. – quality)	+	+	+
Category 8 (cir. – process)		+	

Table 8. Match of circumstance and GM category

Table 8 shows that only the circumstance in the grammatical form of preposition is used in all three categories. On the other hand, category 6 deploys all kinds of circumstances, while the categories 3 and 8 are not concerned with the circumstances realized by the structures of prepositional phrase and adverb.

The three groups of circumstance specific in structure are involved in metaphorical shifts with similar frequency. In particular, the circumstances realized by prepositional phrase, preposition and adverb respectively occur 101, 71, and 97 times in the data. With respect to the detailed types of circumstance, Location (directional) and Manner are the grammatical functions with relatively higher incidence.

In this section, GM instances are quantified in terms of category, subcategory and syndrome. The quantification provides us a profile of the distribution of GM instances in Chinese. In addition, the quantifying work reveals how the semantic and grammatical resources are employed in the interaction between semantics and lexicogrammar in Chinese. For example, it is found that the quantity of semantic shifts ending with quality and thing is greater than the shifts with other elements. And the circumstances grammatically realized by preposition phrase, proposition and adverb are almost equal in quantity.

5 GM and context of culture

The review in Section 1 indicates that the deployment of GM must be investigated by considering its immediate context of situation (register) and the more general context of culture (genre). In this study, all the texts are selected from the register of science in Chinese to cover as many as possible GM instances in a relatively small data set. The contextual variable of genre, on the other hand, is used as the criterion for sampling texts from the scientific textbooks involved in this study. The discussion in this section focuses on the assessment of contextual impact of genre difference on the deployment of GM in Chinese. The definition of genre as given by Martin (1992) refers to the staged, goal oriented social process that gives meaning and purpose to our linguistic behavior. Therefore, the analysis of GM in the texts specific in genre demonstrates whether the GM deployment is appropriate for the demand of the general social purpose in Chinese language.

As shown in Section 2, the 37 texts for analysis are selected respectively from the genres of report, explanation and experiment. The 19 texts in the genre of report and the 14 texts in the genre of explanation are the major part of the data. Only 4 or about 10 % of the 37 texts fall into the genre of experiment. Due to statistical constraints, this section examines the GM deployment in the texts belonging to the genres of report and explanation. In this case, this study measures the degree of GM in 33 texts for the purpose of investigating the impact of the context of culture on the deployment of GM in Chinese.

The degree of GM in each of the 33 texts involved is calculated by dividing the total number of GM instances over the total number of the clauses. Table 9 lists the GM degree of each text.

Group 1 (Report genre)				Group 2 (Explanation Genre)			
No.	N1	N2	D.M.	No.	N1	N2	D.M.
1	47	24	1.96	1	46	33	1.39
2	48	25	1.92	2	27	19	1.42
3	42	30	1.40	3	31	14	2.21
4	30	29	1.03	4	41	16	2.56
5	28	23	1.22	5	36	15	2.40
6	54	24	2.25	6	47	32	1.47
7	47	33	1.42	7	20	12	1.67
8	21	21	1.00	8	37	21	1.76
9	46	29	1.59	9	44	36	1.22
10	32	18	1.78	10	29	23	1.26
11	42	32	1.31	11	46	27	1.70
12	31	22	1.41	12	30	20	1.50
13	30	22	1.36	13	47	22	2.14
14	31	23	1.35	14	35	11	3.18
15	42	36	1.17				
16	57	38	1.50				
17	40	33	1.21				
18	25	24	1.04				
19	25	32	0.78				

Table 9. GM degrees of texts in report and explanation genres

In the second cell of Table 9, N1 stands for the total number of GM instances in a particular text, N2 for the number of clauses in that text and D.M. is the degree of metaphor. Table 9 shows that the degree of metaphor in the 33 texts varies from 0.78 to 3.18. It means some texts contain averagely less than one GM instance in each clause while others contain more than three GM instances in each clause.

Statistically, the numbers of D.M. in Table 9 form two groups of subjects, which represent the deployment of GM under different conditions. The groups, respectively consisting of 19 and 14 subjects, are constituted by small samples. In addition, the distributions of the population from which the samples are drawn are approximately normal and have almost equal variance. Therefore, this study uses *t*-test to determine whether the means of the two groups of subjects differ significantly. The null hypothesis to be tested is that the mean number of D.M. is same in two groups at the $p \leq 0.05$ level. The result of calculation with the software of Microsoft Excel is reprinted in Table 10.

t-Test: Two-Sample Assuming Equal Variances

	Variable 1	*Variable 2*
Mean	1.405263158	1.848571429
Variance	0.135637427	0.327736264
Observations	19	14
Pooled Variance	0.216195004	
Hypothesized Mean Difference	0	
df	31	
t Stat	-2.706866615	
P(T<=t) one-tail	0.005473351	
t Critical one-tail	1.695518742	
P(T<=t) two-tail	0.010946702	
t Critical two-tail	2.039513438	

Table 10. *t*-test of GM degree in different genres

The result of calculation shows that a value of 1.696 is needed in one-tail test for significance at the $p \leq 0.05$ level. Since the *t*-test value of 2.707 is much bigger than the

critical value, the null hypothesis can be rejected. Additionally, the value of *t*-test is negative in the one directional calculation. Thus, it is shown that the degree of GM in the texts from explanation genre is greater than that in the texts from report genre. It is further concluded that the deployment of GM is greatly affected by the social purposes in different genres of Chinese writing. In other words, the GM deployment in Chinese is impacted by the context of culture.

The possible reason for the greater degree of GM in explanation genre is that the two genres of report and explanation are concerned with distinctive purposes of expression in scientific writing. Previous analysis of report and explanation genres in scientific writing reveals that reports are generally involved in the description of how the world is organized while the explanations are used to explain why the world is organized in that way (Martin 1993b). Because of this difference in expression purpose, the GM function of taxonomizing which achieves technicality with the resources of nominalization is more important in the genre of report. On the other hand, the GM function of reasoning for the purpose of logical relation encapsulation is highly preferred in the genre of explanation.

With respect to the fact that the encapsulation of logical relation generally deploys more GM instances than the process of nominalization, the average number of GM instances in explanations is very likely greater than reports. As a corollary to this, the occurring frequency of GM instances in explanations, as supported by the result of *t*-test, is much higher than that in reports.

6 GM and language development

In addition to context of culture, the variable of language development is another significant factor responsible for the variation of GM deployment. As discussed in Section 2, the data of this study is selected from secondary school and university textbooks which use different levels of writing. The relevant research indicates that the quantity of GM instances increases with the ontogenetic development of language in children (Derewianka 1995). This study hypothesizes that the Chinese scientific writings in university textbooks have a higher degree of GM than those in secondary school textbooks. For this purpose, this study compares the GM degrees in two groups of texts respectively selected from the textbooks for students of different ages. The 19 texts representing the scientific writing in university textbooks constitute the first group of texts. The 18 texts selected from the secondary school textbooks comprise the second group of texts. In Table 11, the GM degree of each text in the two data groups is illustrated.

Group 1 (University)				Group 2 (Secondary school)			
No.	N1	N2	D.M.	No.	N1	N2	D.M.
1	47	24	1.96	1	42	32	1.31
2	48	25	1.92	2	31	22	1.41
3	42	30	1.40	3	30	22	1.36
4	30	29	1.03	4	31	23	1.35
5	28	23	1.22	5	42	36	1.17
6	54	24	2.25	6	57	38	1.50
7	47	33	1.42	7	40	33	1.21
8	21	21	1.00	8	25	24	1.04
9	46	29	1.59	9	25	32	0.78
10	32	18	1.78	10	44	36	1.22
11	46	33	1.39	11	29	23	1.26
12	27	19	1.42	12	46	27	1.70
13	31	14	2.21	13	30	20	1.50
14	41	16	2.56	14	47	22	2.14
15	36	15	2.40	15	35	11	3.18
16	47	32	1.47	16	30	28	1.07
17	20	12	1.67	17	24	18	1.33
18	37	21	1.76	18	40	37	1.08
19	25	16	1.56				

Table 11. GM degrees of texts in university and secondary school textbooks

The capitalized alphabets in Table 11 respectively stand for the number of GM instances, the number of clauses and the ratio of the two numbers in each text, similar to those in Table 9. Table 11 shows that the measures of GM degree vary considerably across the texts from secondary school textbook (from 0.78 to 3.18), while the variance of GM degree in texts from university textbooks are relatively smaller (from 1.00 to 2.56). This difference of variation appears to suggest that the scientific writing in university texts is more constant in the extent of GM deployment.

In detailed statistical analysis, the values of D.M. in texts from the university textbooks are treated as Group 1 with 19 subjects. Group 2 of subjects refer to the 18 D.M. values in texts from secondary textbook. The null hypothesis to be tested is that the samples come from the scientific writings with the same mean of GM degree. The

hypothesis is tested by a directional *t*-test operating with a significant level of 5 per cent. The calculation result of *t* - test is shown in Table 12.

t-Test: Two-Sample Assuming Equal Variances

	Variable 1	*Variable 2*
Mean	1.684736842	1.406111111
Variance	0.195081871	0.284754575
Observations	19	18
Pooled Variance	0.238637185	
Hypothesized Mean Difference	0	
df	35	
t Stat	1.734060931	
P(T<=t) one-tail	0.04585437	
t Critical one-tail	1.68957244	
P(T<=t) two-tail	0.091708741	
t Critical two-tail	2.030107915	

Table 12. *t*-test of GM degrees in texts with different development levels

According to the result of *t*-test, the critical value of *t* is 1.690 for directional test while the calculated value of *t* is 1.734. Since the calculated value exceeds the critical value, the null hypothesis is rejected. That is, the two groups of texts come from scientific writings with different mean degrees of GM. Considering that the test is directional and the calculated value of *t* is positive, it is claimed that the texts from university texts are more metaphorical than the texts from secondary textbooks. With this conclusion, this study justifies the hypothesis that the Chinese scientific writings in university textbook have a higher degree of GM than those in secondary school textbook. Thus, the deployment of GM in Chinese is affected by language development.

The higher degree of GM in the texts from university textbooks is very likely related to the increase of *technical knowledge* in the textbooks. Halliday (1998), from the point of view of ontogenesis, associates the reconstrual of experience in the form of GM with the emergence of *technical knowledge*. It is claimed that children begin to organize their knowledge around abstract entities by construing happening and quality as nouns

in primary school and our experience is further construed with GM to develop logical progression in secondary school (Halliday 1999). In the process of language development, therefore, individuals have to use more abstract and metaphorical discourse for the purpose of coping with increasing amount of *technical knowledge*. In the university textbooks which introduce more advanced science, there is a greater amount of *technical knowledge* than in the secondary school textbooks. Thus, the increase of *technical knowledge* in the university textbooks may give rise to the more frequent use of GM.

It is also noted that the calculated value of *t* is not considerably bigger than the critical value of *t*. This means the different between the university and secondary school textbooks in the degrees of GM is small. The relatively small difference is probably related to the close temporal distance between the writings in secondary school and university textbooks. As mentioned in the discussion of data collection, the university textbooks are used only about three years later than the secondary school textbooks.

7 Conclusion

In this paper, a data consisting of 37 Chinese texts from the textbooks for science teaching purpose is analyzed to investigate the use of GM in Chinese. This analysis of GM in real texts shows the distribution of GM in Chinese and reveals the correlation between the GM deployment in Chinese and its external environment.

By investigating how frequently different categories of GM instances are used, this study obtains a quantitative profile of GM in Chinese. The profile first reveals that the

semantic shift from process to thing is the most pervasive GM category in Chinese. Secondly, it is found that about 35% of the GM instances in Chinese present in the form of nominalization. Thirdly, the profile shows that most GM instances in Chinese occur in the metaphorical construal of figure as nominal group. All these findings are compatible with what has been found in previous research of GM in English (Ravelli 1985). This preference for *thinginess* in GM correlates with the fact that the primary motif of ideational GM is the drift towards *thing* (Halliday and Matthiessen 1999). Considering that things are the most easily taxonomized semantic element, it could be predicted that the preference for *thinginess* is the common feature of GM in any language.

The quantitative profile also illustrates the special features of GM distribution in Chinese. The most salient points are the unexpected low frequency of semantic shift from quality to thing and the high occurrence of semantic shift ending as quality. According to the discussion in Section 4, these two points can be explained by the preference for one pattern of ascriptive figure reconstrual and the lack of postmodifier in Chinese. More generally, the analysis in this paper has shown that the characteristics of GM distribution in Chinese are engendered by the typological properties of the language.

The investigation of GM syndromes extends and complements the findings in the quantification of GM categories. The observation of GM instances in data demonstrates that most of them occur in the form of cluster. In addition, these GM clusters are identified as seven GM syndromes in Chinese, which center on certain GM categories. These findings support Halliday's (1998) claim that GM tends to occur in syndromes which are driven by controlling types of GM. More importantly, this study reveals that

the significance of certain GM category in constructing GM syndrome is not always corresponding with its quantity. In particular, the quantification of GM syndromes in Chinese shows that more than half of the GM instances in data are driven by the GM categories occurring in a low frequency.

Apart from these major findings in the exploration of GM distribution, this paper quantifies different subcategories of GM instance in data. Through the quantification, the study provides information about how different types of Process, Quality and Circumstance are employed in the construction of different subcategories of GM. For instance, some types of Circumstance in Chinese are found to correlate with particular GM subcategories. This correlation is attributable to the distinction between different types of Circumstance in typological structure.

To summarize, this study shows that GM distribution in Chinese is not random but determined jointly by the general tendency of GM construction and the particular typological properties of the language.

In order to investigate the relationship between GM deployment in Chinese and its external environment, this study statistically examines the degree of GM in text groups different in context of culture and level of language development. This study first compares the GM degree in two groups of texts respectively belonging to report and explanation genres. The comparison shows that the extent of GM deployment in the explanation genre is greater than that in report genres. Secondly, this study compares the GM degree in two groups of texts representing the scientific writing in university and secondary school textbooks. The comparison shows that the extent of GM deployment in the university textbooks is greater than that in the secondary school textbooks. These findings of comparison show that GM deployment in Chinese is

affected by context of culture and language development. More generally, this study suggests that GM in Chinese is a lexicogrammatical resource which must be investigated with the consideration of particular linguistic environment.

In addition to the findings mentioned above, this corpus based study of GM in Chinese provides quantitative evidence for confirming or refuting the arguments advanced in relevant research. By studying scientific Chinese in various fields, Halliday and Matthiessen (1999) suggest that range of types of GM in Chinese is similar to that in English. This suggestion is supported by the fact that all the thirteen types of GM in English are also observed in the data of this study. Halliday and Matthiessen (1999) also propose that "the scope of GM in technical and other formal written varieties of modern Chinese is about the same as it is in English". Depending on the results of this study and the research of GM in English (Ravelli 1985), this prediction can be testified. This comparison of GM in English and Chinese should be an issue worth investigating in future research of GM.

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