



Nominalization in Medical Papers: A Comparative Study

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Abstract

Medical writings are generally standardized in language and concentrated on highly technical terms, but it can be difficult to understand due to its many forms and complexity as well. This paper adopts Hallidayan Functional Grammar to analyze nominalization in EMP (English for Medical Purpose) and the role played by it.

With a corpus of Discussion Sections of 10 authentic medical papers by native English writers and 10 by Chinese academic writers drawn from very influential medical journals, the author has carried out a formal comparative analysis of three aspects: frequency of nominalization, lexical density.

Firstly, what the author has attempted in this paper is to convince the readers that nominalization is a most powerful device in English by touching upon the relevant aspects with regard to nominalization: its wide range of morphological types as well as its typical functions in constructing EMP. Nominalization makes the whole text a solid block of information. Hence, the messages transferred by EMP allow little doubt or argument. It is shown that the roles played by nominalization are in accordance with the special requirements of EMP.

Secondly, by identifying, analyzing and interpreting the nominalization in medical papers written by native English writers and Chinese writers from three aspects: the frequency of nominalization, lexical density and thematic progression, it has been found that nominalization accounts for the higher percentage for native writers, which serve to organize texts and might be the reason for their fluency and coherence.

This paper suggests that nominalization plays a crucial role in building the logical structure of medical English papers and improving its formality. The results of the analysis show that Chinese writers have significantly insufficient use of nominalization in their medical papers. Accordingly, in teaching English academic writing to Chinese, attention should be paid to the application of nominalization. The author hopes that this paper will yield some insights and contribute to the studies of grammatical metaphor and the teaching of writing medical papers in China.

Key words: Grammatical metaphor; Nominalization; English for Medical Purpose

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INTRODUCTION

Although medical English falls under the domain of EST, it possesses its typical features, which distinguish itself from the other varieties of EST. Perhaps the most obvious identifying feature of medical English might be considered to be the main lexicogrammatical characteristics.

Medical writings are generally standardized in language and concentrated on highly technical terms. The origin of medical English terms is very broad, which has managed to widen its vocabulary by borrowing words from over ten languages in its development history, mainly from Latin and Greece. There are many methods to construct the medical terms, most of which are polymorphemic with a root morpheme and prefixes, suffixes or infixes. For example: *acritochromacy*, *megabladder*, *herniorrhaphy*, *bacteriostasis*, *arteriovenous*, *epidemic*.

Another feature is grammatical: 'the construction of nominal groups and clauses, deployed so that they could be combined to construe a particular form of reasoned argument: a rhetorical structure which soon developed as the prototypical discourse pattern for experimental science' (Halliday, 1994).

In Ortony's (1993) introduction to the book *Metaphor and Thought*, he states that 'science is supposed to be characterized by precision and the absence of ambiguity and the language of science is assumed to be correspondingly precise and unambiguous—in short literal.' Black (1993) also claims that metaphorical language lacks scientific precision. Therefore, metaphor as a kind of figure of speech is historically avoided in scientific discourse, and 'we need the metaphors in just those cases where there can be no question as yet of the precision of scientific statements'. However, today, metaphor is no longer deemed illicit and a violation of the scientific discourse principles of clarity, precision and verifiability. The attitude towards metaphor in scientific discourse has changed. Grammatical Metaphor, transference of the semantic-grammatical relation in essence, is abundant in EMP.

Halliday (1994) believes that nominalization was a new and significant feature in scientific writing:

Thus the device of nominalizing, far from being an arbitrary or ritualistic feature, is an essential resource for constructing scientific discourse. We see it emerging in the language of this period, when foundations of an effective register for codifying, transmitting and extending the 'new learning' are rapidly being laid down

As we have said earlier, when a process meaning or a property meaning is realized in the form of a noun or a nominal group, the realization is called nominalization. It turns expressions of various categories into nouns. If a syntactic analysis would be the solution to deverbal nominalizations, well-known facts about restrictions on productivity and lexicalization phenomena would be left unaccounted for. (Rathert & Alexiadou, 2010) Nominalization, in the sense, is the transference of the domain of process configuration to participants or the transference of one domain of process to another domain of process.

1. FUNCTIONS OF NOMINALIZATION IN EMP

Halliday and Martin (1993) describe nominalization as grammatical metaphor since a process is transformed into a more abstract phenomenon. This is a common feature of scientific discourse. As is indicated, texts in which there is a great deal of nominalization can be very dense because information can be compacted and it may be hard to process. Nominalization can also lead to the meaning relationships between parts of the information being

implicit or potentially ambiguous. This can be a problem when the reader does not have the knowledge needed to unpack a particular noun group. So, if denominalized language is easier to process than highly nominalized language, why do writers of English use nominalization in EMP?

Generally speaking, there are some functions which nominalization can perform.

(i) Once the process, which is congruently expressed as a verb, is expressed as a noun, it can function as a noun, and hence occupy subject or object position in an equative sentence, but the nominalized processes do not distort the verbal meaning of the source verb. When the process has been converted into thing, it can be modified (Bloor & Bloor, 1995). This *Classifier + Thing construction* is precisely what the scientist wishes to do.

Example 1

Further histopathologic and immuohistochemical investigations have revealed a patchy infiltration of monoclonal lymphoplasmacytoid cells in the bone marrow, more consistent with an extranodal immunocytoma under development.

In this sentence, the process *investigate* becomes a Thing *investigation* and occupies the Theme position with *further histopathologic and immuohistochemical* as its modifier.

Example 2

This study observed that equal concentration of GLU and NMDA could introduce a robust inward current with similar peak values, indicating that GLU current mainly consisted of NMDA current.

Here, the verb *concentrate* is nominalized and becomes *concentration*, and then the other constituents of the clause *equal* and *of GLU and NMDA*, can be expressed as the premodifier and postmodifier of the new noun respectively.

This function of nominalization is particularly useful in science. Firstly, it makes it possible to construct technical taxonomies and, secondly, once we have nominalized a process, it can easily be modified and related to other processes, which makes it possible for the scientist to develop his or her argument by using complex passages packed into nominal groups as Themes.

(ii) Same varieties of discourse may vary in their degree of formality and this difference is reflected apparently by the frequency of nominalization. The difference of formality in written discourses is, in nature, different choices of meaning from the language system and will, doubtlessly, be demonstrated in its lexicogrammatical realizations among which nominalization is the most important one. Halliday (1994/2000) points out that 'The nominal group is the primary resource used by the grammar for packing in lexical items at high density'. Ure (1977) also holds the viewpoint that 'lexical density' might be a norm used

for measuring degree of text formality. She maintains that the higher the lexical density of a text is, the more formal the text appears. Both Halliday and Ure think that nominalization is closely related to text formality, because of the use of nominal constructions causes the higher lexical density in a text and then the more formal it is. Therefore, nominalization can be seen as an indicator of text formality. In a functional point of view, to measure lexical density, we need to simply divide the number of lexical items by the number of ranking clauses. While Halliday unpacks metaphor step by step to their congruent versions, we adopt the opposite direction, that is, we will focus on how metaphors come into being by showing how congruent versions become the current metaphorical versions. This analysis indeed involves packing the metaphors since we have to find out the steps of the metaphorical process after they revert to the more congruent forms. As Halliday & Matthiessen (1999) points out, 'in deriving any one element we should have to take two or more steps in the course of unpacking.' See the following examples:

Example 3a

The use of the Nebulizer Chronolog allowed objective assessment of compliance with metered-dose inhaler use. (Lexical density = 10; 10 lexical items and 1 ranking clause)

This can be unpacked into:

Example 3b

If the Nebulizer Chronolog was used, objective assessment of compliance with metered-dose inhaler use would be allowed. (Lexical density = 5; 10 lexical items and 2 ranking clauses)

This sentence can be further unpacked into:

Example 3c

If the Nebulizer Chronolog was used, it would be allowed to assess the compliance with metered-dose inhaler use objectively. (Lexical density=10/3<5; 10 lexical items and 3 ranking clauses)

In the above examples, the lexical density of 3a is higher than 3b, and 3b higher than 3c. Therefore, example 3a is the most formal sentence, while 3c has the lowest formality. This further proves that nominalization is the indicator of text's formality. Here we also discover that the high tendency of lexical density is largely due to the reduction of ranking clauses in the sentence, which is very often, realized by the application of nominalized processes. By nominalizing, processes and properties are turned to Things and represented as participants of the clause, the ideational content is then densely packed in nominal constructions. Many function words are left out and the clausal patterns are rather simple. Therefore, the more frequently nominalization occurs, the more formal the text is. Therefore, the frequency of nominalization occurrence indicates the formality degree of English discourses.

(iii) Seldom do scholars keep nominalization in perspective in their examination of cohesive devices. According to Hu (2002), 'Lexical coherence involves the semantic connection or reiteration, or replacement by other words, or co-occurrence among part of the lexicon in a text.' The analysis of textual cohesion can be achieved through two features: (1) anaphoric reference, which focuses more on the lexico-grammatical level, (2) thematic progression using the tool of the Theme- Rheme construct.

The choice of Theme, clause by clause, is what carries forward the development of the text as a whole. In texts with a more stepwise structure as EMP, involving sequences of instructions or logical argument, one is more likely to find the Theme of one clause selected from within the Rheme of the preceding clause. By nominalizing processes or attributes, the writer can have a wide choice of elements for Theme position in the clause. One may want to use a nominalization to introduce a topic that one develops in the next few sentences. Usually the nominalization functions as a participant in another clause and serves as the starting-point for the clause. Nominalizations can facilitate smooth transitions between clauses by serving as subjects that refer back to ideas in previous clauses. As a matter of fact, nominalization is a powerful tool in textual cohesion. Here is an example:

Example 4

*Brevican is **expressed** by neurons and glial cells during natural development. In brain and spinal cord injury, the **expression** of brevican by proliferated astrocytes is up-regulated.*

Textual cohesion may be established in a text by word repetition or the choice of a word which is related in some way to a previous one.

Example 5

*Doscherholmen et al. 10,24,25 and others 26-28 have **studied** vitamin B12 **absorption** in patients with primary acid hyposecretion (pernicious anemia or simple gastric hypochlorhydria) or pharmacologically surgically induced hypoacidity (ant-acid administration, H2-receptor antagonists, partial gas-trectomy, or vagotomy). These **studies** demonstrated **abnormal absorption** of protein-bound vitamin B12 when compared to crystalline (free) vitamin B12, supporting the importance of acid/peptic-mediated liberation of dietary vitamin B12 to allow its subsequent **absorption**. Our study shows that the **normal amounts** of the free, crystalline form of vitamin B12 are **absorbed** after gastric bypass. Therefore, the mechanism for **absorption** of free vitamin B12 must be **adequate** after Roux-en-Y gastric bypass (i. e, there is adequate IF available and free vitamin B12 complexes with IF appropriately to be absorbed in the distal ileum). In contrast, there is a **significant decrease in absorption** of the naturally occurring food-bound vitamin B12. Our observations implicate an **inadequate release***

(maldigestion) of dietary vitamin B12 as the cause for the **malabsorption** in these patients, confirming the requirement for acid/peptic-mediated liberation of dietary vitamin B12 for subsequent absorption.

(v) Thus far, we have argued that nominalization plays a key role in text cohesion. However, any attempt to account for the function of nominalization raises an important question: why is scientific language concise? We shall argue here that nominalization also plays an important role of encapsulation (Thompson, 2000). By nominalizing processes and attributes, people can contain a large amount of information in a comparatively small place by packing a large number of lexical items into one clause. Nominalization has two qualities which are useful here. First, by ‘nouncing’ a process, the writer can reflect the fact that he or she has negotiated and established the meaning of the clause centered around the process. Second, it is available to function as a Theme. In other words, it can encapsulate a full clause in the previous sentences to a nominalization which serve as a basis for the next step in the argument, a starting point as a Theme. This is another conclusive proof that nominalization can serve as thematic connection.

Example 6

*Different people may have different physical, pathological, psychological and emotional reactions under the same natural or social environment... the **life information** that originated from human bodies can be divided into two categories as biological information (organic **bioinformation**) and social one (psychological information and **psychobioinformation**). The coexistence of biological and social information is typical of human being.*

In this example a meaning is brought in as a full clause, and is then encapsulated in a nominalization which serves as the starting-point for the next clause. This example also illustrates another important use of nominalization. Technical terms ‘bioinformation’ and ‘psychobioinformation’ are both nominalizations, encapsulating a concept which has been established clausally in the previous sentence. The relationship between the technical terms and their clausal expressions can be seen as a ‘condensation’ of the clause. Since they condense a clause down to a word, nominalized technical terms are clearly very economic.

(v) By the incongruent way of nominalizing processes or attributes in EMP, academic writers can disguise their own roles as observers and interpreters—a disguise which is culturally accepted as a necessary aspect of objectivity. By omitting the reference to people, knowledge can be

presented as though it has some external objective reality quite apart from the people who are engaged in observing or researching it. See the following example:

Example 7

This case report demonstrates the successful use of HDCV and RIG in confirmed gestational rabies exposure. The vaccination combination (HDCV and RIG) appears safe and efficacious when given during pregnancy, as demonstrated by the IgG antibody response at 8 and 24 weeks (parturition) for the mother and at parturition for the infant (Table II). With respect to rabies incubation, clinical effectiveness is suggested because both mother and infant are doing well during follow-up.

2. NOMINALIZATION IN MEDICAL PAPERS: A COMPARATIVE STUDY

2.1 Data for the Analysis

The present study compares and investigates medical papers produced by native English speakers and Chinese writers to see if nominalization plays a significant role in their writing. Limitations in the length of this thesis made it impossible to deal with the whole spectrum of nominalization in EMP. In order to get a deeper insight, it seemed necessary to focus our attention on some of the aspects. Of the great variety of choices, for the purpose of the present thesis, the Discussion Section (DS) was chosen. Our data for analysis contain 10 Discussion Sections of medical papers written by native writers of English from *Annals of Surgery* and the *American Journal of Medicine* (N1-N10) and 10 by Chinese writers from *Journal of Medical Colleges of PLA* (C1-C10). All are highly influential English medical journals.

The analysis involves three steps. The first step of the analysis identifies the frequency of nominalization that occurs in each Discussion Section. The second step was concerned with comparing the lexical density to prove that papers written by native English writers have higher formality than those by Chinese writers. The third step involves the analysis of thematic progression which contributes to the textual cohesion.

2.2 Frequency of the Occurrence of Nominalization in Each Text

The frequency of nominalization is obtained through the division of nominalization by the total words in the whole text. A frequency of 1/12, for example, means that nominalization occurs on average once every 12 words of the text.

Table 1
Frequency of Nominalization in DS by Native English Writers

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Nominalization	21	34	50	17	56	49	48	19	43	37
Total words	253	480	597	266	897	923	916	233	780	745
Frequency	1/12	1/14	1/12	1/16	1/16	1/19	1/19	1/12	1/18	1/20

Table 2
Frequency of Nominalization in DS by Chinese Writers

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
nominalization	29	23	14	29	19	20	20	21	12	15
Total words	399	532	286	469	489	521	390	535	236	411
frequency	1/14	1/23	1/20	1/16	1/26	1/26	1/20	1/25	1/20	1/28

Table 1 and 2 shows the frequency of nominalization occurring in the corpus. It can be seen that the frequency for the DS of native English speakers is normally higher than those by Chinese writers with C1 as an exception.

2.3 Lexical Density

In formal written language, there are fewer clauses, as we mentioned above, 'the ideational information of two or more clauses may be realized as one' (Ravelli, 1988). Thus the possibility of two or more cases of grammatical metaphor being combined in the same nominal group would mean that two or more clauses are being expressed as a single participant. This means that lexical items are found at a far higher density than in the spoken language.

Lexical density is measured by the number of lexical items divided by the number of ranking clauses. It should be noted that lexical density is just a matter of degree. It is not absolute. The lexical density of a text is meaningful only when compared with that of another text. When we say the lexical density in a certain text is high, we must have compared it with other texts.

Most of research on lexical density is made on the basis of simple comparisons between groups of single sentences. According to the functionalists, such investigation should be taken among the full texts rather than among single sentences. Table 3 and 4 present the comparison.

Table 3
Lexical Density in DS Written by Native English Writers

Discourse No.	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
Total words	253	480	597	266	897	923	916	233	780	745
Lexical items	103	249	251	128	502	544	503	118	366	326
Ranking clause	12	30	27	14	51	55	55	14	42	38
Lexical density	8.6	8.3	9.3	9.1	9.8	9.9	9.1	8.4	8.7	8.6

Table 4
Lexical Density in DS Written by Chinese Writers

Discourse No.	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
Total words	399	532	286	469	489	521	390	535	236	411
Lexical items	231	271	169	258	288	312	222	315	130	231
Ranking clauses	32	38	27	38	38	42	28	42	17	33
Lexical density	7.2	7.1	6.3	6.8	7.6	7.4	7.9	7.5	7.6	7.0

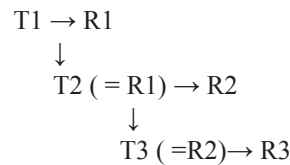
Table 3 and 4 show the lexical density in each text. As is shown, the Discussion Sections by Chinese writers have lower lexical density than those by native ones because of the less occurrence of nominalization. Thus there are more ranking clauses to share the lexical items. To quote Halliday (1994/2000), ‘Typically, written language becomes complex by being lexically dense: it packs a large number of lexical items into each clause’. This result basically corresponds with our predications.

2.4 Thematic Progression

This section is based on the understanding that there are organizing principles beyond the level of the sentence. One of these organizing principles is the functional sentence perspective of thematic progression (Danes 1970). Thematic progression, introduced by the Prague School of Linguistics and attributed to Danes, refers to certain kinds of information structure that are created by the sequencing of Theme/Rheme in relation to given/ new information— whether the Theme and Rheme contain given and new information; Whether emphasis is effected in some way, e.g. through a marked Theme, or whether given information is delayed in the Rheme. Thematic progression reflects the information development—how the addresser organizes information in a text, and this development may proceed parallel to one another, or could be interwoven with each other. In line with this, Mathesius defines Theme as ‘the starting point of the utterance which is known or at least obvious in the given situation and from which the speaker proceeds,’ and Rheme as ‘that which the speaker states about or in regard to the theme of the utterance’. In other words, the Theme of an utterance consists of elements which express information which is known or obvious, or ‘something which can be gathered from the previous context.’ The Rheme, on the other hand, ‘consists of elements that express something new, something unknown from the previous context’ (Firbas 1964). This concept of Theme and Rheme underlies Danes’ concept of thematic progression which he describes as ‘the choice and ordering of utterance themes, their mutual concentration and hierarchy as well as their relationship to the hypertheme of the superior text units to the whole text, and to the whole situation.’

Danes demonstrates that the organization of information in texts is determined by the progression in the ordering of utterance themes. Thus he proposes the following three major patterns of thematic progression which may occur in text as the simple linear thematic progression, the thematic progression with the continuous or constant theme, and the thematic progression with the derived theme. He also contends that these three patterns may combine in various ways to produce other patterns, one of which is the thematic progression with an explosion of a split rheme. The last pattern seldom appears in the discourse of EMP, so we will only elaborate on the other three here.

Simple Linear Theme

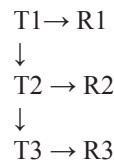


This is the most elementary and basic thematic progression which was stated by Danes. In this pattern, the Rheme of one clause becomes the Theme of the subsequent clause.

Example 8

*The bedside assessment of splenic enlargement will not obvious **diagnostic** imaging when such information is vital to further therapeutic management of the patient such as assessments for lymphoproliferative disorders. However, in other situation, the added **diagnosis** that abdominal ultrasonography will bring to the clinician may not be as critical.*

Continuous (constant) Theme

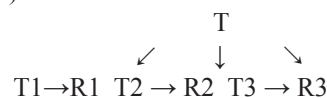


The constant Theme Pattern, where a common Theme is shared by each clause and this Theme equates with given information, is also common in EMP. In this pattern, the same Theme appears repeatedly, though not necessarily with identical wording. See the next example:

Example 9

*Two retrospective **studies** previously reported that the physical examination of the spleen exhibited test sensitivities of 20% and 28%, and test specificities of 100% and 98%. These **studies** employed autopsy or nuclear medicine results as the gold standard. Prospective analysis of palpation maneuvers have found test sensitivities varying between 54% and 59%, and test specificities of 69% to 100%.*

(iii) Derived Theme



In this pattern, the particular themes are derived from a hypertheme (of a paragraph, or other text section) in which the choice of the derived themes will be controlled by various special usage of the presentation of subject-matter.

Example 10

The data on our cohort of 7,857 patients demonstrated that with increased physician experience (as measured by postgraduate training level or time during the academic

year), the sensitivity of physicians for admitting patients with acute myocardial infarction, acute ischemic heart disease, and major complications to the hospital increased, but these physicians were also more likely to admit patients without these diagnoses to the coronary care unit and hospital. These differences reflected a change in the threshold for admission, not an improvement in diagnostic accuracy with increased experience. This finding was documented by physician experience causing a movement to a higher point along a single ROC curve, rather than a shift to a new or better ROC curve.

The development of the text is determined by the

pattern of progression of information from one Theme-Rheme nexus to another. In this study, the frequency of thematic progression patterns will be measured by the number of progressions of any one thematic progression type divided by the total number for each Discussion Section.

With this in view, we examined professional genres of written medical papers by native English writers and Chinese writers to see their difference in terms of their thematic progression. The distribution of the three patterns of thematic structure in all 20 DS are examined and shown respectively.

Table 5
Thematic Progression in DS by Native English Writers

	N1	N2	N3	N4	N5	N6	N7	N8	N9	N10
R1 → T2	65%	62%	68%	68%	62%	61%	66%	61%	64%	61%
T1 → T2	32%	37%	25%	29%	30%	34%	30%	35%	33%	32%
↗ T1 T ↘ T2	3%	3%	7%	3%	8%	5%	4%	4%	3%	7%

Table 6
Thematic Progression in DS by Chinese Academic Writers

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10
R1 → T2	58%	52%	56%	59%	52%	50%	59%	57%	51%	52%
T1 → T2	40%	45%	41%	36%	43%	43%	37%	40%	46%	44%
↗ T1 T ↘ T2	2%	3%	3%	5%	5%	7%	4%	3%	3%	4%

In looking at the distribution of thematic progression patterns across these discussion sections, we find that the simple linear and the constant thematic progression patterns occur frequently in all DS. Both native English writers and Chinese writers have the tendency to use two of the patterns of thematic structure: the linear thematic pattern and the constant thematic pattern coordinately in their way of writing English medical papers and the former has higher proportion for both groups. However, despite the fact that these two patterns appear in all texts, there are some differences. From the tables we know the simple linear pattern which tends to be used to organize and develop information in paragraphs involving explanation or argumentation, occurs with greater frequency in the DS written by native English writers. This seems to indicate that Chinese writers learning English as a second language have difficulty in this aspect and may not be able to identify the identical wording or synonymous expression easily from the previous Theme.

CONCLUSION AND IMPLICATIONS

This paper has adopted a systemic functional approach to investigate how meaning is realized in grammatical metaphor so as to provide a different perspective on looking at the deficiency in the use of nominalization that may be present in Chinese writers' medical English writing. Through the analysis of the data in terms of the frequency of nominalization, lexical density as well as the comparison of thematic progression between native English writers and Chinese writers of English medical papers, the findings show that Chinese writers do not use nominalization as frequently as native writers. The investigation into the use of nominalization in EMP also shows that metaphorical expression is more characteristic of the language of native English speakers than those with English as a second language like Chinese.

What, then, are the implications of the present study on the teaching of medical English? There are two essential directions for utilizing the results of this thesis.

On the one hand, they could serve as a starting point for courses on genre analysis of medical papers with special emphasis on their grammatical metaphor in the form of nominalization which enhances the features of scientific precision, conciseness and objectivity. On the other hand, an understanding of the functional role and textual consequences of grammatical metaphor is essential for a full understanding of the meaning of any text.

Many Chinese students are able to perform well in the use of general English, appearing to have a firm understanding of the English language; in reality, however, many of these students are not yet proficient in academic English and struggle because the EMP teachers have failed to supply them with adequate learning strategies to succeed in their classrooms. Writing effectively, whether involves many different areas of knowledge and skill, such as the ability to generate suitable content, the ability to form syntactically correct sentences, the knowledge of a sufficiently wide range of vocabulary etc.

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