

An Automatic Reference Aid for Improving EFL Learners' Formulaic Expressions in Productive Language Use

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Abstract—Formulaic language is important to language acquisition; however, English language learners are often reported to have problems with formulaic expressions. Several lists of formulaic sequences have been proposed, mainly for developing teaching and testing materials. However, their limited numbers and insufficient usage information seem unable to benefit formulaic language use. To address these issues we have developed GRASP, a reference aid for formulaic expressions, to promote learners' productive competence. Users are allowed multi-word inputs to target their desired phrases or collocations. Utilizing natural language processing techniques, our system categorizes and displays the structures and sequences in a hierarchical way. The corresponding example sentences are also provided. The formulaic structures serve as a quick access index. The formulaic sequences and corpus examples illustrate the real world language use. Importantly, automatic summarization from language data lends support to the idea of data-driven learning. A single-group pre-posttest design was adopted to assess the effectiveness of GRASP on 150 Chinese-speaking college freshmen. The results indicated that our reference aid made a substantial contribution to students' performance on formulaic expression use in a sentence completion task, compared with the existing tools. Notably, the less proficient students showed marked improvement.

Index Terms—Formulaic expression/sequence, productive competence, reference tool, natural language processing, multi-word input, data-driven learning

1 INTRODUCTION

FOR most language learners, it is very difficult to have the good command of appropriate word combinations needed to achieve fluency in English writing or speaking e.g., [1], [2]. They are prone to put together words unidiomatically from their vocabulary inventory of individual items, when really a prefabricated chunk is needed to create a native result. For example, learners have problems in determining a proper verb and preposition to go together with the noun “an order” to make the sentence “He placed an order for some books online.” If students have learned the formulaic expression “place an order for”, they could combine word sequences more efficiently and fluently.

In past decades, the role of formulaic language has been stressed in language use, processing and acquisition e.g., [3], [4], [5]. Formulaic language also plays a crucial role in

facilitating native fluency [2]. This importance is empirically substantiated in two aspects. Formulaic language forms a considerable proportion of any discourse [3], [6]. Approximately one-third [7] to one-half [8] of language is composed of formulaic elements. From the perspective of cognitive science, studies support the argument that “formulaic language offers processing efficiency” [9] which directly facilitates efficient and effective communication [10], [11], [12]. Specifically, formulaic sequences are read and understood more quickly than non-formulaic equivalents in context e.g., [13], [14], [15], [11].

High prevalence and efficient mental processing have led researchers to introduce formulaic language into L2 teaching and learning e.g., [3], [16]. Research and practice in language education demonstrate that the learning of formulaic sequences contributes to fluency in both spoken [17], [18] and written discourse [19], [20]. In other words, learning formulaic language helps the development of communicative competence [21] and the achievement of native-like fluency [2], [17], [22], both of which are keys to the general language acquisition process [23].

However, language learners have shown a lack of awareness and knowledge of formulaic language e.g., [24], [21]. Given the fact that the development of formulaic language competence is a daunting challenge for many language learners, both specific instruction and automatic reference aids are needed to facilitate their formulaic language use. In view of such a pressing need, formulaic sequences clearly should be placed prominently in language teaching textbooks and materials. Several lists of formulaic expressions have been compiled, such as the Academic Formula List

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GRASP
GRAMMAR AND SYNTAX-BASED PATTERN-FINDER

Please enter words you want to GRASP :

Select Query Mode
 Collocation

Tag Definition

The pattern=**make DT JJ difference** (246)

make a big difference (56)

- But even a small donation can **make** a big **difference** to one child 's life .
- Something as small as a brisk fifteen-minute walk each day can **make** a big **difference** to health .

make a significant difference (20)

- Even in 1987 voters did not expect the return of a Labour or Conservative government to **make** a significant **difference** .
- Remarkably this subtle difference in the way an idea is put **makes** a significant **difference** to the response .

make a great difference (19)

- It **makes** a great **difference** to our research work , to both our projects .
- It certainly **makes** a great **difference** to our lives when we see prayer as delighting in God .

Expand all
In-between
 2 (1151)
 3 (554)
make DT JJ difference (246)
make PDT DT difference (158)
make RP DT difference (36)
make RB JJ difference (24)
make IN JJ difference (13)
 -3 (97)
 -2 (37)
 -1 (14)
 1 (4)
Preceded by patterns
Followed by patterns

Fig. 1. GRASP information presentation.

(AFL) [25] and the Phrasal Expressions List [9], which are detailed in Section 2. However, a limited number of formulaic sequences with little usage information are inadequate for a comprehensive understanding of formulaic language use. To address this issue, we develop GRASP [26], a reference aid which provides a usage summary of the query phrase in the form of formulaic structures (i.e., syntactic patterns) and frequent formulaic sequences (i.e., lexical phrases). It aims at providing immediate assistance to learners in their writing tasks and helping them develop productive competence in speaking and writing, instead of passively recognizing text meaning only.

GRASP is designed for learners whose first language is not English, and can be used either for self-learning or with teacher's guidance in a classroom or computer lab setting. In the classroom scenario, teachers would assign a number of collocations or phrases and engage students in using GRASP to determine the corresponding formulaic expressions. Students could be evaluated through sentence completion assignments. For example, students might be asked to query the collocation "make difference". Using GRASP, the student inputs this collocation and selects the query mode *collocation*. Note that unlike most existing reference tools (e.g., online dictionaries), GRASP

allows multi-word input, so the student can query either consecutive word sequences (defined as a phrase in this study) or non-consecutive word sequences (defined as a collocation) in search of their surrounding usage information at both syntactic and lexical levels.

Referring to Fig. 1, on receiving his request, GRASP initializes three zones on the left: syntactic patterns in-between, preceding and following the query phrase. As shown, the yielded patterns are ordered by the frequencies of different distances of the words in the query phrase. In the first row in the in-between zone, the number 2 indicates the distance of "make" and "difference". In other words, only one word appears in-between the query phrase and they together form a pattern "make * difference" which is found 1,151 times in the corpus (the number in the parentheses). Note that the negative numbers indicate the distance only if the words in the query phrase appear in reverse order.

In this case, if the user would like to see the patterns containing more informative and expressive information, he can click on the second row (e.g., distance 3 and frequency 554) to find the components of the pattern "make * difference". GRASP generates at most five representative formulaic structures with individual counts, such as "make DT JJ difference" ("DT" for determiners and "JJ"

adjectives) with 246 appearances. These formulaic structures provide a general idea on how the querying phrases are usually used in varied scenarios. The organized pattern information serves as a quick navigation index which contributes to faster consulting.

Next, a further click on any formulaic pattern triggers the lexical information in the central region of the screen. Similarly, for each pattern, GRASP suggests at most five most common instances together with their corresponding frequencies and example sentences. For example, the lexical instances of “*make DT JJ difference*” are “*make a big difference*” with 56 occurrences in the British National Corpus (BNC).

In the same way, the preceding and following usage information can also be directly accessed. For visual aid, the query phrase in each example sentence is highlighted for “noticing” [27]. This is in order to accelerate learners’ full understanding of the real essence of the word usages. In short, GRASP effectively grasps frequent surrounding lexical choices to extend the query phrases or collocations into formulaic expressions depending on the user’s needs.

This paper is structured as follows: Section 2 gives a brief overview of learners’ problems and the availability of pedagogic materials, and it then compares existing reference tools. Section 3 describes the development of GRASP and the experimental settings. Section 4 analyzes and discusses the effectiveness of GRASP. Finally, Section 5 concludes and suggests future research directions.

2 RELATED WORK

2.1 Difficulty in Developing Formulaic Language Competence

Mastering a foreign language is a challenging and frustrating experience for second language learners. One problem is the acquisition of formulaic language (or prefabricated chunks). Many language learners have shown a lack of knowledge of formulaic language [28], especially at the pragmatic level. Devoting considerable time to recognizing and memorizing a large inventory of vocabulary in isolation instead of in context, they still have difficulties in using appropriate word combinations in language production e.g., [1], [2]. Coupled with the fact that these learners pay less attention to formulaic sequences while learning, they rarely reach native proficiency [29], [17]. More than that, the “unrandomness” [30], [31] or the “limits of adaptability” on lexical substitution in formulaic sequences [3] might be an important factor contributing to the difficulties learners have experienced in mastering formulaic language [12], [32]. In other word, “the variation (if any) allowed in native-like usage is much more restricted” [2]. Thus, changing conventionalized forms may lead to grammatical but unidiomatic expressions. For example, the phrase “*in the near future*” (instead of “*in the recent future*”) illustrates the native speakers’ preferences for certain word sequences over others [21].

2.2 Availability of Pedagogic Materials

Although formulaic sequences are recognized as being beneficial to learners’ language fluency, common traditional pedagogic materials (e.g., textbooks and tests) seldom prioritize such sequences for learners. Researchers tackle the deficiency by creating lists of formulaic

sequences for use in classroom application and in the development of teaching materials. For example, Shin and Nation [33] provide a list of the most useful spoken collocations based on the ten million word spoken section of the British National Corpus [34] for the purpose of creating teaching and learning materials. Simpson-Vlach and Ellis [25] compile an Academic Formula List, a list of common and special formulaic sequences used in Academic English. The formulaic sequences are extracted from corpora of academic usage such as the Michigan Corpus of Academic Spoken English (MICASE) (1.7 million words) [35] and the BNC files of academic speech and writing (431,000 words and 931,000 words respectively). More recently, Martinez and Schmitt [9] have created a Phrasal Expressions List (PHRASE List), a list of the 505 most frequent non-transparent or more figurative formulaic sequences for receptive purposes. More specifically, the opaque multiword expressions such as “*at all cost*” are phrases that cannot be broken down, and these readily cause comprehension problems.

The above three lists share the same goal of providing guides in traditional language testing and syllabus design, and especially facilitating learners’ receptive knowledge of formulaic sequences. However, such lists are clearly far from being comprehensive. Besides the limited scope, the lack of syntactic patterns and usage information is unsatisfactory in helping learners develop their productive competence. To address such issues, automated systems which provide formulaic structures, sequences and their usages are needed to satisfy learners’ demands. However, relatively little research has been done in this area. It is extremely time-consuming to examine the large number of sentences in corpora and identify the systematic relations between syntactic structures and lexical phrases. Fortunately, using natural language processing techniques, the opportunity to accomplish such a task is now available. With this in mind, we have developed GRASP, an automatic formulaic sequence reference aid to assist learners in expanding the knowledge and use of formulaic sequences.

2.3 Comparisons among Existing Tools

Research on formulaic language has been receiving increasing attention and has proliferated over the past decade. With the development of computer technology, fast searching for instances of recurring word combinations in corpora becomes possible [36]. Among them, studies of concordancers for suggesting collocations have received most of the attention [37]. Concordancers typically provide a word’s grammatical or collocational behavior by displaying example sentences. Recently, such corpus-based tools have been developed and made available. Several relevant systems are introduced and compared in the following.

Word Sketch Engine [38], a well-known corpus query system, automatically provides separate collocate lists for each grammatical relation the word participates in. Take a verb as an example: its collocates, including subjects, objects, modifiers, and prepositions and other co-occurring words are all presented in different lists. When a user clicks on each collocate, a set of corresponding example sentences from the corpus are displayed along with the pattern in use.

TABLE 1
Comparison of GRASP and Existing Tools

GRASP attributes	Word Sketch	TANGO	StringNet 1.0	ConcGram 1.0
multi-word query	×	×	✓	✓
syntactic patterns	×	×	✓	×
usage information	×	×	✓	×
organized display	×	×	×	×
free software	×	✓	✓	×

TANGO [39], a collocational concordance system, assists learners in collocation finding. TANGO provides collocation information concerning two major collocation structures: A-N (adjective-noun) combinations as well as V-N (verb-noun) combinations including V-N, V-P-N, and V-N-P structures (where P is a preposition). On receiving a single-word input with the defined collocation type, TANGO displays its collocates for reference (along with their frequency) and the corresponding example sentences. Learners then need to deduce the usages of each collocation by themselves. TANGO is designed for self-inductive learning tailored to intermediate or advanced English learners.

StringNet 1.0 [40] is a lexico-grammatical knowledge base consisting of a massive archive of hybrid n -grams for the research of construction, “the basic units of language representation” (i.e., formulaic sequences) [41], [25]. The hybrid n -grams contain any co-occurring combination of lexical items and part-of-speech (POS) tags. For example, the phrase “pay attention to” can be generalized to “pay *Noun* to” or “pay attention *Preposition*”. Including any contiguous combination of gram types ranging from *bi*-grams to 8-grams, StringNet 1.0 is mainly designed for investigating constructions and a range of multiple word expressions, and also for supporting NLP applications such as error detection and correction and pattern detection in webpages.

One more concordance system is ConcGram 1.0 [42], a phraseological search engine. It is designed to find all the co-occurrences of words and instances in a text or corpus, irrespective of constituency variation (e.g., “increase” and “expenditure” co-occurs in “increase in expenditure” and “increase in the share of public expenditure”) and positional variation (e.g., “expenditure would inevitably increase”). As with our system, Concgram 1.0 is able to find more possible word combinations which enable users to discover a more extensive description of patterns of collocations and their meanings.

As shown in Table 1, these existing reference tools have their strengths and limitations. First, single-word queries would retrieve too many collocations with diverse meanings. This might distract and confuse users. To gain precise access to the desired formulaic sequences, multi-word query has the advantage of targeting the specific word sense the user desires. Allowing multi-word querying, StringNet 1.0 and ConcGram 1.0 provides learners with a clearer view of the word associations of any specified queries.

Existing concordancers typically present too much information on a single screen and users are left to deduce the

patterns and usages by themselves. Categorizing information seems to more effectively facilitate language learning [43]. StringNet 1.0 serves such needs; however, it fails to organize the patterns. In contrast to the above four tools, GRASP, more than a concordancer, addresses the above limitations and is expected to better meet learners’ needs. It is worth noting that because “formulaic sequences are much more than strings of words linked together with collocational ties” [44], GRASP is developed specifically to serve the purpose of suggesting formulaic expression use.

Besides the functional issue, an evaluation of the effectiveness of the reference tools applied to computer-assisted language learning (CALL) is required in order to understand actual student use in pedagogical contexts. Only TANGO [45] and GRASP have been applied in the classroom with supporting effectiveness evidence. Other systems have not yet been demonstrated usable for language learners and teachers.

Overall, few studies have concerned computer-assisted formulaic language learning. The current study therefore aims at developing a reference tool for formulaic expression use and assessing its effectiveness for the purposes of the study. Two main research questions are addressed:

1. Does GRASP benefit students’ productive performance of formulaic sequences compared with other online tools? If so, to what extent does GRASP facilitate the achievement of students with different proficiency levels?
2. To what extent do students show improvements in the different lexical types, verbs, adjectives, prepositions and articles, which facilitate formulaic sequence use?

3 METHODOLOGY

To suggest the representative formulaic structures and sequences, GRASP retrieves the key phrase and its neighboring lexical items and computes the n -gram frequency of each word sequences. Then they are ranked based on their counts. We assume that the higher the count, the more common the expression. Thus, the retrieved in-between information for the collocation “in future” forms formulaic expressions which are suggested according to their corresponding frequency, such as “in the near future” (465), “in the foreseeable future” (104), and “in the immediate future” (54). Similarly, the formulaic structures are organized and displayed. In this way, we can extend a phrase or a collocation by giving its preceding, following, in-between usage patterns as well as the usage patterns of the inverted query words. After summing up and ranking the individual frequency counts, GRASP suggests the five most common syntactic patterns and lexical instantiations. On top of that, GRASP retrieves example sentences (limited to 25 words in length) for each formulaic sequence from the BNC, if available, to illustrate the lexical usages in a real-world environment. The example sentence retrieval for the lexical instances uses concordance techniques.

Section 3.1 describes the development of GRASP and the display of the formulaic expressions at both syntactic and lexical levels. Section 3.2 covers the experimental design for evaluating the effectiveness of GRASP.

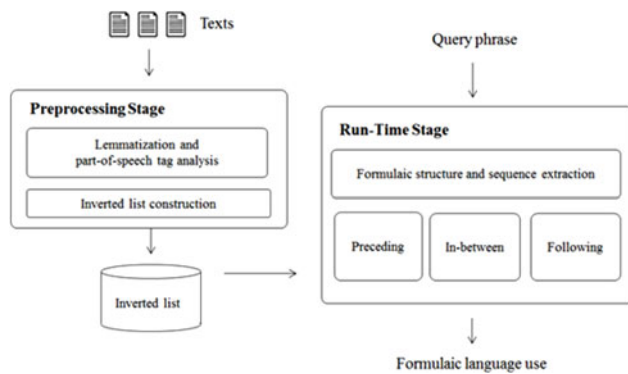


Fig. 2. Development process of GRASP.

3.1 Development of GRASP

The corpus used in this study is the British National Corpus, a balanced 100-million word collection of samples of written and spoken British English from a wide range of sources including newspapers, periodicals and journals, academic books and popular fiction, university essays and so on. It was chosen mainly because of its size and widespread and longstanding use as a research instrument.

This section provides a detailed description of the development process of GRASP (Fig. 2) including the internal construction and external functionalities. The development of GRASP is based on several essential NLP techniques including lemmatization, POS tagging, phrase extraction and sentence retrieval. We take the following steps to generate the formulaic structures and expressions characterizing the contexts of the query phrase.

3.1.1 Preprocessing Stage: Lemmatizing and Tagging Sentences in the BNC

During corpus preprocessing, we first lemmatized a total of approximately 5.6 million sentences (i.e., found the stems of surface word forms in sentences) in the BNC to reduce the impact of inflectional morphology of words on the statistical analysis. Next, we generated the most probable POS tag sequence for each sentence, mainly because POS tagging provides a way to grammatically describe and generalize the contexts of a query phrase. The following example illustrates one sentence with POS tags.

The (DT) *British* (JJ) *Section* (NN) *refugee* (NN) *office* (NN) *has* (VBZ) *played* (VBN) *a* (DT) *leading* (VBG) *role* (NN) *in* (IN) *this* (DT) *area* (NN) *of* (IN) *work* (NN) .

Here we used the GENIA tagger [46] developed by the Tsujii Laboratory. After lemmatizing and syntactic analyses, all sentences were used as examples for the extraction of formulaic structures and sequences.

3.1.2 Runtime Stage: Extracting Formulaic Structures and Formulaic Sequences

To provide language learners with an overall picture of word usages, at run time GRASP automatically identifies all the sentences containing the query phrase and groups the contextual words into syntactic patterns based on their assigned POS tags. At the same time, the corresponding

lexical items are summarized by GRASP to form formulaic sequences to depict how they are used in context. As mentioned above, the formulaic structures and sequences are sorted and displayed based on their frequency.

It is noteworthy to mention that after manually scrutinizing and automatically identifying the lexical information in the corpus, we found that the word segments surrounding the query phrase within a window size of two words satisfactorily serve informative and expressive functions. For example, the lexical items appearing in-between the V-N collocation “*reach agreement*” contribute to a common formulaic sequence “*reach a preliminary agreement*” while in the P-N collocation “*in future*” leads to “*in the near future*”. Similarly, the lexical items following the query phrase play a pivotal role in correctly concatenating the subsequent word sequence. For example, the frequent words “*to*” and “*the*” adjacent to the V-N collocation “*make difference*” suggest that preposition “*to*” and noun (instead of infinitive “*to*” and verb) are the most common usage following “*make difference*”. Such information appears to be of great benefit to learners’ syntactic and lexical knowledge. On the other hand, Gamon and Leacock [47] claim that the window size of two words achieves better performance in detecting learners writing errors. Therefore, in this study, GRASP extracts word segments surrounding the query phrase within a fixed window of two tokens. (Note that the window size is adjustable if necessary.)

The following three examples illustrate how GRASP categorized the usage patterns and lexical items surrounding the query phrase as well as suggesting the representative formulaic sequences.

Preceding usage patterns. The usage information preceding the query phrase is one dominant component of a formulaic sequence. For example, verbs or adjectives co-occurring with the query noun phrase would form V-N collocations or A-N collocations. Collocation knowledge has been proven to help language learners achieve native-like fluency [48], [49]. Here we use the phrase “*useful purpose*” to illustrate how GRASP suggests the preceding information. After classifying the contextual words along with the corresponding POS tags and computing their individual frequencies, the lexical item “*serve*” is found to become the most common verb along with articles or determiners like “*no*”, “*a*”, “*some*” and “*the*” to form formulaic sequences such as “*serve no useful purpose*”, “*serve a useful purpose*” and so on in the BNC. Further, GRASP summarizes the POS tags of the lexical items and reveals that **verbs** and **determiners**, compared with other parts-of-speech, were more frequently co-occurring with “*useful purpose*”. The form “*VB DT useful purpose*” is suggested to be the most common formulaic structure (“*VB*” for base verbs). By doing this, GRASP generates several possible formulaic structures and instances of formulaic sequences preceding the query phrase, so as to picture word usages in natural settings.

In-between usage patterns. The in-between usage information of the query phrase, since it is more descriptive, is useful for developing a learner’s vocabulary repertoire, particularly for writing. As Ediger [50] states, “variety in selecting words to convey accurate meanings is necessary in speaking and writing.” In view of such needs, GRASP provides in-between information to help learners improve their expressive

language skills. The collocation “in future” is used to exemplify the in-between patterns. After screening all sentences containing “in future” in the BNC, GRASP summarizes the patterns within a pre-defined distance and shows that the most frequent formulaic patterns and chunks appear when one or two words co-occur within the query phrase. For example, when only one word appears in-between, the word sequences “in *the* future” (the pattern “in DT future”) and “in *our* future” (“in PRP\$ future”, where “PRP\$” stands for possessive pronouns) are the most common formulaic expressions. On the other hand, when two lexical items occur in between the query phrase’s words, more informative prefabricated chunks are generated. For instance, the lexical items “the near”, “the foreseeable”, “the immediate” and “the distant” lead to the formulaic sequences “in *the near* future”, “in *the foreseeable* future”, “in *the immediate* future” and “in *the distant* future”, which are generalized to the formulaic structure “in DT JJ future”. The in-between syntactic and lexical information GRASP provides supports learners’ development of lexical richness [51].

Subsequent usage patterns. The usage patterns following the query phrase serve as a tie to link the subsequent word sequences. For example, conjunctions (e.g., “although” and “neither”), transitions (e.g., “also” and “in brief”) and prepositions (e.g., “at” and “by”) are used to describe relationships between word sequences.

Most existing collocation tools (e.g., TANGO) mainly focus on providing suggested collocates. However, they typically ignore the following words co-occurring with the displayed collocations, and thus fail to provide a more comprehensive picture of word usages. In view of the importance of the subsequent information, GRASP extracts and categorizes the most commonly used lexical items serving as reference for language learners. We use the collocation “make difference” to demonstrate the syntactic and lexical behaviors following the query phrase. As previously, GRASP provides two-word patterns and lexical instances. In this case, the **preposition** “to” is found frequently placed after “make difference”. Moreover, **determiners** are the most common part-of-speech immediately occurring behind the **preposition** “to”. As a result, these syntactic components contribute to the formulaic structures “make difference IN DT” (“IN” for prepositions). At the lexical level, “to the” form the formulaic sequences “make ~ difference to the”.

Quite a few EFL learners seem prone to incorrectly use “to” as infinitive instead of “to” as preposition to link the following word sequences such as in the sentence “Practice makes a big difference **to* learn language” (the correct sentence is “Practice makes a big difference *to* language learning”). The uses of “to” as infinitive and “to” as preposition are often confusing for learners. Unfortunately, existing spelling checkers, such as in Microsoft Word, fail to detect such usage errors. In contrast, GRASP provides proper usages in both syntactic and lexical forms, so as to clarify the different usages for learners.

Usage patterns for inverted query words. On the other hand, sometimes the query words are likely to be used in reverse order (e.g., “agreement ~ reach” for the collocation “reach agreement”). Reverse order usage yields a more varied set of results. To provide an overall view of the usages of the query phrase, GRASP accommodates this, aiming for more

TABLE 2
Common Formulaic Structures and Sequences Surrounding
“Agreement ~ Reach”

usage pattern	formulaic structure	formulaic sequence
preceding	DT JJ <i>agreement reach</i>	<i>a provisional agreement has been reached</i>
in-between	<i>agreement</i> VBD VBN <i>reach</i>	<i>agreement had been reached</i>
subsequent	<i>agreement reach</i> IN DT	<i>agreement was reached between two parties</i>

possible syntactic and lexical behaviors. The common formulaic structures and the corresponding formulaic expressions in the BNC for “agreement ~ reach” were as shown in Table 2.

Automatically generated formulaic structures and expressions are more abundant than the manually compiled lists. Moreover, the categorized and organized information provides learners with wide choices of formulaic sequences for their contexts.

3.2 Experimental Design for Assessing the Effectiveness of GRASP

We conducted an experiment related to the learners’ performance of a sentence completion task to examine whether, and to what extent, GRASP benefits their acquisition of formulaic language. In this study, GRASP is simulated as in a self-learning situation. The background of the participants, the development of the materials, the scoring criteria and the experimental procedures are introduced below.

Participants. The participants in the study were 150 Chinese-speaking EFL college freshmen. They came from the Department of Material Science and Engineering ($n = 61$) and Computer Science ($n = 89$). The students had at least six years of formal instruction from junior to senior high schools and were at the intermediate level regarding their overall English competence.

Materials and Instruments. For the purpose of assessing how effectively GRASP improves learners’ performance in the use of formulaic sequences, we designed a pre- and post-test to compare participants’ performance in a sentence composition task.

A worksheet and a test sheet were developed for exploring participant’s improvement due to GRASP. We first manually selected 46 collocations (e.g., “reach ... agreement”) and phrases (e.g., “... useful purpose”) from the 100 most frequent collocations in the BNC. Then we extracted their most frequent formulaic sequences and example sentences in the BNC (e.g., “reach *a preliminary agreement on*” and “serve *no useful purpose in*”). Meanwhile, we revised the extracted sentences consulting the *Longman Dictionary of Contemporary English*. Each sentence used in the tests was lexically and structurally relatively simple (the length of each sentence was no more than 15 words) to reduce the students’ cognitive load; the design allowed us to assess their performance of formulaic sequences. The revised version was verified by a CALL and TESOL (Teaching English to Speakers of Other Languages) professor.

After administering a pilot test to identify the feasibility and effectiveness of the operational procedure, a total of 20 collocations and phrases were determined and listed on

the worksheet to familiarize the participants with the usages of formulaic sequences. Further, due to the limited survey time, we randomized 15 out of the 20 phrases as the test items, which were used to develop a sentence-completion test. In other words, the test items were all covered in the worksheet. The strengths of the sentence-completion format lie in three factors: easing the writing and answering task, reducing the effect of guessing, and supporting the assessment of mastery [52], [53], [54], [55]. The test items in the pre- and post-tests were identical except for their order.

Each test item covers one collocation (V-N, A-N and P-N collocations). The format of the regular test item is one English sentence with two blanks, but there was also one test item containing only one blank. In other words, a total of 29 blanks were embedded in the test. Each blank requires the students to supply one or more words in response. The missing words cover verbs, adjectives, articles and prepositions, which are crucial components of formulaic expressions and usually co-occur with the given collocations or phrases to determine the use of the formulaic sequences. In this task, these four lexical types totaled 38 lexical items in the 29 blanks. Words irrelevant to the target words for forming formulaic sequences were provided and attached to the corresponding Chinese translation to keep the focus on testing students' knowledge of formulaic sequence usages. Take the test item "have impact" as an example, the sentence pair is as follows:

Chinese: "環境保護對地球 (the earth) 有深遠的影響 (have... impact...)"

English: "Environmental protection has _____ impact _____."

In the Chinese sentence, the English word sequence "the earth" was provided because it is irrelevant to the target formulaic sequence, whereas the collocation "have impact" in bold was given as a reminder of the query being the English counterpart of the Chinese phrase "有深遠的影響 (profound impact)". Students needed to fill in the blanks with one or more appropriate lexical items to form the required formulaic expression. The first blank could be filled with "a profound" (any possible lexical expressions were allowed), and the second one with "on the earth". The filled words led to a complete sentence "Environmental protection has a profound impact on the earth." In this test, our four targets are possibly distributed across verbs, adjectives, articles and prepositions. As can be seen in the example above, the adjective, article and preposition in "profound impact", "a/an impact" and "impact on" correspondingly are expected to be either common errors or primary lexical types students are not skilled at. We also tested students' command of verbs since verbs are a salient lexical type. For example, students were required to give the verb "make" to collocate the noun phrase "record profit" to form a formulaic sequence "make a record profit". The students' performance on the four lexical types was examined in detail in this study. It is worth noting that although most existing collocation reference tools retrieve and display collocates, they typically ignore function words like articles and determiners, which happen to be closely related to frequent errors made by the

learners [56]. In contrast to these tools which provide a limited view of word usages, GRASP is equipped with the functionality of querying these four lexical types to enable learners to obtain a much better overall picture of the use of formulaic expressions.

The instruments used to compare with GRASP in this study are *Longman English Dictionary Online* and *Google Translate*. *Longman English Dictionary Online*, one of several common dictionaries for English learners, offers a number of collocations, phrases and example sentences. On the other hand, *Google Translate*, a multilingual machine-translation service, translates written text from one language into another. Quite a few second language learners (L2) favor *Google Translate* because they tend to rely on their native language (L1) in communication [49].

Consider a learner attempting to look up the usage of the phrase "place an order for". He can only query "place" or "order" using the *Longman English Dictionary Online*. Several trials may lead him to "place orders" with no subsequent preposition information. He also could consult *Google Translate* by inputting the Chinese phrase "下訂單". The output is "orders" without any information of the preceding verb and the subsequent preposition. In contrast, allowing multiword input, GRASP provides the in-between information, the article "an", as well as the subsequent preposition "for". These function words are indispensable in formulaic expressions.

The participants were allowed to consult either of the popular online reference tools mentioned above, or use both.

Design of the scoring criteria. Since there exist no principled criteria, we created our own to assess students' performance in the fluent use of formulaic sequences. A three-point grading scale ranging from 0 to 2 was used to determine students' performance. The point value 2 was assigned to each blank (58 points in total). Students would be awarded two points if the words filled in each blank were correct or acceptable (e.g., the article "a" plus the adjective "big" or "huge" are correct in "Practice makes a big difference to language learning"). On the other hand, students who provided a partially correct answer or made minor spelling errors in each blank would receive one point (e.g., if the article "a" was missed, even though the verb "make" was correctly used in "The real estate agent made a record profit on house selling"). Otherwise, those who failed to provide any correct answers would get 0 points (e.g., the misuse of the preposition "on" in "Tom placed an order for some books online"). We had two experienced TESOL lecturers score the students' tasks.

Experimental Procedures. A complete administration of the test took about 90-100 minutes. In the first 25-minute pre-test, the students were required to complete the 15 English sentences. Then, after being introduced to GRASP, all students were randomly divided into two groups and allowed 40 minutes to familiarize themselves with the word usages of the phrases on the worksheet. One group (G) consulted GRASP, and the control group (C) were allowed to consult one or both of the online tools mentioned above. During the next 25 minutes, the participants were asked to perform another sentence completion task. Note that during both the pre-test and the post-test, no tool supports were provided.

TABLE 3
Comparisons of Students' Average Scores and Standard Deviations in Sentence Completion Task

	pre-test	post-test	improvement
GRASP	40.98 (12.91)	55.78 (11.65)	36.11%
Control	39.18 (11.26)	48.25 (11.94)	23.15%
Total	40.07 (12.09)	51.97 (12.35)	29.70%

Note: Group G ($N = 74$) indicates the students learned formulaic sequence use by consulting GRASP whereas the control Group C ($N = 76$) consulted Longman English Dictionary Online, Google Translate or both. Full marks = 100.0. Numbers in parentheses are the standard deviations.

4 RESULTS AND DISCUSSION

The results of the current study comprise two parts. The first quantifies the different effectiveness between GRASP and the existing tools on learners' performance of formulaic language use, based on students' test scores. The second compares learners' improvement in four lexical types using the existing tools and GRASP, on the basis of the number of accurate lexical choices.

4.1 Different Effectiveness of the Existing Tools and GRASP on Learners' Performance of Formulaic Language Use

To determine effectiveness, the average scores of the 150 students in the pre- and post-tests of the sentence completion task were used as performance indicators (the mean is 40.07 and 51.97 out of 100.00, respectively).

The improvement is calculated by subtracting the post-test scores from the pre-test scores, and dividing by the pre-test scores (e.g., the improvement of Group G is $(55.78-40.98)/40.98$). As seen in Table 3, it is clear that all students achieved expected gains with the help of reference tools. However, Group G achieved better performance compared with Group C. The students' improvement on the task scores with different tool supports was further examined by an analysis of variance (ANOVA). The results indicated significant differences between Group G's and Group C's improvement on the sentence completion task using different reference tools ($F(1, 148) = 6.611, p = 0.011$). That is, the students' formulaic sequence use improved markedly and reached the statistical significance level with the help of GRASP.

Next, we attempted to explore whether GRASP was of greater benefit to the less proficient students. To achieve this, students' proficiency levels and the tools they consulted were taken into consideration. Students' test scores in the pre-test were used as an indicator of their proficiency levels. Students who scored above or equal to average (40.07) were classified as high proficiency whereas those with below average scores were low proficiency. Thus, all 150 students were divided into four groups: GH, GL, CH, and CL.

As shown by the third column in Table 4, students' improved scores were measured by the subtraction of the post-test scores from the pre-test scores. Clearly, both GH and GL performed far better than CH and CL. The result corresponded to the above analysis and showed that

TABLE 4
Further Analyses of Students' Improvement Based on Proficiency Level

proficiency	mean score in pre-test	improved score in post-test	multiple comparisons		
			GH	GL	CH
GRASP Groups					
GH	50.26	11.47	-	-	-
GL	30.15	18.28	6.81*	-	-
Control Groups					
CH	48.71	7.67	-3.80	-10.61*	-
CL	30.55	10.52	-.94	-7.76*	2.86

Note: * $p < 0.05$. The average score 40.07 in the pre-test was used for dividing all 150 students in Group G and Group C into groups of high and low proficiency levels: GH ($N = 40$), GL ($N = 35$), CH ($N = 36$), CL ($N = 39$).

GRASP provided considerable benefit for students compared with using the two existing tools. But the high proficiency students gained less benefit from GRASP than less proficient ones. To further investigate whether the less proficient students showed significant improvement, the improved scores of the four groups were further submitted to ANOVA. Since a two-way ANOVA did not show significant interaction, we tried a one-way ANOVA. The multiple comparisons indicated the subtraction of the improved scores for each of the two groups. For example, the comparison between GH and GL is 6.81 (i.e., $18.28-11.47$). As can be seen by the last three columns in Table 4, GL showed significant mean differences compared with the other three groups, GH, CH, and CL (p value = 0.004, 0.000, and 0.001, respectively), while there existed no significant performance differences among GH, CH, and CL. In other words, GL made the most significant achievement compared with the other three groups. Overall, GRASP evidently helped students show better performance on formulaic sequence use in the sentence completion task. Especially for the less proficient students, who need extra help becoming engaged learners, GRASP serves a substantial role in supporting formulaic sequence learning.

It seems reasonable to infer that students were unable to manage formulaic language use well due to the restricted functionalities and information display of the existing reference tools (Longman English Dictionary Online and Google Translate). First, single-word query in the Longman English Dictionary Online required students to make several more trials to successfully target the query phrases. This was time-consuming, an important aspect. Further, the surrounding usage information for the located phrases was largely absent. Even when available, learners needed to deduce the usage patterns by themselves.

The limited lexical information provided by the Longman English Dictionary Online seems insufficient to help learners cope with the demand of varied contexts. For example, consider a student attempting to learn the formulaic expression "make a big difference to" in the Longman English Dictionary Online. Suppose he first inputs the "difference" and searches

the phrases containing “make” and “difference” and surrounding lexical items. After performing the sequential search, he learned a formulaic sequence “make a/the difference to”. However, the in-between adjective for enriching the expression was unobtainable.

Regarding *Google Translate*, it mainly serves as a source of translations. It fails to provide usage information for the desired query phrase. For example, a user tried to find the formulaic expression “have a profound impact”. The query of the corresponding Chinese phrase “有深遠的影響” leads to a satisfactory result, but unfortunately, no following lexical information was provided to concatenate other word sequences after the phrase.

In contrast, GRASP transcended the limitations of the existing online tools. Multi-word querying allows users to directly target at querying the usages of the desired phrases or collocations without consuming single-word query searches. Query results are properly categorized and well organized formulaic structures and sequences. The formulaic structures allow learners to quickly grasp and navigate various lexical uses when composing formulaic expressions, while the surrounding lexical items explicitly illustrate the use of formulaic sequences in different contexts. Both the enhanced functionalities and the hierarchical organization of lexical information provided by GRASP were demonstrated conducive to the acquisition of formulaic language use. It is noteworthy that the findings of the great progress that the less proficient students made showed reasonable expectations for teachers about individual differences among students when they used GRASP.

4.2 Comparison of Learners' Improvement in Four Lexical Types with the Existing Tools and GRASP

This research question addressed whether and to what extent the reference tools affected students' gains for different lexical types. To investigate students' performance here, we analyzed a total of 38 missing words in the 29 blanks embedded in the test. These missing words fell into four lexical types: verbs ($n = 5$), adjectives ($n = 8$), prepositions ($n = 14$) and articles ($n = 11$), which are essential elements of formulaic expressions. We assume that the more correct use students provided, the better the command of formulaic language students showed. A careful examination of the item analysis of the 29 blanks in the task by each student is extremely labor-intensive. Thus, a small-scale analysis of students was conducted. From the pool of students, 30 out of 150 were randomly selected: Group G (participant number = 16) and Group C (14). Students' improvement in individual lexical types was based on the differences of the number of correct lexical types they provided in the pre-test and post-test. The total number of an individual lexical type students should answer is the number of the lexical type multiplied by the number of the students who consulted a certain tool (e.g., the total number of articles that should be answered by Group G is 11×16).

Students' improvement associated with the different effectiveness of the two reference tools was revealed using the tests of between-subjects effects. The results showed

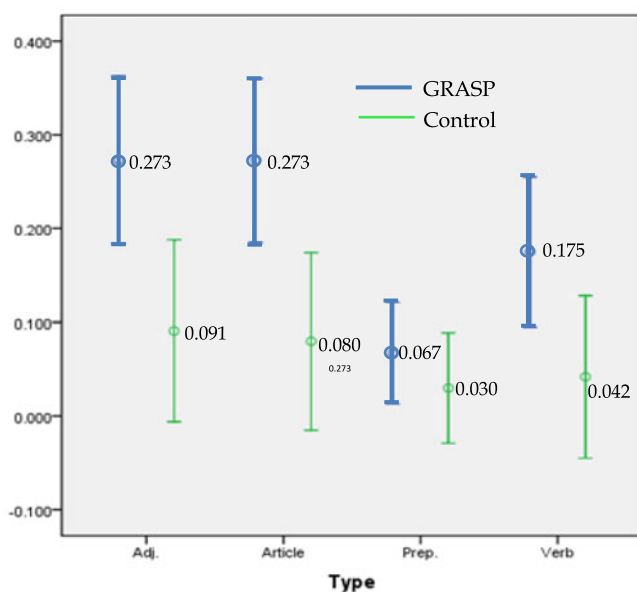


Fig. 3. Group means for improvement in four lexical types.

that the improvement rates in all four lexical types of Group G were significantly higher than those of Group C ($F = 13.408, p \text{ value} = 0.001$). That is, students gained greater benefit from GRASP in facilitating the use of different lexical types, the elements of formulaic expressions. To factor out the students' performance variation in individual lexical types, the estimated marginal means were calculated. The group means of the improvement in four lexical types and the corresponding upper and lower bounds of a 95 percent confidence interval of Group G and Group C were obtained and presented graphically as a clustered high-low-close chart (Fig. 3). A clear trend can be seen in the performance difference between Group G and Group C, showing that GRASP made a substantial contribution to students' lexical choice, compared with the existing tools.

Then we took a closer look at individual lexical types. Group G showed significantly positive gains in adjectives (17.5 percent) and articles (18.6 percent), far better than Group C, and even reached the statistical significance level based on the 95 percent confidence interval. Similarly, Group G produced noticeable improvements in verbs (12.7 percent) and prepositions (3.2 percent), although there was no statistically significant achievement.

Adjectives are used to make more precise modification and serve clearer communication. The effective use of adjectives can greatly improve learners' writing ability. Article use appears to be problematic mainly because they are context-specific, and sometimes beyond simple rules. They are usually unstressed function words [57] and do not exist in the Chinese language system. GRASP successfully helped students yield greater improvements in adjectives and articles. It can be inferred that GRASP enriched students' lexis and improved the use of articles. On the other hand, students' commands of prepositions and verbs were not strong enough. English prepositions seldom have their Chinese counterparts [58]. Moreover, English prepositions relate closely to collocations or idioms instead of grammar

rules [59]. Concerning verbs, the major obstacles to proper V-N collocations (one type of formulaic sequence) are L1 interference, misuse of synonyms, and misuse of delexicalized verbs [1], [49], [5]. The findings are consistent with those of previous studies which suggest that prepositions and verbs are the two most difficult lexical types for EFL learners [1], [49].

The short-term treatment in this study seems unable to significantly produce appreciable improvement in the use of verbs and prepositions, probably due to their complexity and difficulty. If students are allowed adequate time to consult GRASP, they should achieve substantial gains on verbs and prepositions. Verbs and prepositions should be highlighted and displayed in GRASP for the purpose of raising learners' awareness. The highlighted information could induce language features which could be utilized in both the classroom settings and in the self-learning situation. In short, some revision of the interface of GRASP and specific instructions could help learners become more aware of the uses of verbs and prepositions, i.e., achieving noticing [27].

5 CONCLUSION

In this study, we develop GRASP, a reference aid for formulaic language learning. The function of multi-word querying allows users to directly target the usages of the desired phrases or collocations. Utilizing natural language processing techniques including lemmatization, POS tagging, phrase extraction and sentence retrieval, GRASP automatically generates the formulaic expressions at both syntactic and lexical levels, which are displayed in a hierarchical way. At the same time, the corresponding example sentences are also provided. Both the usage patterns and corpus examples illustrate authentic language use, aimed at improving learners' productive language competence. The function and display of GRASP lends support to the idea of data-driven learning (DDL) [60].

To evaluate the effectiveness of GRASP, 150 EFL college freshmen were recruited to perform a sentence completion task, serving as both a pre-test and post-test. Their test items involved 15 English sentences, each with one or two blanks, a total of 29. Each of the 29 blanks entails filling in one or more missing words. Among the missing words, we targeted 38 lexical items falling into four lexical types: verbs, adjectives, articles and prepositions, which are crucial components of formulaic sequences. Before the post-test, students were introduced to GRASP and were randomly divided into two groups to familiarize themselves with the usages of 20 collocations and phrases using the assigned tools. The experimental group consulted GRASP, whereas the control group was allowed to consult either the *Longman English Dictionary Online* or *Google Translate*, or both.

Students' performance in formulaic expressions was evaluated. First, the analyses of students' scores in the sentence completion task revealed that the students consulting GRASP showed significant progress compared with those consulting the existing tools. The examination of students' performance in the four lexical choices yielded similar results. Further investigation on individual lexical types illustrated that students' gains in adjectives and articles

reached the statistical significance level, whereas verbs and prepositions did not.

GRASP can also be applicable to be incorporated into classroom teaching and activities. In the pedagogical practices, specific instructions on how the formulaic sequences are used in various scenarios could be emphasized, especially regarding verbs and prepositions, in order to promote learners' knowledge and awareness of word concatenation. For example, teachers may assign their students several collocations or phrases and engage them in consulting GRASP to learn the corresponding formulaic expressions. Students' command of formulaic language use could be evaluated through the sentence completion task periodically.

One more practical suggestion could be taken into consideration. Paraphrasing learning [61] could be accelerated by GRASP. In other words, we can group together the formulaic sequences sharing semantic equivalence but different usages, such as the phrases "take a lead in", "set an example by", "play an exemplary role in", and "give a lead in". This way, learners systematically acquire a set of formulaic sequences along with their corresponding usages in various contexts, which would also be more conducive to productive language use.

This study supports the effectiveness of GRASP on learning formulaic expression use. But there are limitations in this study which could be usefully investigated and improved. Regarding the experimental design, greater numbers of participants, perhaps other less proficient students should be involved for observing how GRASP benefits their performance of formulaic expressions. In addition, more items and in-depth analysis may help explore students' potential difficulties and the extent of the benefit of GRASP. For example, the adverb modifiers (e.g., "be *fully* aware of") and the classifiers (e.g., "a *colony* of ants") could be included. On the other hand, further error analysis may be conducive to identifying the causes of learners' language errors (e.g., L1 interference or interlanguage problems [62]). Moreover, it might be expected that increased exposure to GRASP would produce further significant performance gains. Further, a delayed post-test should be given to measure students' long-term retention, because it could be the case that most students forgot most formulaic expressions soon after the experiment.

Most importantly, tool comparison could be improved. The *Longman English Dictionary Online* and *Google Translate* should be investigated separately to examine their individual impacts on learners. Alternative tools such as online corpus querying systems (e.g., Corpus of Contemporary English (COCA) [63] could be used for comparison with GRASP because they are both corpus-based systems. It would be interesting to conduct a usability study on the effectiveness and the learnability of both tools.

The system display could be revised. For example, highlighting the verbs and prepositions could enhance language features. Highlighting such as this will contribute to promoting learners' awareness in both the classroom settings and in the self-learning situation. On the other hand, the display of parts-of-speech could also be revised. Many students indicated that the part-of-speech labels were not widely acknowledged. While developing GRASP, we adopted Upenn Tagset [64] to show the parts of speech, but students have been accustomed to the labels used in

grammar books. Take adjectives and adverbs as examples: students favor "Adj." over "JJ" and "Adv." over "RB". Similarly, more common notations such as "provide someone with something" or "provide ~ with ~" used in dictionaries can replace the ones in GRASP, in this case resulting in "provide NN with NN".

The modifications suggested above should further increase the effectiveness of GRASP and enhance its efficiency in assisting learners in the acquisition of formulaic expressions.

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