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Research Article

Exploring the Application of the Random Matrix Thinking Model in Teaching English Predicate Constructions

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This paper, the random matrix thinking model, studies the grammatical features of verbs on random matrix and logical relations and designs a model for teaching English predicate constructions by combining random matrix thinking and arithmetic rules. In this paper, an attention mechanism-based English predicate verb recognition method and a BERT-based English predicate verb recognition method are proposed for the characteristics of predicate verbs as the focal point of sentences. Since the attention mechanism can obtain the long-distance semantic dependency information in the sentence, the attention mechanism-based method can effectively improve the recognition performance of the predicate verb compared with the traditional way. The BERT-based English predicative verb recognition model improves the former approach by taking full advantage of the input corpus and improving the model performance. A random matrix-based predicate verb uniqueness discrimination method is proposed for the uniqueness of predicate verbs in sentences. By setting the classification fitting conditions, the data can be optimized to output and fully fit the global identity of the predicate verb in the penalty during the training process, and better results are achieved.

1. Introduction

Artificial intelligence has become essential for public life with the rapid development of information technology. Natural language processing, as a subfield of artificial intelligence, refers to the use of computers to process the form, meaning, and sound of natural language, as well as to manipulate and process the input, output, recognition, analysis, and comprehension of words, sentences, and chapters, which have many significant effects on the interaction between computers and humans. In today's information explosion, information processing faces substantial challenges, so it becomes essential to use automated tools and techniques to help people process and analyze this information [1]. It is in this environment that information extraction has emerged. The main task of information extraction is to extract specific information, such as structural and semantic information, from structured, semistructured, or unstructured text, helping us classify, remove, and reconstruct the vast amount of content. Information extraction mainly contains four significant tasks: entity recognition, relationship extraction, event recognition, and network information extraction [2]. An important research direction of random matrices is the concentration inequality of random matrices (tail inequality), which is applied in many research fields such as compressive perception, quantum computing, and optimization, to model the performance of natural systems under uncertainty perturbations. Construct meaning and verb meaning interact in the construction of sentence meaning; on one hand, the construct plays a suppressive role on the verbs that enter it, for the verb meaning also influences the choice of verbs by the construct. The use of nonprototypical verbs gradually makes the construct derive new meanings based on the central purpose, thus forming a multisense construct network. Suppose there exists a concentration phenomenon in the tail behavior of stochastic fluctuations. In that case, the critical system properties can be effectively observed, and

therefore, it is of interest to study the concentrated performance of stochastic matrices.

The traditional rule-based and statistical-based predicate verb recognition methods have achieved good results on predicate verb tasks and have proven their effectiveness experimentally. However, the predicate verb recognition methods rely on manually constructed features and numerous natural language processing tools [3]. In this process, manual construction of features engineering requires a large amount of domain knowledge. Natural language processing tools have some limitations, which may make the processing tools inefficient during the construction process because of the low quality of the corpus and the slight reference range. The models cannot use the feature engineering constructed by them when they encounter new domain data due to weak generalization ability. All the aforementioned problems have led to the fact that the predicate verb recognition task has not yet achieved better results. In contrast, deep learning methods have achieved good results for natural language processing tasks by automatically obtaining more feature information through multidimensional operations compared to traditional natural language processing conventional methods.

Theoretical support for the teaching of grammar is provided by constructive grammar. The grammatical reality may also reflect the basic principles of human cognition [4]. The grasp of the overall meaning of constructions is consistent with the mental perception of "completeness," which is governed by some cognitive principles such as the "principle of order." The grasp of the overall meaning of constructions is consistent with the mental perception of perfects and is governed by some cognitive principles such as the "order principle," the "adjacency principle," the "inclusion principle," and the "quantity principle." In practice, teachers should abandon the teaching method of differentiating and teaching different sentence patterns through subcategories and analyzing word sequences and instead emphasize to students the grasp of the meaning of constructions. Constructive grammar is suitable for teaching marked constructions, constructions, external noun constructions, left isolated constructions, and theoretical constructions such as transitive constructions, intransitive constructions, infinitive constructions, inflectional constructions, consequential constructions, and double transitive constructions [5]. For example, when teaching the double transitive construction, teachers do not make students understand the structure by subcategorizing the verbs, analyzing the subject, the predicate, the indirect object, the direct object, or the recipient's inflicted object, and so on. Instead, they can tell students that the constructional meaning of this construction is "intentional giving transfer" and that any instance of entering the construction is the meaning of an expression is a combination of the semantics of the construct and the semantics of the vocabulary [6]. In this way, we can move from a pedagogy that emphasizes sentence form to one that emphasizes meaning. The random matrix thinking model has an excellent ability to extract high-level features, which improves the efficiency of the English predicative verb uniqueness model and enables more accurate recognition of unique predicative verbs using only classifiers.

2. Related Works

In the early 20th century, traditional statistical physicists considered that the eigenvalues of Hamiltonian quantities were the only physical quantities that determined the energy level. To deal with these systems, physicists used statistical methods to randomize the microstates of each system together with the Hamiltonian amounts, which matrices can represent. In 1951, Chen et al. first proposed to use random matrix theory. Since then, random matrices have gradually gained wide attention in many fields of mathematics and physics [7]. In the 1960s, Gomez et al. explored the idea of random matrices in-depth and published five excellent papers in 1962, regarded as the seminal works in the development of random matrix theory [8]. The random matrix theory has been skillfully applied to solve various scientific research and engineering practice problems—field, solving the channel capacity problem of MIMO communication. In October 2009, an international conference, RMTFWS2009, was held in Europe on random matrix theory, and random matrix theory has become a hot spot in today's academic world. The idea of random matrices has become a research hotspot in today's literary world and has received much attention from scholars. During its development in the past century, random matrix theory has gradually penetrated various disciplines, including nuclear physics, cosmology, number theory, mathematical physics (+producible systems), finance (+time series analysis), crystallography, quantum chaos, efficient matrix generation, signal processing, image processing, streaming media analysis, traffic, trajectory tracking, NLP, biological neural networks, artificial design networks (+deep learning), complex networks (+community), complex networks (+community detection), statistical inference, Big Data, and even cultural structure research. Random matrix theory can be seen everywhere in life. In the future, random matrix theory will continue to be explored deeply by scholars and play a decisive role in the development of social productivity.

After the introduction of construction grammar theory, it quickly attracted the attention of most linguists. In the early days, the research on construction language mainly focused on its concept and theoretical connotation. For example, Ebrahimi et al. used construction grammar theory to examine their research's linguistic and constructional meanings [9]. Kekki and Ivaska explored the relationship between constructional structure and its syntactic representation [10]. Cusworth and Dodsworth examined typical constructions and atypical "hyphenated" sentences, thereby thinking about the research scope of construction grammar, the general mechanism of the itinerary, and the cross-linguistic characteristics of constructions [11]. With the further development of this theory, scholars have gradually expanded its scope of application to case studies of specific structures, such as a series of studies by Jackson et al., the constructional meaning of each component in unique sentence structures such as transitive construction, "ba," and

"bei" is discussed [12]. The relationship between the components and the constructional meaning is analyzed. Kline analyzed VV constructions, such as "love Azadi," and pointed out that Chinese has a robust construction tendency because Chinese lacks lexical morphological changes, so it is more economical in expression [13]. Kline et al. analysis of the construction of "Huan NP" witnessed the construction's gestalt characteristics and discussed the construction's hierarchy [14]. Qi and Zhang examined the common expression "A is not going anywhere" in spoken language. They proposed that while reviewing the syntactic and semantics of the construction itself, it is also necessary to "explain the contextual appropriateness of the construction," and the context in which the expression is used and how it is used must also be explained [15]. In their research, Ennis and Losinski analyzed the evolution process of the emerging title construction in contemporary Chinese "Zui + A + NP" from a rhetorical construction to grammatical construction [16]. A preliminary explanation is given with the characteristics. Contractor D regarded the high-frequency expression "that's called an A" in spoken Chinese as construction and discussed its appropriate context, the characteristics of construction variable components, and the interaction between constructions and parts [17]. Yang et al. discussed how the constructional context affects the speaker's intention and motivation in English imperative, conditional constructions from a cognitive-pragmatic perspective [18].

For English predicative verb recognition, formal predicative verb recognition is mainly based on the level of syntactic analysis, primarily relying on manually annotated predicates, using methods mostly for English-dependent syntactic analysis. The recognition methods are primarily divided into rule-based and statistical-based. The rule-based ones are especially, such as the simple typical rule-based recognition method proposed by Zhang et al. When dealing with verbs, most of the verbal predicates can be identified based on the characteristics of the English words themselves, that is, excluding auxiliary verbs and verbs in passive voice, all other verbs are identified as predicates; when dealing with nouns, the noun predicates are mainly referred to the specified noun predicates in the training set, and they are regarded as predicates if they appear against each other [19]. Although it is a simple method, it can cause some impact on the performance by incorrectly processing nouns due to the lack of rigor in the processing of noun predicates. Statistically based, various features are set in the Co Nll2008 corpus, such as Xiang and Foo using the same qualities in predicate recognition and word sense credit and getting better results [20]. For example, Reisman et al. proposed more and more valuable features to expand further the feature set of predicate recognition, which led to a significant improvement in the performance of predicate recognition [21].

3. Random Matrix Thinking Model Construction

With the development of information and computing science, more and more fields generate and collect a large amount of high-dimensional data, further promoting the study of random matrix theory, which has also become an essential part of modern statistical theory. The research related to random matrix theory is also applicable to analyzing high-dimensional data, including covariance matrix, regression analysis, and hypothesis testing. This paper also completes high-dimensional data analysis based on the research related to random matrix theory [22]. Some knowledge about the random matrix theory covered in this paper will be introduced next. One of the most critical studies of random matrix theory is the asymptotic spectral properties of random matrices when their dimensions tend to infinity, and research results on the asymptotic properties of random matrices, such as the semicircle law and the Marchenko-Pastur law, have been widely used in data analysis.

In statistical analysis, many statistics can be expressed as some functional form of empirical spectral distribution (ESD), so the ESD of a random matrix plays a crucial role in studying the properties of random matrices. Suppose R is an $m \times m$ dimensional symmetric matrix with eigenvalues of λ_i^R $(i = 1, \ldots, m)$, then the ESD of the matrix R can be defined as follows:

$$F_m(t) = \sum_{i=1} \frac{1}{m - \lambda_i^R}. \tag{1}$$

The Stilettoes transform is an essential tool for studying the spectral properties of random matrices. The probability density function of the spectral distribution can be obtained by its Stieltjes transform. The following equation can give the Stilettoes transform of the bounded variational function $G(x)$:

$$G(x) = \int_{z=1}^{n} \frac{dG_\lambda + 1}{\sqrt{\lambda + z}}. \tag{2}$$

Unlike the traditional matrix theory, a random matrix is a matrix whose internal elements are random variables, so the random matrix theory can be said to be a theory combining matrix theory and probability theory. This subsection briefly introduces some basic concepts and properties in matrix theory and probability theory to better understand when reading.

(1) Matrix multiplication: Matrix multiplication makes sense when the number of columns of the first matrix equals the number of rows of the second matrix. Given that matrix A is a matrix of $m \times p$ and B is a matrix of $p \times n$, the product of A and B is denoted as $C = AB$. The matrix C is calculated as follows:

$$AB_{ij} = \sum \frac{\sqrt{a_{ik} - b_{kj}}}{\sqrt{a_{il} + b_{ij}}}. \tag{3}$$

(2) Matrix eigenvalues: For a square matrix A of order n, if there exists a number X and a nonzero n-dimensional vector x such that the relation $A\lambda = x\lambda$ holds, then λ is said to be an eigenvalue of matrix A, and the corresponding vector x becomes the

eigenvector into which the eigenvalue enters. Transforming the equation $Ax = \lambda x$ yields $(A - \lambda E) = 0$. We call this coefficient determinant the characteristic polynomial of A. This is a system of chi-square linear equations consisting of n unknowns n equations, and a sufficient necessary condition for him to have a nonzero solution is as follows:

$$(\lambda_0 - A) = \begin{Bmatrix} \lambda_0 - a_{12} & -a_{1n} \\ \lambda_0 - a_{22} & -a_{2n} \end{Bmatrix}. \tag{4}$$

The eigenvalues of a matrix represent, to some extent, the characteristics of the matrix. There are only two kinds of matrix transformations in linear algebra: rotation and stretching. For the case where a matrix transforms a specific vector by stretching only, we take this vector as the eigenvector of the matrix, and the ratio of stretching is the eigenvalue corresponding to the eigenvector. More specifically, if a square matrix A has n linearly independent eigenvectors, then A can be eigen decomposed and decomposed as follows:

$$A = \sum_{n=1} \frac{\sqrt{Q+1}}{Q}, \tag{5}$$

where Q is a square matrix $n \times n$, and A's eigenvectors are each column of Q. The matrix ˆ is a diagonal matrix consisting of the eigenvalues of A. Here we should clarify that a matrix can be considered a linear transformation, including two kinds of transformations: rotation and stretching, where the eigenvalues of the matrix are the scale of the stretching transformation. For example, one of its eigenvalues in a matrix A is λ. The corresponding eigenvector is x, that is $Ax = \lambda x$, Ax representing the vector x after the matrix A transformation to λx, the vector transformation does not change the direction of x. Still, it only expands x in the original order by two. The construction process of the matrix is shown in Figure 1.

Contextualization in the teaching of thinking model construction means creating authentic and concrete teaching situations to promote education and learning. Real, concrete contexts in teaching can drive the cognitive process, maintain the development of practical activities, adjust the emotional experience, and strengthen the implementation of knowledge and skills, which are crucial to cultivating and developing students' core literacy [23]. The use of contexts to pose new and unknown questions to students can stimulate students' interest in learning, enable them to enter the role quickly, and promote the implementation of knowledge under the part of contexts. Thinking model constructive teaching develops interaction between students and text, students and students, and teachers and students in the classroom to develop students' thinking skills. The traditional classroom teaching model is a teacher-centered, book-centered, and classroom-centered teaching model. Creating realistic and concrete situations is one of the most important aspects of a lesson, and teachers should constantly enrich themselves and find and filter out appropriate teaching situations. The explicit goal of model building is to let students know what model to construct in this lesson and what problems to solve with the completed model. Under the guidance of the objectives, students will know what to do in this lesson and what practical problems to solve with the model. Students will be led by the teacher to complete a task around the objectives, find evidence, and think outside the box to quickly complete the construction of the model and improve the teaching effect. The structure of the thinking model is shown in Figure 2.

In the teaching of thinking model construction, analyzing the principles means exploring the principles or understanding ideas to be used when learning a particular point of knowledge or solving a specific type of problem. This thesis studies the joint problem-solving thinking model in the college entrance examination questions; the test is the students' comprehensive ability, the selection of the latest innovative research results of scientists, the type of questions will use the image questions, students must break through the cognitive barrier to make the college entrance examination questions to reach the thinking progression. Natural language processing, as a subfield of artificial intelligence, refers to the use of computers to process the form, meaning, and sound of natural language, as well as to manipulate and process the input, output, recognition, analysis, and understanding of words, sentences, and chapters, with many important implications for the interaction between computers and humans. This requires students to combine what they have learned with the question material, use the principles or knowledge they have learned to reason with evidence about the new test content, think and analyze deeper, dig for the truth, and explore. Truth and identify solution ideas to solve the same type of questions. Building models in thinking model building teaching means building thinking models. The previous step that is to analyze the principles has been explored involving knowledge points or solving a specific type of problem when the codes or understanding of ideas to be used, the subsequent need for students to summarize it, forming the learning of new knowledge or solve unique expertise or the same type of problem when the mind map or road map or steps, and so on, step by step to build a thinking model.

4. Design of a Model for Teaching English Predicate Constructions

The theory of constructional grammar also pays attention to the complex interaction between constructions and verbs, arguing that the valence of the abstract sentence form of construction comes from the prototypical verbs that enter it. Once construction is formed, it, in turn, integrates the lexical meanings of other nonprototypical verbs that enter it, making them consistent with the overall valence of the construction; the meaning of the construction and the meaning of the verb interact in the construction of the sentence meaning, on one hand, the construction plays a suppressive role on the verbs that enter it, and the meaning of the verb influences the choice of verbs by the construction [24]. The use of nonprototypical verbs gradually makes the

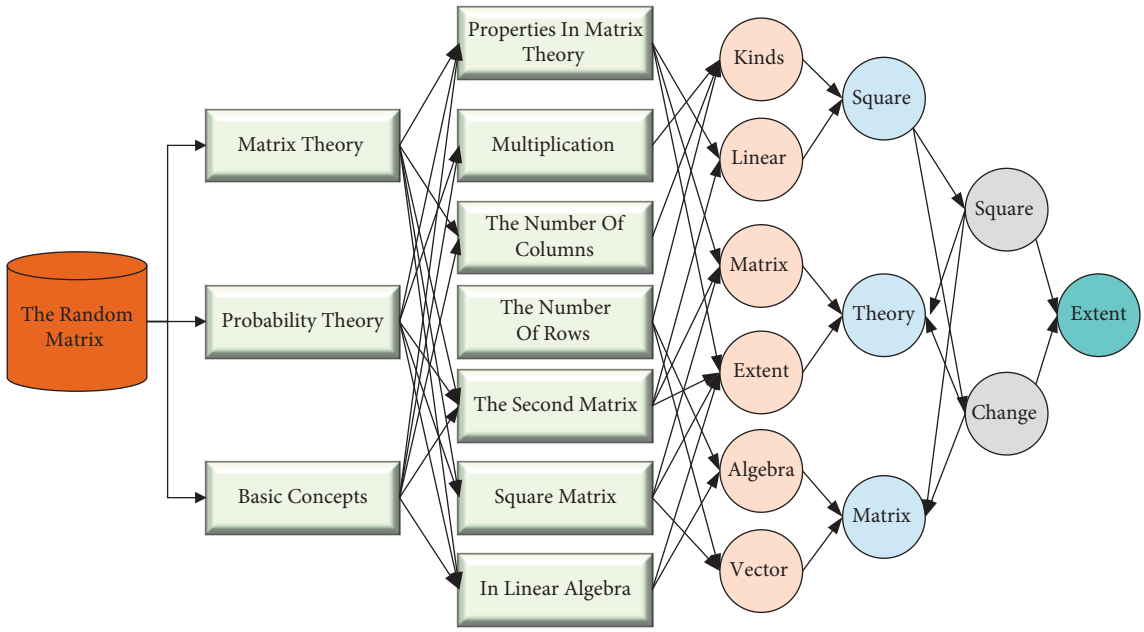

Figure 1: The construction process of the matrix.

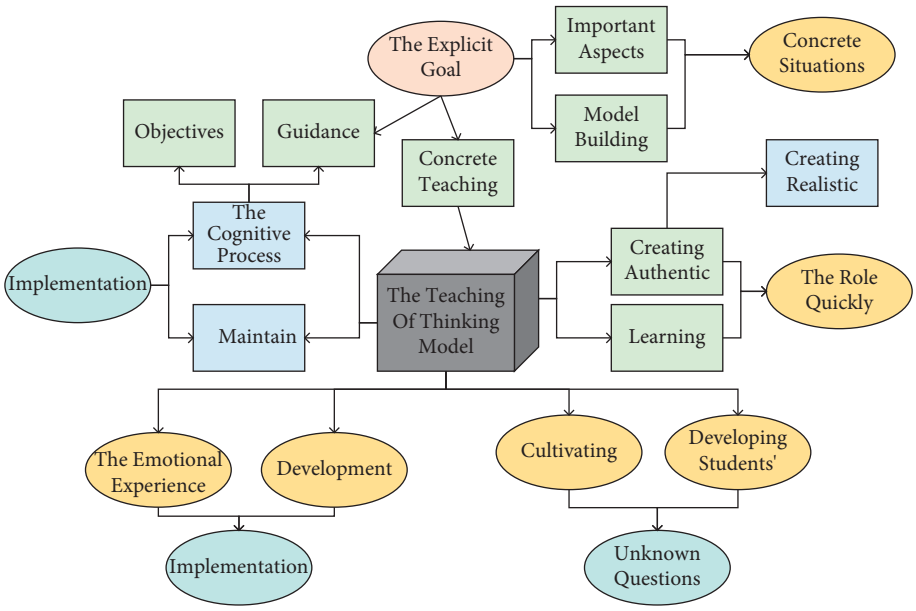

Figure 2: Construction of the thinking model.

constructions derive new meanings based on the central meaning, thus forming a multisense network of constructions. Construal grammar also considers the universality of cross-linguistic generalization of meta-constructions, the so-called "connection problem" of traditional grammatical systems – the regularity between event participants and surface grammatical forms – as a tendency attributed to human cognitive (perceptual and attentional) processing or The Salient Participants in Prominent Slots Generalization (SPPS) and Pragmatic Mapping Generalizations (PMG) are proposed as universal features of human cognitive (perceptual and attentional) processing or pragmatics. The transitive construction of like and the adjectival passive construction of fighter exceeded that of other similar target words. The use of the transitive constructions of the three mental state verbs progressed significantly from the low intermediate level (ST2) to the high intermediate level (ST5) but receded a bit (backslide) to the high level (ST6), with the use of the intransitive constructions of like reaching the highest at the low intermediate level (ST3) and the use of the object prepositional constructions of admire and like getting the highest at the intermediate level (ST4). However, the psychological development of verb construal use was not obvious: the development of the Ving As construal for

amusing reached its highest at the low intermediate level (ST3) and then tended to decline; the development of the adjective passive construal for fighting and please followed a similar path, progressing from a high low intermediate level (ST2), slipping a bit at the intermediate level (ST3), from a high intermediate level (ST4) to the advanced bass level (ST5) and then to the advanced level (ST6); the Ved As of please also reflects the same developmental path. There is no regression in developing the high level (ST6) of the psychologically induced verb and object constructions. The use of verb constructions by learners at different levels in the corpus is shown in Figure 3.

Based on the study of the conceptual agreement between the communicative parties, Pickering and Garrod proposed the interactive alignment theory of dialogue using experiments, pointing out that the association is the realization of similar forms of linguistic representation. According to this theory, the smooth performance of a conversation requires that the interlocutors achieve interconnection at six levels: phonological, phonemic, lexical, syntactic, semantic, and situational patterns, or, in other words, complete similar forms of linguistic representation, as shown in Figure 4. When these six levels achieve similar forms of linguistic representation, it also means that the parallelism on the six levels is performed so that the parallel structure on the six levels is created. They argue that the association can trigger the association at another level. The parallelism at the four levels of phonology, phonemic, lexical, and syntactic, belongs to formal equality; the sameness of semantic and situational patterns belongs to the parallelism of meaning, that is, meaningful association; thus, the formal equivalence triggers the association of importance. One of the most critical studies of random matrix theory is the asymptotic spectral properties of random matrices when the dimensionality of random matrices tends to infinity, and research results on the asymptotic properties of random matrices such as the semicircle law and the Marchenko-Pastur law have also been widely used in data analysis. Conversational interaction association theory also argues that the association of informal parties does not presuppose shared concepts; the direct impetus for association comes from mental priming, which automatically activates associations at different levels of linguistic representation; cognitive priming is automatic and unconscious, requiring no processing effort or explicit negotiation between the communicative parties, and no conceptual agreement between the communicative parties. In the communication process, the communicator is not trying to guess the mental state of the other party but simply to make connections with the other party at all levels of language representation.

The internalization link is crucial for teaching English grammar in colleges and universities. The explicit grammatical knowledge mastered by students will be transformed into implicit knowledge or can appear to be subsumed or crossed and directly enter the conscious output or active output level. Therefore, the internalization link should organically combine the online teaching model with the offline teaching mode when building English grammar [25]. It can be said that this hybrid teaching mode needs to be used

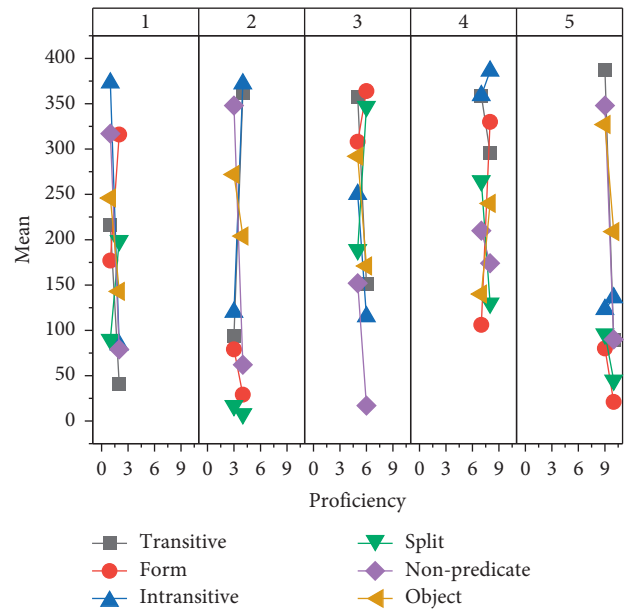

Figure 3: Verb constructions used by different levels of learners in the corpus.

throughout the construction process. This is because, on one hand, it can use the rich educational resources online to break the time and space barriers that appear in the teaching process.

On the other hand, it can also use offline classroom teaching to solve teaching problems promptly and achieve twice the result with half the effort. In the specific construction process, institutions and teachers should focus on the advantages of the two teaching modes and integrate them. Teachers should guide students to carry out independent online practice for online learning. At present, the development of education has led to more and more learning boards and even learning software on online education platforms, so teachers can guide students to consolidate their English grammar knowledge through the online practice and make them turn their knowledge into ability in the course, and even cultivate students' awareness and capacity of digging problems, analyzing problems, and solving problems independently from a particular perspective. For offline English grammar teaching, classroom discussions are mainly carried out. Since grammar forms and applications come from life, teachers should guide students to create a native-like environment for using grammar rules in a nonnative environment to weaken the influence of the environment on grammar teaching and learning and further improve students' English grammar. The comparison of different models of education is shown in Figure 5.

Both long- and short-term memory networks and attention mechanisms have demonstrated excellent performance in natural language processing tasks. This model combines these two networks and applies them to English predicate verb sequence model recognition. Like named entity recognition, English predicate verb recognition can be modeled as a sequence labeling problem: given an input sequence (sentence), a maximally labeled path is returned.

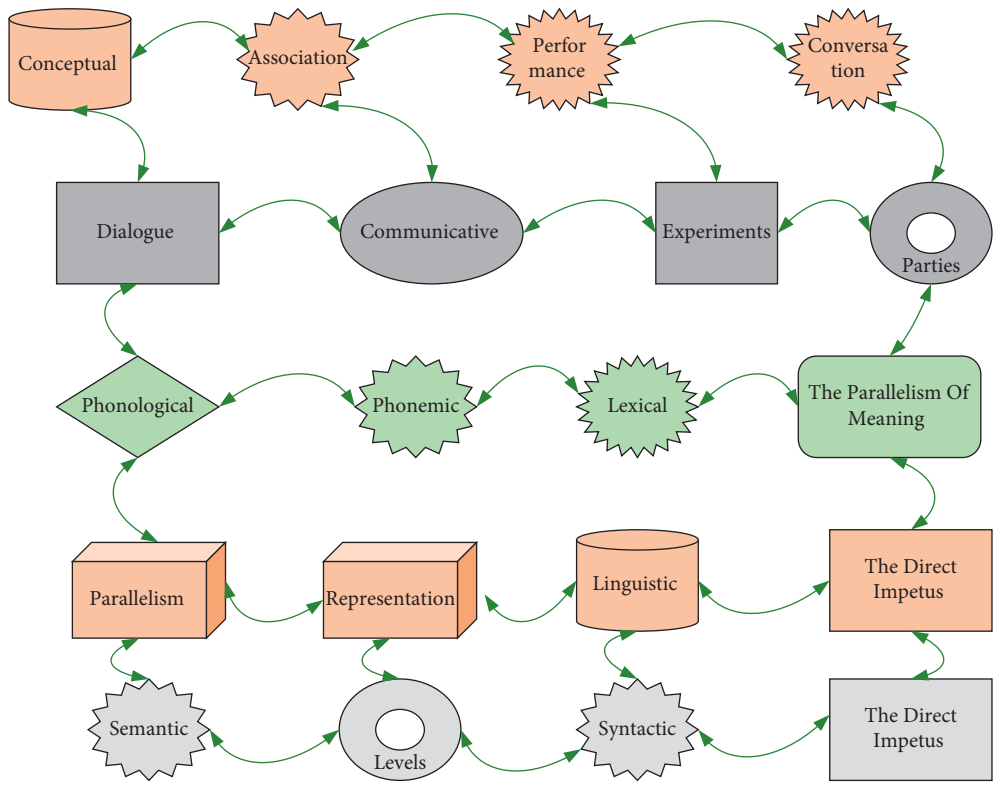

Figure 4: Interaction linkage model.

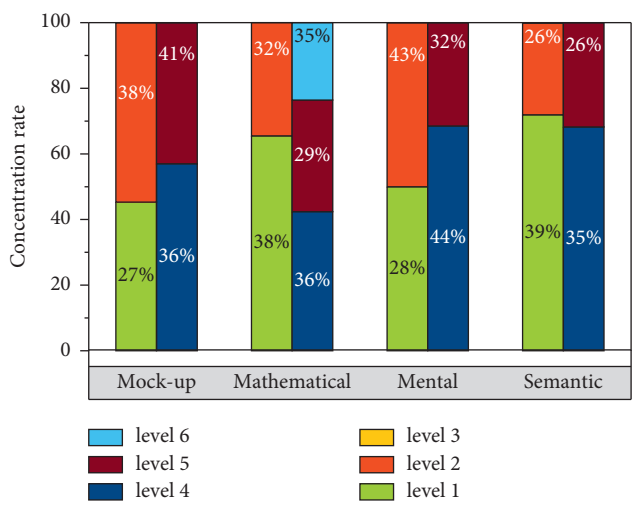

Figure 5: Comparison of different models of teaching.

The introduction of random matrix theory in English teaching is perfectly feasible and necessary. It is a perfect vehicle for young English students to apply their knowledge to research at the frontiers of physics. This paper uses a BILSTM-CRF model combined with the attention mechanism for predicate verb recognition. The model first inputs characters, then processed by word embedding and obtained the dependencies within the sentences by a bidirectional recurrent neural network [26]. Then, the abstract features are selected with the attention mechanism. Finally, a maximized labeled path is returned through the CRF layer. The improved attention-BI-LSTM-CRF model and training method can effectively solve the problems of word separation and lexical annotation in English natural language processing and have better performance than the previous models. In which the main layers of the model are presented as follows:

(1) Embedding layer: The premise of computer processing tasks is the need to replace various unrecognizable symbols with recognizable spatial vectors. First, the text data need to be a mathematical and structured representation; that is, using the form of distributed vectors can be a complete representation of the sequence information. In English word vector processing, a word is usually used as a processing unit, then converted into a word vector. Unlike the English representation, which is flexible in use, a word often contains multiple words, and each word may imply a different meaning. The word embedding layer used in the word embedding layer is the English word vector of Wikipedia trained by the Word2Vec tool. For descriptive convenience, let $S = w_1, w_2, \ldots$ denote the input sentence. The words in the sentence w_i are mapped into a vector e_i through a lookup table W_c for distributed representation. This is done by first converting each word in the S-sentence into a word vector matrix $w^w \in m^{d\times v}$. The aforementioned equation d^w denotes the size of the word embedding, and V represents a fixed size dictionary. Then the

word w_i is mapped into a vector e_i using matrix-vector multiplication.

$$e_i = \int \left(W^{w-1} \times V^i\right). \tag{6}$$

(2) BILSTM layer: BILSTM is implemented through the following steps; the first step is the Sigmoid function layer in the "forgetting gate" to select the retained or discarded information by calculation. The main operation of the forgetting gate is to obtain the information from $h_t - 1$ (previous output) and x_t (current input) and then determine the output number as 0 or 1 according to the state of the cell. One means "keep completely," and 0 means "discard completely." The next step is to determine the new information to be placed in the cell state, divided into two steps. First, the function layer of the relevant input gate layer determines the value to be updated and then the layer creates the candidate vector values that can be added to the state C_t. And in the language model, we need to keep the cell state updated. The expression is as follows:

$$C_t = \tanh \frac{\sqrt{h_{t-1} + x_t}}{W_{C-1}} - b_c. \tag{7}$$

(3) CRF layer: The CRF layer requires the predicted scores of each label in the labeled sequence as input. The CRF layer uses a dynamic planning algorithm to calculate the maximized output path through the label probability transfer matrix. In the model training process, the label probability transfer mechanism can be used to constrain the output path; for example, each labeled unit in the output path always starts with the label "B" or "O" instead of "I." These constraints can be learned automatically by the CRF layer. Illegal sequences in the output label sequence can be avoided using the CRF layer.

5. Analysis of Results

5.1. Random Matrix Thinking Model Tested in Teaching English Predicate Constructions. In addition to quantum decoherence, random matrix theory also has critical applications in quantum optics, chromodynamics, and two-dimensional quantum gravity. Besides, random matrix theory also has vital applications in number theory, infinite communication, neural networks, and financial analysis. However, according to the authors' research, very few English majors and teachers know or have been exposed to the theory of random matrices, which is a pity. In terms of the basis of elementary random matrix theory, for example, it only involves the integral variable substitution in calculus; Jacobi determinant in linear algebra; probability distribution in probability statistics; common polynomial properties in the general theory of special functions, and so on. Thus, an introduction to the idea of elementary random matrices could well be placed in a course for English majors. Therefore, introducing the theory of random matrices in the English major is feasible and necessary. It is also a perfect vehicle for young English students to apply their knowledge to the frontier of physics research. This experiment compares the estimation performance of Re LU-ELM, k-LSSVM, multiclass-SVM, MUSIC, and Capon algorithms through simulation. The RBF kernel function is used for the support vector machine, and the Re LU function is used as the activation function for the extreme learning machine with the number of hidden layer cells N100. The curves of RMSE variation with a signal-to-noise ratio of the five DOA estimation algorithms for the large array case are obtained, as shown in Figure 6.

The ideal university English teaching is a unique ecosystem formed by teachers, students, and the educational environment. Therefore, we can consider it composed of its ecological subject and background. Owing to the limited time and effort of the study and the impact of the new crown epidemic, the investigation of the ecological environment in this study only considers the humanistic, institutional, and physical settings on the campus. It does not think the social and family settings outside the university interact with each other to pursue a dynamic balance and influence teaching in the university's English teaching ecosystem. The ecological subjects mainly include students and teachers. People, as independent individuals, are characterized by diversity and differences. Each student has a unique personality and learning method, and each teacher has different teaching philosophy and design, which are interdependent and bound to each other. In nature, individuals of the same species work together to form biological groups to survive better, and similarly, there are groups of students and teachers in college English teaching [27]. There is competition, cooperation, dependence, and constraints within and between groups, and the relationship is more complex but harmonious, symbiotic, and synergistic development. Third, a community in the ecological sense is a collection of multiple groups in the same space and time. In the university, English teaching ecosystem, the student and teacher groups together form a community that covers various dynamic relationships between teachers and students in teaching and learning. Therefore, the existence of complementary coexistence and harmonious relationship between the two groups is the only way to generate a good university English teaching community and promote the sustainable development of the university's English teaching ecosystem. A comparison of university English teaching data is shown in Figure 7.

Any college English teaching and learning activities are carried out in a particular environment, and the development of the ecological subject is affected by it. Therefore, the ecological environment is another essential part of the college English teaching ecosystem besides the environmental issue. As the intermediary linking, the ecological subject in the college English teaching ecosystem, the teaching environment involves the humanistic climate, the material environment, and the institutional environment. The human background includes teacher-student relationships, external support, and so on; the material environment includes learning places, tools, materials, and so on; the

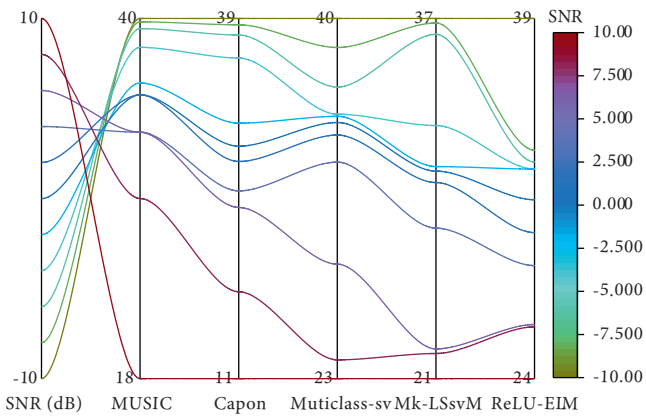

Figure 6: Comparison of RMSE of five methods in the case of large arrays.

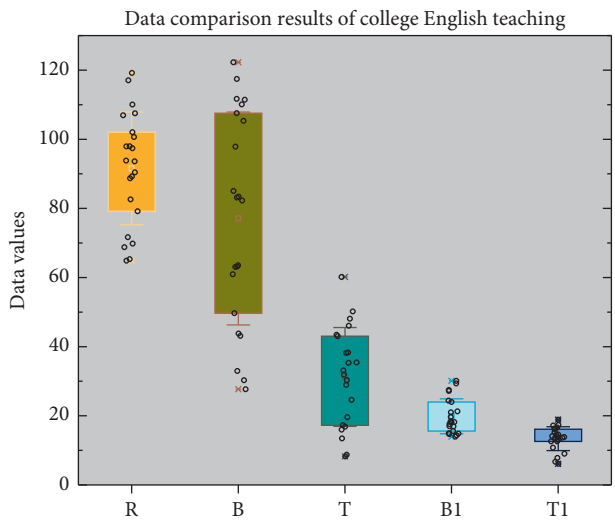

Figure 7: Comparison of university English teaching data.

institutional environment includes curriculum system, teaching content, teaching methods, evaluation, and so on.

5.2. Realization in the Teaching of Predicate Constructions. In this experiment, we use the Chinese predicate verb labeling data set and allocate the training set, validation set, and test set as 6 : 2 : 2. The experimental environment of the BERT-BILSTM-CRF model in this experiment is the same, so we do not elaborate here. And the model training parameters were adjusted by comparison and finally determined, as shown in Figure 8. The experimental results show that the BERT-BILSTM-CRF model achieves better results in predicate verb recognition after pretraining by corpus. The BERT-BILSTM-CRF model is better than the simple BILSTM model and CRF model, and the *F*-value is also 1.42 percentage points higher than the ATT-BILSTM-CRF model. The reasons for this are first, from the viewpoint of network structure, the BERT model is fully bi-directional and deep in layers, which makes the space of representable functions large enough to overcome the problem of long-

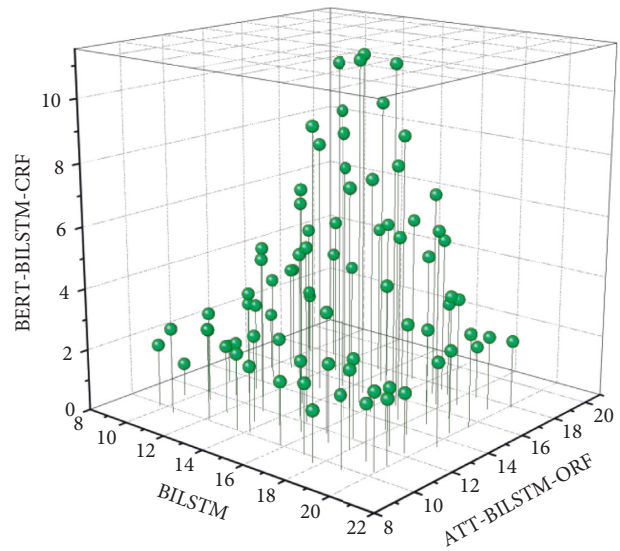

Figure 8: BERT-BILSTM-CRF model training parameters.

distance dependence better; secondly, the pretraining task of BERT is cleverly designed to handle the LM task in addition to the additional sentence-level task, which is more helpful for the representation and learning of sentence semantics [28]. Compared with the traditional word vector, the inclusion of the BERT pretraining model can be regarded as a sentence-level contextual representation, which can make full use of the input corpus and better identify the central features for predicate verbs. The BERT pretraining model, which is trained with a vast amount of data, combined with BILSTM and CRF, leads to a certain degree of improvement in the recognition performance of this model.

The data set for this experiment still uses our annotated Chinese predicate verb annotation data set. First, the sentence is divided into two parts, left and right, centered on the annotated predicate verbs. The verbs in these two parts are selected using the Ziemba lexical annotation tool. Each verb chosen from these two parts is combined with the only annotated predicate verb in the sentence to form a predicate verb candidate pair. If the uniquely labeled predicative verb is combined with the verb on the right, the predicative verb preposition class is included. If the uniquely labeled predicative verb is combined with the verb on the left, the predicative verb postposition class is created. The uniqueness recognition model is used, and the training and test sets are 8 : 2. In the experiments, the following parameters are set after several tuning sessions: word vector dimension is 100, position vector dimension is 50, loss value is set to 0.9, the batch size is set to 50, iteration number is 50, and the maximum length of input sentences is set to 50. The average single training time comparison of the algorithm is shown in Figure 9.

Through the experiments, we can find that the experimental results can solve most of the predicate verb uniqueness problems and achieve a better performance in the predicate verb recognition problem. The ATT-BILSTM-CRF uniqueness model has a 0.17 percentage point higher *F*-value than the ATT-BILSTM-CRF sequence labeling model.

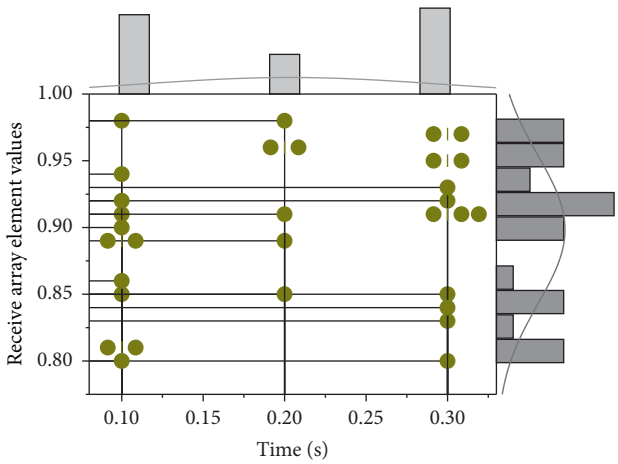

Figure 9: Comparison of average single training time of algorithms.

The BERT-BILSTM-CRF uniqueness model has 0.73 percentage points higher *F*-value than the BERT-BILSTM-CRF sequence labeling model. The predicate verb uniqueness model is better in classification because the random matrix thinking model does not require tedious feature engineering and saves a lot of workforce. The random matrix thinking model has an excellent ability to extract high-level features, which improves the efficiency of the English predicative verb uniqueness model. The unique predictive verbs can be identified more accurately using only the classifier. From the point of view of material dialectics, no matter in concepts or material entities, all movements (verbs) are movements of substances (giving and receiving things). All substances are substances in some action or state, and all substances (entities) and predicate verbs always present some sort of giving and receiving relationships. These features of the grammatical categories of verbs are reflected in the constructions and have certain pedagogical and logical relations. Only a dialectical understanding of these grammatical categories allows a truly flexible grasp of the system of thinking about English grammar.

6. Conclusion

With the increasing attention to English learning and the continuous development of higher education, as a compulsory course, college English lays the foundation for cultivating international and comprehensive talents who are about to enter society. College English is thus given more responsibilities and obligations. Based on the characteristics of English predicative verbs as the focus of sentences, we propose a Chinese predicative verb recognition method based on the attention mechanism and an English predicative verb recognition method based on BERT by improving the traditional recurrent neural network model based on the random matrix thinking model and adding attention mechanism and BERT pretrained language model. The neural network-based ATT-BILSTM-CRF and BERT-BILSTM-CRF models are used. The method shows that the predicate verb is challenging to recognize as the sentence's focus. And the neural network recognition model proposed in this paper has a significant improvement in recognition performance compared with the traditional machine-learning model. The predicate verb recognition task effectively obtains the structural and semantic information of the sentence and provides the theoretical basis and technical support for other jobs in natural language processing. Grammar is an integral part of the language system and plays a crucial role in language learning. The teaching model based on the random matrix thinking model can better meet the implicit needs of college English teaching for grammar teaching and, at the same time, can meet the individual needs of students, which has a positive effect on the cultivation and improvement of students' comprehensive English application ability.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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