

## *Retraction*

# **Retracted: Cognitive Feature Extraction of Puns Code-Switching Based on Neural Network Optimization Algorithm**

### **International Transactions on Electrical Energy Systems**

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### **References**

- [1] J. Zhang, Q. Liao, and L. Li, "Cognitive Feature Extraction of Puns Code-Switching Based on Neural Network Optimization Algorithm," *International Transactions on Electrical Energy Systems*, vol. 2022, Article ID 6535308, 11 pages, 2022.

## Research Article

# Cognitive Feature Extraction of Puns Code-Switching Based on Neural Network Optimization Algorithm

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Code-switching is the choice of a language, a variant of using multiple languages in the same conversation. Broadly speaking, code-switching refers to adjusting one's language style, appearance, behavior, and expression in order to improve the comfort of others in exchange for fair treatment, quality service, and employment opportunities. "Besieged City" is considered a masterpiece of 20<sup>th</sup>-century China. From the data point of view, this work has a total of 110 code shifts, but there are many studies on this language phenomenon, but none of them involve the perspective of register. However, language translation research based on register theory is of great significance. It is generally believed that the human brain's thinking is divided into three basic ways: abstract (logical) thinking, image (intuitive) thinking, and inspiration (awareness) thinking. Artificial neural networks are the second way to simulate human thinking. Therefore, this paper proposes research on cognitive feature extraction of pun code-switching based on a neural network optimization algorithm. It mainly introduces code-switching under cognitive language and also briefly analyzes code-switching and speech feature extraction and uses a neural network optimization algorithm to conduct an in-depth analysis of code-switching. Finally, in the experimental part, the experimental analysis of the famous novel "Besieged City" is carried out, the application of 89 language code-switching in the text is deeply analyzed, and the data analysis of its three variables is carried out from the perspective of register. The experimental results show that: in novels, there are two types of code-switching: preparation and improvisation. 24 code-switches are prepared, accounting for 26.9%, and 10 code-switches are improvisation, accounting for 8.9%. As for the verbal code-change, there are both preparatory and impromptu ones. 36 code-switching cases were improvised, accounting for 40.4%, and 19 code-switching cases were prepared, accounting for 21.3%. The analysis also confirms that the more formal the text, the less linguistic transformation it contains.

## 1. Introduction

Code-switching is an increasingly common phenomenon, and its manifestations and connotations are constantly evolving and developing. Code-switching, as a result of language contact, refers to the switching between two or more language variants in the same conversation. Since the 1970s, many linguists have studied the phenomenon of code-switching in many fields. However, language changes are very complex and subtle and are inextricably linked to the cognitive, sociocultural, and psychological motivations of language. From the perspective of cognitive linguistics,

the theory of code-switching is explained, and through the influence of various factors, it is revealed that code-switching is an active expression of language ability, which can be presented at different levels of dialogue. In communication, some words are considered vulgar, ominous, unpleasant, or even offensive. Because of taboo, people cannot, dare not, and do not want to use these words; this phenomenon is called language taboo. As a reflection of social taboos, language taboos are a complex cultural and social phenomenon ubiquitous in human society. "Code-switching" can effectively avoid these sensitive words in communication. In two language environments, code conversion is

inevitable and is the product of cross-cultural communication. Social progress and language development are important factors for this phenomenon. First, due to the development of social civilization, speakers are urged to improve their status and status through language transformation. Second, the social environment has different requirements for language and content. By studying the code-switching phenomenon in “Besieged Castle” from the perspective of register in functional linguistics, the research dimension of code-switching in this theory has been enriched.

The article focuses on code conversion in cognitive language, and briefly analyzes code conversion, the extraction of phonetic features, and the in-depth analysis of the neural network optimization algorithm. Finally, in the experimental part, taking “Besieged City” as an example, the application of code-switching in 89 places is deeply analyzed, and the data analysis of these three variables is carried out from the perspective of the register. The innovation of this paper is that the paper not only adopts the neural network algorithm, but also optimizes it and also analyzes the three variables in the register. This paper adopts the research method combining quantitative analysis and qualitative analysis. In the process of research, it is possible to obtain more perfect analysis results when they are properly combined and applied to text analysis, which also makes the paper more valuable for research.

## 2. Related Work

Code-switching is a linguistic term. A code is a term used by sociolinguists to refer to a language or any variant of a language. The matrix language framework predicts that, in the presence of specific linguistic differences, the differences present in the primary language of the interaction will overwrite the differences in the secondary languages. Aly studied the prosodic aspects of code-switching in Spanish-Basque bilinguals, which are not currently reflected in the bilingual literature [1]. In previous research, there has been an emphasis on distinguishing and alienating cross-language versus code-switching, in part because the latter refers to the combination of two discrete systems corresponding to named languages. In this conceptual paper, Balam outlined opposing views of cross-language and code-switching and highlighted important parallels that have not emerged in discussions of cross-language and code-switching to date [2]. In terms of listening comprehension, it has been found that coding shifts come with processing costs. However, the listener can get the desired code-switching cues, thus reducing switching costs. Shen et al. converted the encoding between English and Chinese into a monolingual and studied the effect of preserving the expected speech cues on the recognition of code-switched words [3]. Song conducted a sociolinguistic analysis of the code-switching practice of Korean-English bilingual children from the perspective of language socialization [4]. Although they all introduced the code-switching of puns, they did not conduct in-depth research on its algorithm, and the neural network algorithm can optimize its speech conversion.

In order to solve the problem of parameter change effects that will reduce the performance of the missile terminal guidance system, Lin and Cheng proposed a novel neuro-fuzzy missile terminal guidance law. Alternately apply three different neural network optimization algorithms at each step, such as gradient descent (GD), SCG (scaled conjugate gradient), and the Levenberg–Marquardt method [5]. Artificial neural network (ANN) is a powerful little tool that is widely used for many data classification tasks. Amh et al. proposed different types of nature-inspired meta-heuristics. He outlined the concepts and components used in order to summarize and simplify the state-of-the-art in order for readers to find suitable approaches in real-world applications [6]. Automatic classification of power quality disturbances (PQDs) is a challenging problem for both utilities and industry. Jeevitha and Mabel proposed a new technique for the automatic classification of single and hybrid PQDs. The algorithm he proposed consists of discrete wavelet transform (DWT) and optimal feature selection of BAT (PNN-BAT) PQD based on the probabilistic neural network [7]. They not only introduced the neural network optimization algorithm, but also introduced the bilingual code conversion, but the article lacks innovation. If there is no conversion of more bilinguals, it just stays in one way and lacks innovation.

## 3. Neural Network Code-Switching Algorithm

*3.1. Code-Switching from the Perspective of Cognitive Linguistics.* Human language ability is an important part of human cognitive ability. Cognition is the basis and prerequisite for language application, and language is the cognitive activity of human beings, which is the result of the mutual influence of psychological, cultural, social, experience, ecological, and other factors. Code-switching is a cognitive-based rhetorical method, which is code-switching based on multi-dimensional language variants. Fundamentally speaking, it organically combines various factors such as the linguistic view of register generation, sociological community, and the psychological environment of cultural psychology, thereby forming a synergistic effect of various factors [8, 9].

The register is a general term for the occasion or field of language use. Languages used in different fields will have different styles. Register generation is an important cognitive linguistics theory, which respects the reality of language to a large extent and focuses on the guidance and limitation of language. Linguists once believed that register is a general term for a language environment or field, which is a collection of various factors, rather than a simple language variant scene. Field, tenor, and mode are the three major variables in the register. The language field is the situation in which language is produced, and its subject is the subject of the conversation [10]. The tenor refers to the relationship between the speaker and the hearer, that is, the communication intention of the speaker. Discourse is a way of communication; it contains a variety of rhetoric and communication methods [11, 12]. The choices made by language users in a specific environment have their characteristics.

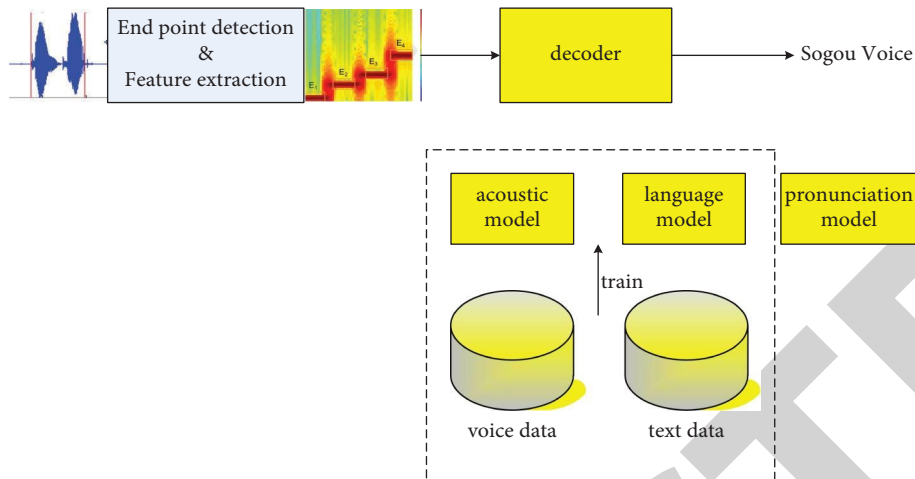


FIGURE 1: Speech feature extraction.

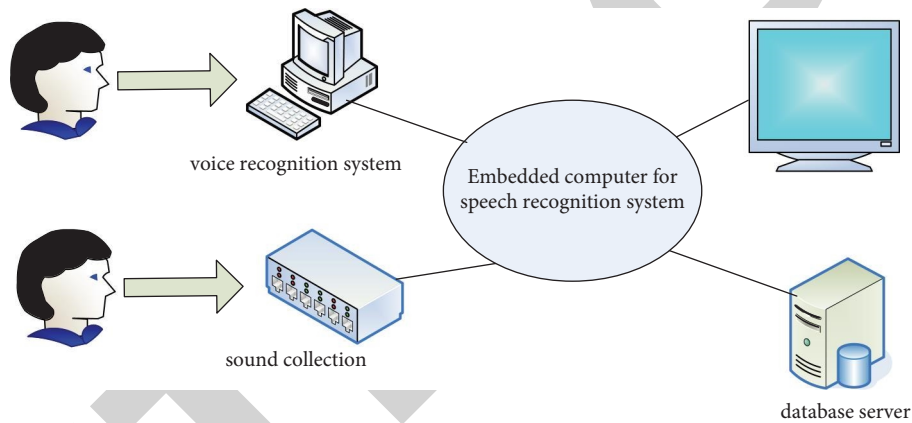


FIGURE 2: Block diagram of the speech recognition system.

And it is composed of specific words and syntax, resulting in semantic structure and social meaning, which objectively requires people not only to pay attention to its accuracy when using it, but also to make appropriate adjustments and changes according to changes in the language field, tenor, and language mode. Changes in the language field, tenor, and language style will lead to changes in style, so as to achieve different communication effects so that the transformation of code plays a leading role [13, 14].

The register is embodied by the language form, no matter what kind of discourse, the language form is very important in realizing the register. The study of register theory is not only to describe the use of language, but also to reveal the dynamic characteristics of the three variables of field, tenor, and mode and to fully demonstrate the thought and production process of language under register theory. Combining the theory and practice of language phenomena provides a new theoretical model for the fields of language, society, cognition, and culture [15].

**3.2. Speech Feature Extraction.** The feature extraction flow chart of speech is shown in Figure 1.

The speech recognition system is shown in Figure 2. The basic characteristics of speech recognition systems are that they must be precisely defined, sufficient training data can be obtained, and they must be universal [16, 17]. English is often modeled with context-dependent phonemes, and Chinese is less copronounced than English, so a syllable model can be used. The amount of training data required for this method depends on the complexity of the model. The model was designed to be too complex, exceeding the capacity of the training data and resulting in a large performance degradation [18]. The application of a speech recognition system can be divided into two development directions: one direction is a large vocabulary continuous speech recognition system, which is mainly used in computer dictation machines, and a voice information query service system combined with the telephone network or the Internet. These systems are all implemented on computer platforms.

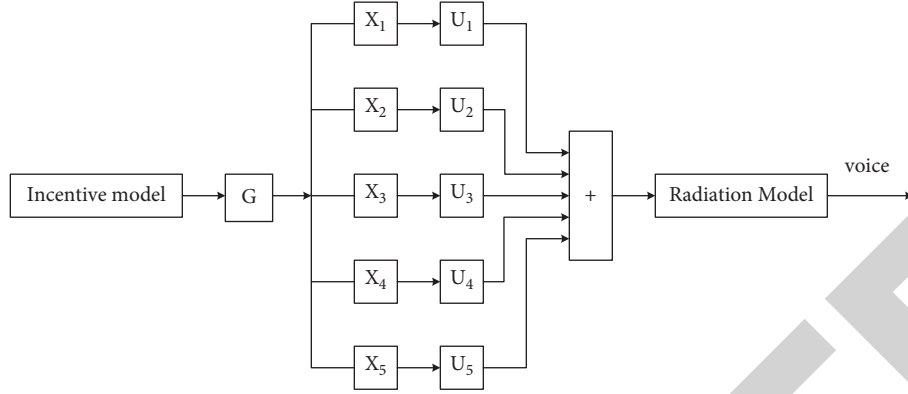


FIGURE 3: Formant model for parallel type.

### 3.3. Code Switching

3.3.1. *Incentive Model.* The mathematical formula of the oblique triangle wave is expressed as

$$f(m) = \begin{cases} \frac{1}{2} \left[ 1 - \cos\left(\frac{\pi m}{M_1}\right) \right], & 0 \leq m \leq M_1, \\ \cos\left[\pi\left(\frac{m - M_1}{2M_1}\right)\right], & M_1 \leq m \leq M_1 + M_2, \\ 0, & \text{other.} \end{cases} \quad (1)$$

The form of the omnipolar model of an oblique-triangular  $L$ -transform is

$$F(l) = \frac{1}{(1 - c^{-ED}l^{-1})^2}. \quad (2)$$

Mathematical formula of  $L$  transform:

$$C(l) = \frac{X_u}{1 - l^{-1}}. \quad (3)$$

The ancient voiced excitation model is

$$V(l) = F(l)C(l) = \frac{X_u}{1 - l^{-1}} \cdot \frac{1}{(1 - c^{-ED}l^{-1})^2}. \quad (4)$$

3.3.2. *Channel Model.* The vocal tract model of speech signal regards the vocal tract as a resonant cavity, and the format is used to represent the frequency of the resonant cavity. The transfer function of the cascaded channel model can be expressed as:

$$U(l) = \frac{F}{1 - \sum_{r=1}^M x_r l^{-r}} \quad (5)$$

$$U(l) = \frac{\sum_{r=1}^K y_r l^{-r}}{1 - \sum_{r=1}^M x_r l^{-r}}. \quad (6)$$

Let  $M > K$

$$U(l) = \sum_{r=1}^N \frac{X_r}{1 - Y_r l^{-1} - E_r l^{-2}}. \quad (7)$$

The frame diagram shown in Figure 3 depicts a parallel formant model when series  $N$  is equal to 5.

The composition of the cascade formant model is relatively simple and generally used to describe most vowels. Compared with the cascade model, the number of cascades depends on the length of the vocal tract. When nasalized vowels, nasal cavity participation in resonance, and obstructive sounds or fricatives cannot be represented, then the cavity has antiresonance characteristics, and it is necessary to consider adding zero points, which are described by the zero-pole model.

Combining the advantages and disadvantages of the cascade mode and the parallel mode, the hybrid mode (as shown in Figure 4) formed by merging the two modes is automatically converted to the corresponding series type or parallel type through the control of the turbid/clear switch.

Radiation Model:

$$L_Z(\phi) = \frac{i\phi K_k Z_k}{K_k + i\phi Z_k}. \quad (8)$$

The complete digital model of speech signal shown in Figure 5 can be described by the above three models of excitation, vocal tract, and radiation in series, and the transfer function can be expressed as

$$G(l) = X \cdot V(l)U(l)K(l), \quad (9)$$

$U(l)$  is actually an all-pole model.

$$U(l) = \frac{1}{1 - \sum_{R=1}^M x_r l^{-r}}. \quad (10)$$

First, after the Laplace transform of this formula, it can be gotten:

$$l_Z = \frac{\omega K_k Z_k}{K_k + \omega Z_k}. \quad (11)$$

Convert the above formula into the form of the  $l$  transform:

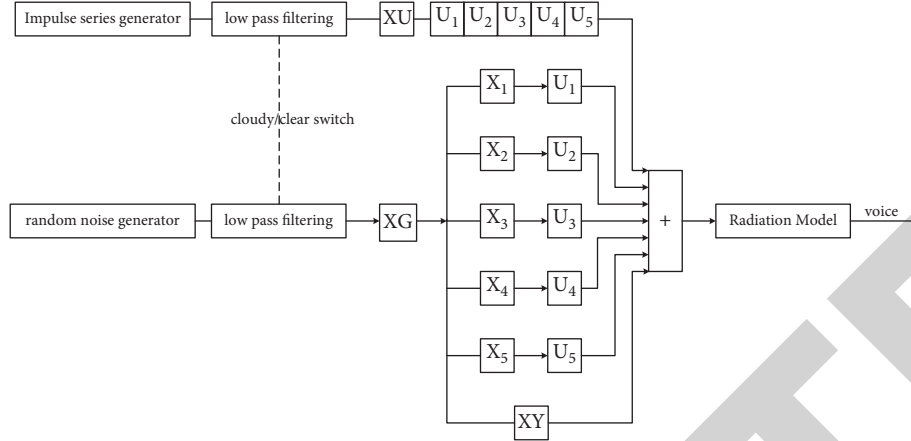


FIGURE 4: Mixed formant model.

$$K(l) = K_0 \frac{(1 - l^{-1})}{(1 - K_1 l^{-1})}. \quad (12)$$

The value of  $K_1$  is so small that it can be omitted, and then we get

$$K(l) = K_0(1 - l^{-1}). \quad (13)$$

### 3.4. Speech Conversion Based on Neural Network

**3.4.1. Neural Network.** Shown in Figure 6 is a simple neuron model that has multiple inputs, a single output, and also an internal threshold, which is characterized as a nonlinear function [19, 20]. Neurons can be divided into multipolar neurons, which have one axon and multiple dendrites. Bipolar neurons have two processes, one is a dendrite and the other is an axon. Pseudo-unipolar neurons send out a process from the cell body, which is not far from the cell body, and divide into two branches in a “T” shape.

The total signal received by the neuron is

$$v = \sum_{j=1}^M s_j a_j - \varphi. \quad (14)$$

The signal that this neuron can transmit to the next neuron at this point is

$$b = g(v). \quad (15)$$

A step function can be used by  $g(\bullet)$ , and the formula is as follows:

$$g(v) = \begin{cases} 1, & (v \geq 0), \\ 0, & (v < 0). \end{cases} \quad (16)$$

The activation function  $g(\bullet)$  can also use the Sigmoid function expressed as follows:

$$g(v) = \frac{1}{1 + e^{-\alpha v}}. \quad (17)$$

**3.4.2. Speech Conversion Based on Linear Predictive Coding (LPC) Model and Neural Network.** The gene profile is transformed by the method of gene synchronization, and the transformation coefficient is defined as the ratio of the average total distance between the source and target speaker genes, so the transformation coefficient is also called the scale factor. The scale factor  $\beta$  can be expressed as

$$\beta = \frac{q_w}{q_d}. \quad (18)$$

In order to improve the conversion efficiency, it is also necessary to adjust the required energy of the target language. The ratio of the average energy of the segment of the source language signal and the target language signal represents the transformation coefficient, and its mathematical formula is as follows:

$$\alpha = \frac{c_w}{c_d}. \quad (19)$$

In the formulas,  $c_w$  and  $c_d$  represent the average energy of the speech signals of the source speaker and the target speaker, respectively. The energy of the segment signal of the test speech is reconstructed according to the scale factor  $\alpha$ , and the energy of the desired signal can be obtained.

## 4. Corpus Experiments on Code-Switching in Novels

**4.1. Premise of Code-Switching.** Most of the characters in the novel are studying abroad or have a certain understanding of foreign languages, so the transformation of language symbols is widely used in the novel. A large number of code-switching in novels is a very common phenomenon, and in novels, code-switching is an important means of communication. Language can reflect characters' characteristics to a large extent, so the use of code-switching in novels is closely related to the manifestation of characters' characteristics [21, 22]. Code-switching not only reflects the speaker's cognition and attitude towards the topic being discussed but also reflects the identity of the participants in the topic and the role



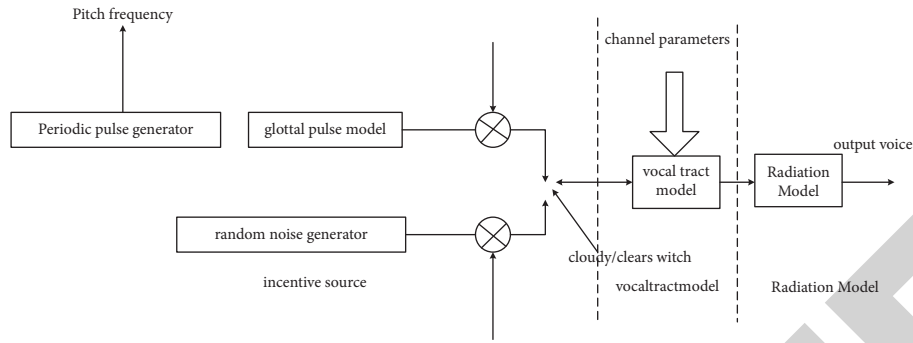


FIGURE 5: time domain model of speech signal generation.

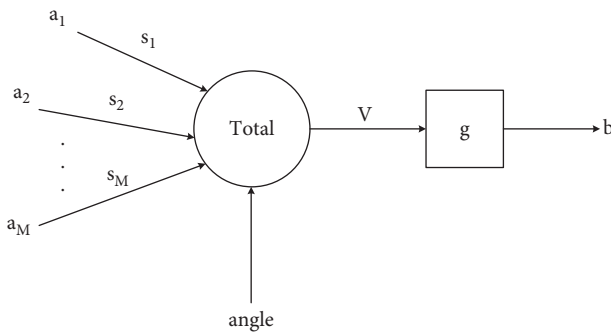


FIGURE 6: Neuron model.

relationship between them. What this paper wants to prove is that the appearance of any form of code-switching is not accidental or whimsical and that code-switching is restricted by the social environment, discourse environment, and so on. This sudden language change plays a subtle and irreplaceable role while shaping and shaping the characters [23, 24]. Due to differences in thinking and culture, English and Chinese language expressions are sometimes untranslatable. When the speaker cannot accurately express the words, phrases, or sentences in English in Chinese, or in order to avoid misunderstanding caused by translation errors, or when the translation process is cumbersome, the speaker can use the strategy of code-switching and use the original English expression directly, which is easier and less hassle.

**4.2. Distribution of Code-Switching in Novels.** The distribution of code-switches in novels is extremely uneven in structure. Some code-switches are as small as only 1 or 2 words, while some code-switches are as large as a segment. The distribution of such code-switching is related to factors such as participants in communicative activities, communicative scenarios, and topics of discussion. According to the statistics of this paper, there are a total of 110 cases of code-switching in novels. These code-switches occur between the dialogues of the novel's characters and in the author's narration. Code-switches in parentheses are not included in the collected data because they are translations of specific names of people, places, books, or brands [25, 26].

As can be seen from Figure 7, the code-switching in chapters 2, 3, 7, and 9 accounts for 81% of the total, with a total of 89 cases. The code-switching in these chapters is relatively concentrated and typical. Due to space limitations,

in this study, 89 code switches in these four chapters were selected as the research data.

Among these code-switched data, code-switching can be roughly divided into three categories: Chinese-English code-switching, Chinese-French code-switching, and Chinese-German code-switching. The specific distribution is shown in Table 1:

Table 1 shows that the frequency of Chinese-English code conversion is the highest, because most of the characters in the novel have studied abroad, have a better understanding of British and American culture, and are proficient in English and Chinese. Another important reason is that the author studied at Oxford University and is more proficient in English than in other languages. Regardless of the form of code-switching, they drive the development of the novel's storyline.

The distribution of code-switching is shown in Table 2:

It can be seen from Table 2 that the code-switching in the novel is mainly intra-sentence code-switching, with 72 cases, accounting for 80.9%. Inter-sentence code-switching was relatively rare, with a total of 16 cases, accounting for 17.9% of the code switches. The code-switching at the end of the sentence is even less, there is 1 case in total, accounting for 1.1% of the code-switching. In the 72 intra-sentence code-switching, the code-switching part-of-speech distribution characteristics are sorted out. These code-switching words basically have a certain meaning, that is, they are basically real words, such as nouns, verbs, adverbs, and adjectives. The specific situation is shown in Figure 8:

As can be seen from Figure 8, the number of nouns appearing is 52, accounting for 72.2% of the total number, while the verb adjectives only appear seven times, accounting for 9.7% of the total number, and the adverb is even less, only appearing 4 times, accounting for 5% of the total. It can be seen that code-switching of nouns is dominant in code-switching within sentences.

In this novel, due to various reasons, there are a lot of language conversion phenomena. In the novel, the transformation of linguistic signs is an important factor, which not only reflects the author's understanding of the subject discussed, but also reflects the different social roles. The article attributes the situation of determining the register to any change in the register, tenor, and mode, which will lead to the change of register.

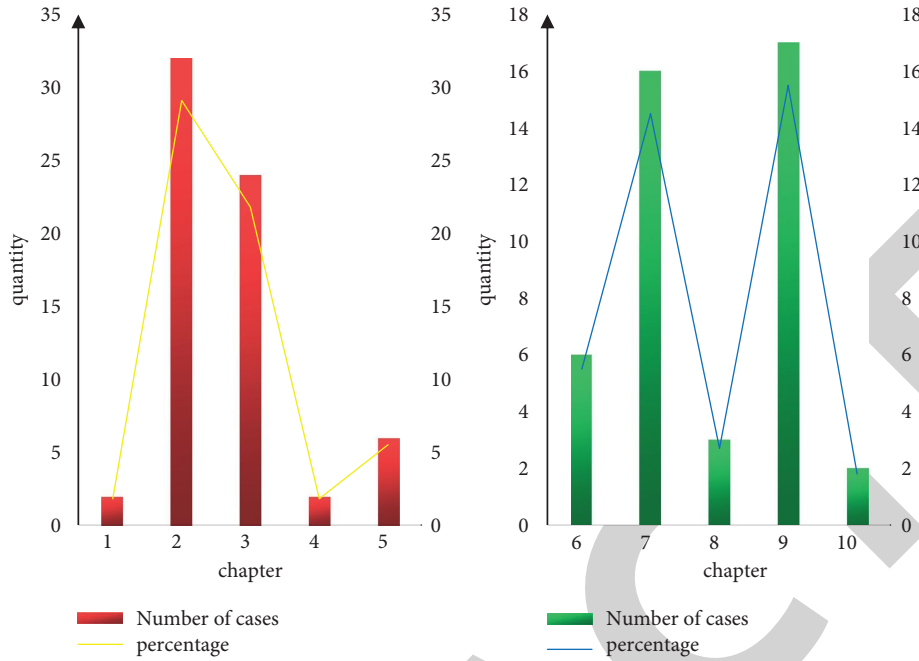


FIGURE 7: The distribution of code-switching in each chapter of the novel.

TABLE 1: Types of code-switching (a).

Types of code switching	The number and percentage of code-switching	
Chinese-English conversion	77	86.5%
Chinese-French conversion	11	12.4%
Chinese-German conversion	1	1.1%

TABLE 2: Types of code conversion (b).

Code-switching type	Number of code conversions	Proportion
Intra-sentence code-switching	72	80.9
Inter-sentence code-switching	16	18
End-of-sentence code-switching	1	1.1

Code-switching is often used flexibly and freely in impromptu oral communication, often subconsciously. Compared with spoken language, written language is more conscious when using code-switching, and communicators often choose code-switching deliberately in speech activities to transmit relevant information and reflect communicative intentions. Here the author deliberately and skillfully chooses the code, which not only depicts his self-righteous psychology, but also produces a humorous expression effect.

From Table 3, it can be concluded that the higher the formality of the context, the less frequently code-switching occurs. In novels, the proportion of code-switching in written language is 38.2%, while in oral communication, the proportion of code-switching is 61.8%, far exceeding that in written language.

selection of language users at various levels of consciousness through various internal and external factors in language activities. Since natural language has three basic characteristics: variability, negotiation, and compliance. Therefore, in the process of communication, this article can choose from different angles. Why do communicators change codes in language activities? Code-switching is a specific language choice, and all language use and comprehension are choices made by both parties. In fact, in order to survive better, human beings and even the entire biological world will take the initiative to transform themselves in order to obtain a larger living space. In order to adapt to a certain language behavior, the communicator performs code-switching in order to achieve or complete a certain communicative goal.

4.3. Adaptability of Code-Switching in Novels from the Perspective of Register. The use of language is the continuous

4.3.1. The Adaptation of Code Switching to the Language Field. In fiction, the variable field of register affects the distribution of code-switching. To some extent, the use of



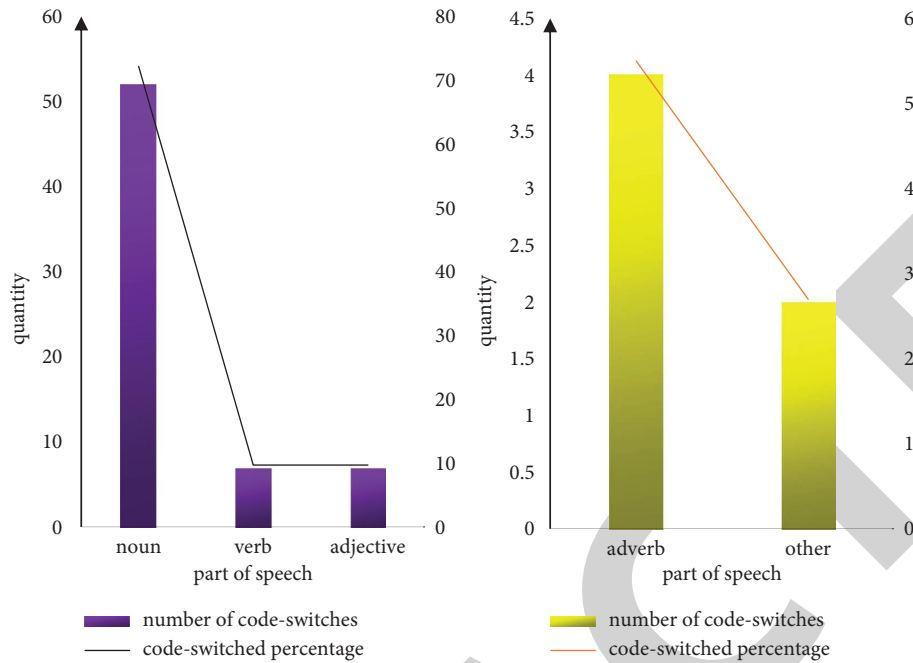


FIGURE 8: Part-of-speech distribution for code-switching.

TABLE 3: Distribution of code-switching in spoken and written languages.

Spoken/written	Code-switching examples	Code conversion percentage	Code-switching type
Written language	34	38.2	C/E; C/F; C/G
Spoken language	55	61.8	C/E; C/F
Total	89	100	C/E; C/F

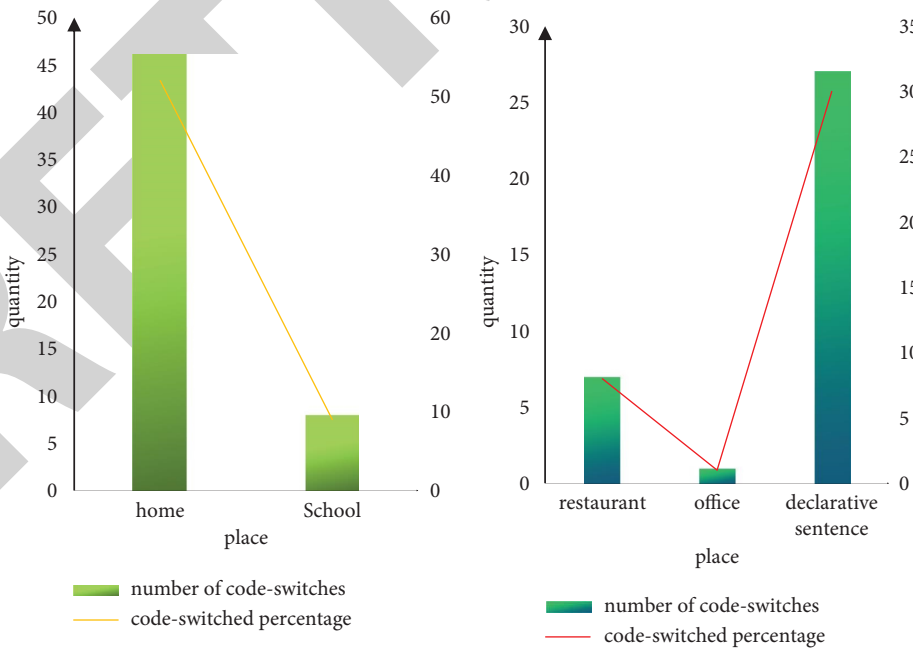


FIGURE 9: The distribution of code-switching in different fields.

code-switching is conditioned by the field. There are many reasons for code-switching in fiction. For example, under a certain social and cultural background, there are certain

conventions, and people’s speech and behavior should conform to these conventions. But in daily communication, people may talk about topics that are considered taboo by

TABLE 4: Distribution of code-switching in different tenses.

	Equal status	Unequal status
Number of code-switches	61	28
Code-switched percentage	68.5	31.5
Code-switched percentage code-switched percentage	C/E	C/E; C/F; C/G

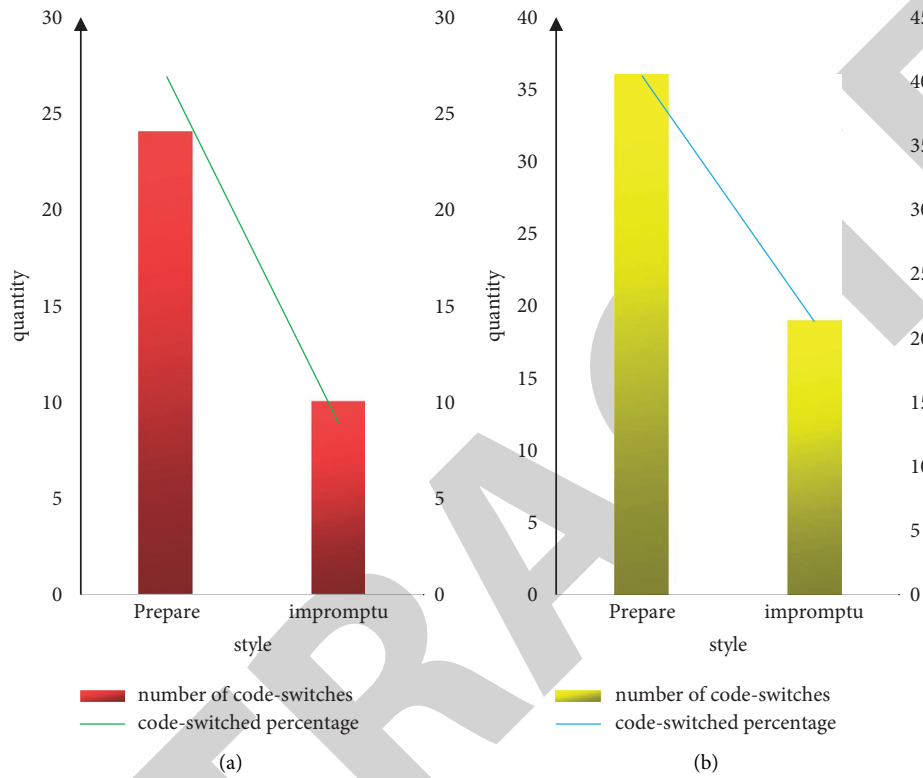


FIGURE 10: Distribution of code-switching in different modes. (a) Written language. (b) Spoken language.

social conventions. In order to achieve a certain communicative purpose, this article cannot avoid these problems. If these topics are discussed directly, it will embarrass both sides of the communication. To transmit information smoothly in this specific language field, code-switching is a good choice. By changing the code, the communicator successfully avoids taboo topics and achieves the purpose of communication. Therefore, code-switching has become a language strategy that is often used in communicative activities. From the perspective of the language field, when the topics are love, academics, arguments, show-off, and quarrels, code-switching is more likely to occur. For these topics, it is also well understood that code-switching occurs. First, the main characters in the novel are mostly intellectuals and well educated, and they use code-switching to fit their identities. Second, as stated above, the use of code-switching conforms to social conventions. In short, the code-switching that occurs in a specific field must conform to this field. The following article analyzes the selected 89 code-switching examples by analyzing the variables in the language field to illustrate the adaptability of code-switching to the language field in the novel.

As can be seen from Figure 9, among these 89 different speech fields: as far as the variable of location is concerned, 46 code switches occurred at home, accounting for about 52%; 27 code switches appeared in the author's narrative, accounting for about 30%; 8 cases of code-switching occurred in schools, accounting for about 9%; 7 code-switching fields were in restaurants, accounting for 8%; and only 1 case of code-switching occurs in the office, which is about 1%.

**4.3.2. Adaptation of Code Switching to Tenor.** Language can reveal the role relationships and social status of communicators. Code-switching, as a result of language choice, can also indicate the social status of the interlocutor. To a large extent, the use of language implies factors such as the speaker's educational background, the formality of the conversation, character relationships, and social status. In fiction, a series of tenor variables constrain the use of code-switching, among which the main variables are the social status of the participants and the relationship between characters. From the analysis of tenor variables, the distribution of code-switching in novels is shown in Table 4:

The table analyzes the distribution of 89 code switches in different tenses. Through analysis, it is found that a total of 61 code-switches appear in the tenets of unequal social status, accounting for about 68.5%, and 28 code-switches appear in the tenets of equal social status, accounting for 31.5%.

**4.3.3. The Adaptation of Code-Switching to Language Patterns.** The channels and media used by the language to express language communication. This sentence may be improvised or prepared in advance. It can be spoken, such as in face-to-face conversations, or telephone conversations; it can also be written in words, such as poems, letters, and novels; or in both cases, for example, broadcast news is served in written form to the spoken word, while oral training in the classroom is carried out orally. Written communication is very different from oral communication in the use of language. The words used in oral communication are more easy-going and easy to understand. The sentences used are relatively short, but sometimes very long, and the grammatical structure is complicated. Written language is generally more formal, with complex and accurate words and long sentences. Although the grammatical structure is complex, the relationship is very clear.

In the following, this paper classifies the selected 89 code-switching examples in the novel from the modal analysis of register variables, as shown in Figure 10:

Through analysis, this paper can draw the distribution of code-switching in spoken language and written language: code-switching in written language is either prepared or impromptu, of which 24 are prepared, accounting for 26.9% of all code-switching, there were 10 impromptu cases, accounting for 8.9%. Code-switching that occurs in spoken language is either prepared or impromptu. Among them, 36 cases were impromptu, accounting for 40.4%, and 19 cases were prepared, accounting for 21.3%. The analysis results also verify that the more formal the text, the less code-switching it contains.

To sum up, by analyzing the adaptation of code-switching to the subject and environment of language field variables, different transitivity is reflected, and the conceptual function of code-switching is realized. The adaptation to the tenor is analyzed from two aspects: The relationship between characters and the relationship between author and reader in the novel. Code-switching achieves its interpersonal function by choosing different tone systems to accommodate these relationships. In terms of language style, it mainly analyzes the adaptation of code-switching to spoken and written language and selects appropriate theme-theme, information system, and some cohesive means, and the discourse function is reflected. By analyzing the examples of code-switching in the novel, it is exemplified that this language choice plays a pivotal role in shaping the character's character.

## 5. Conclusion

Although code-switching is a common phenomenon in human social speech communication, it is not a random

language use. Code-switching is not only a communicative strategy and means, but also a behavior that is influenced by various factors such as social culture and cognitive psychology and plays an important role in verbal communication. Through the analysis of the code-switching in the novel, this paper concludes that the choice of code-switching is to successfully achieve a certain communication purpose, which can accurately and conveniently convey information and opinions to the other party and show the social status of both parties to a certain extent. Code-switching can also achieve specific socio-pragmatic functions. Code-switching is studied from the perspective of register, and it is found that the field, tenor, and mode have a great influence on the code-switching. By analyzing the cases of code-switching in novels, the article can see the important role of code-switching in novels. Code-switching can effectively reflect a person's social status, avoid social embarrassment for communicators, and highlight educational backgrounds. Although the author studies the register variables field, tenor, and mode separately in the article and discusses the adaptability of code-switching to the three variables respectively, as register factors, they all have a selective effect on code-switching. At the same time, the sentence is the product of the simultaneous embodiment of the three functions of concept, interpersonal, and discourse. In other words, it is impossible to separate these factors too absolutely, and we should see the correlation with each other. It is very meaningful to systematically study the relationship between code-switching and pure function in novels, and it is believed that this will enrich the research of code-switching in the field of systemic functions.

## Data Availability

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

## Conflicts of Interest

The author(s) declare that there are no conflicts of interest regarding the publication of this paper.

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