An analysis of the image-text relationship in English advertising from the perspective of systemic functional linguistics

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Abstract: From the perspective of systemic functional linguistics, this paper makes an in-depth multimodal discourse analysis of English advertising using the CNN network as a framework. By taking 100 English print advertisements randomly selected as the research object, this paper reveals the important role of image-text relationship in English advertisement. The results show that in English advertising, images and words complement each other and build meaning together. However, images in most cases are still subordinate to words, which are still the dominant means of expressing meaning. The status relationship of text and text is mainly manifested as interdependence and subordination of image to text. The logical semantic relation covers extension and projection, in which extension is mainly extended and detailed. This study not only enriches the application field of multimodal discourse analysis, verifies the practicability of relevant theories, but also provides some feasible suggestions for advertising design.

1. Introduction

With the rapid development and innovation of science and technology, the modern advertising industry is ushering in unprecedented development opportunities. Modern advertising, as a comprehensive system of multi-symbol resources such as text, image, color and music, presents distinct multi-modal characteristics. Among them, image and text are the core symbol resources of print advertising, and the relationship between them has become a key field of multimodal discourse analysis [1]. Since the end of the 20th century, although multimodal discourse analysis has attracted more and more attention, there are still few examples of multimodal analysis in advertising discourse. Previous analysis of advertising discourse mainly focuses on the language level and fails to fully understand the importance of visual symbols and their interaction with text [2-3]. This paper is devoted to an in-depth study of graphic relationship and its meaning construction in print English advertising, aiming to make up for the shortcomings of this research field and provide a solid theoretical support for the study of graphic relationship. By verifying the validity and practicability of relevant theories, we hope to promote the further development of multimodal discourse analysis in practical applications. At the same time, this study has positive implications for advertising design, which will help commercial information be delivered to target

audiences more accurately and efficiently, and thus enhance the attractiveness and influence of advertising.

2. Related Words

On the premise of reviewing the overall development of ecolinguistics, Ming Cheng developed Hallydiah's approach and defined ecological discourse analysis as an independent paradigm. Based on the guiding principles of eco-physics "diversity and harmony, interaction and coexistence", it extends the functions of experience, interpersonal, text, and logic metafunctions within the framework of systemic functional linguistics. Therefore, theoretical systems of ecological discourse analysis are constructed from the perspective of ecolinguistics, including transitivity system, emotion system, evaluation system, theme system, cohesive coherence system and logic system [4]. Xing C et al.'s research shows that there is a systematic framework of social symbols in multimodal advertising discourse. Based on the research objects of 30 popular video advertising spots, it is concluded that advertising uses intertextuality to establish multiple identities. By means of sharing, innovation, exposition and reporting, this study provides a useful perspective for further cognition of social reality [5]. Inwood suggested that since the 2016 U.S. presidential election, extreme right-wing communities have gained popularity on YouTube, spreading discourse about white supremacy and conspiracy. And examine how this communication can be analysed using methods drawn from systems-functional linguistics and contribute to research interest in the field of media and communication studies. SFL is a socio-semiotic model of language that involves the systematic analysis of language choice in light of its social context. More specifically, the assessment and affiliation framework developed internally by the SFL was utilised to understand how assessment models are put into language [6]. Anna C proposes that impromptu speech tasks provide an ecologically valid sample to examine speech acoustics, but different segmentation methods exist in the literature. Therefore, the purpose of this study was to examine the practicality and reliability of an existing speech segmentation method as specified by systems-functional linguistics and its potential research and clinical applications [7]. R. Wahyuni, K. Out research aimed to find critical discourse analysis in the speech texts of Makarim and Muhadegir Effendi. This lecture was chosen because it is one of the objects of critical discourse analysis. Critical discourse analysis is a method of analyzing the relationship between language, ideology and power. This study adopts a descriptive and qualitative method. The researchers used Norman Fairclough's three-dimensional framework to analyze data from critical discourse analysis. When presenting and analyzing data, researchers used Miles and Huberman's qualitative data analysis theory in Gani, including data reduction, data display or representation, and conclusion drawing or validation [8]. Although there are many researches on language and semantics, there are relatively few researches on the relationship between words and images in English advertisements.

3. Method

3.1 Perspective of systemic functional linguistics

Systemic functional linguistics is an important research content in the field of education, which regards language as a social ideographic resource system and reveals the law of education and teaching by studying the ideographic function of language in education. From the perspective of semantic evolution, the development of an individual is to learn the knowledge and culture constructed by language through a series of language expression processes under the guidance of teachers, so as to cultivate the ability of using language to understand the world and regulate interpersonal relations. In this process, the growth of ideographic potential becomes an ideal

perspective to observe the development of individual learning. The continuous evolution and development of language is the core driving force for the creation and transmission of social knowledge. An in-depth study of the use of language in different social contexts, the semantic differences between different social groups, and how language is transmitted through interaction will help us to reveal the basic laws of social knowledge transmission. The educational process actually takes place in the concrete language communication. Discourse analysis on the scientific construction of knowledge, the reconstruction of context and the process of teaching inheritance can reveal the law of knowledge construction and reconstruction, the regulation and evaluation law of macro education, as well as the law of knowledge inheritance and learning in teaching. With contextualized expressive function as the core, the system functionalism teaching method adopts a macro to micro perspective and is committed to cultivating students' collaborative ability at all levels from context to vocabulary and grammar, so as to form a comprehensive language knowledge and expression ability. The social sign language view, semantic evolution theory and language description theory of systemic functional linguistics provide a powerful perspective for the analysis of graphic relations in English advertising.

3.2 Image-text relationship analysis model

On the basis of the above concepts of systematic linguistics, this paper combined with convolutional neural networks to analyze the graphic relationship in English advertisements. The specific process is shown in Figure 1.
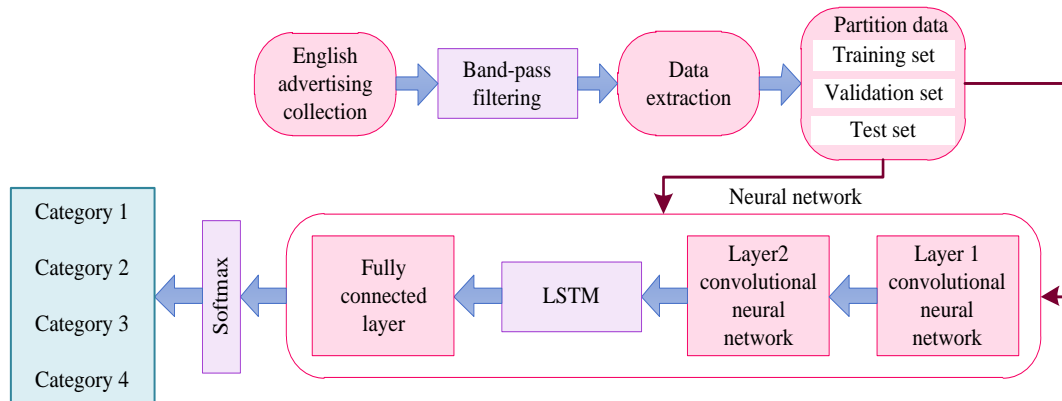

Figure 1: Method flow

For the **image-text** relationship in an English advertisement, the **image-text** relationship $net_j(t)$ in the hidden layer can be expressed by the formula:

$$net_j(t) = \sum_i^n x_i(t) v_{j_t} + \theta_j \tag{1}$$

net represents the number of English ads in the input layer, θ_j is a bias parameter, and t identifies the time node. It is worth noting that the activation of the hidden layer at a specific time node and state is not only affected by the input layer, but also by the state of the hidden layer of the node at the previous time. This mechanism, that is, the "cyclic" application of hidden layer node states to neural networks, is the core feature of recurrent neural networks. The cyclic network calculation method is as follows:

$$net_j(t) = \sum_i^n x_i(t) v_{j_t} + \sum_l^m h_l(t-1) u_{j_t} + \theta_j \tag{2}$$

$$h_j(t) = f\left(net_j(t)\right) \tag{3}$$

m is the total number of hidden layer nodes, and f is the activation function of hidden layer nodes. When constructing neural networks, there are many options for activation functions, including but not limited to sigmoid function, tanh function and binary function [9-10].

For any weight parameters that need to be optimized, calculating the gradient of their optimization objective function and updating the weight parameters according to the gradient is the basic idea of the backpropagation algorithm [11-12]. Common optimization objective functions include sum variance function, cross entropy function and so on. Taking sum variance function as an example, stochastic gradient descent method is used to analyze the learning process of recurrent neural network. The general form of the objective function of the sum and variance is as follows:

$$c = \frac{1}{2}\sum_{k}^{m}(d_k - y_k)^2 \tag{4}$$

For one of the activation functions mentioned above, its derivation becomes very convenient. For example, when a valuable graphic relationship is obtained, the input gate is opened so that valid data can be input, and the input gate remains closed after the effective data is input to the network. If the input gate remains closed over time, the newly input data of the network will not be able to replace the previous incentive output of the unit. At any time, as long as the network output gate is opened, the valid data information can be referred to at any time, so that the network realizes the time distance step and obtains a more effective graphic relationship reference [13-14].

4. Results and Discussion

4.1 The status and semantic relationship of English advertisements

Status relationship is a subsystem of **image-text** relationship system. 100 English advertisements were randomly selected in this paper. The analysis results of status relationship are shown in Table 1. Four main status relationships are displayed in English advertisements, including the independence and complementarity of text and image, as well as the attachment of image to text and text to image. The distribution ratio of these four status relationships in English advertisements is 21%, 41%, 32% and 6% respectively. Among the 100 randomly selected English advertisements, 21 advertisements, accounting for 21% of the total samples, reflect this status relationship. The application of convolutional neural networks in the perspective of systemic functional language provides an effective method for in-depth insight into the status relationship of English advertisements.

Table 1: Status relationship in advertising

Status relationship		Quantity	Percent
Equal status	Graphic independence	21	21%
	Graphic complementation	41	41%
Unbalance	Image text	32	32%
	Text attached image	6	6%
Total	/	100	100%

As an important part of image-text relation system, logical semantic relation covers two aspects: extension and projection. Table 2 shows the graphic relationships in English advertisements in detail, revealing eight types of logical semantic relationships. The distribution ratio of these relation types in the examples is 11%, 22%, 4%, 48%, 2%, 4%, 7%, 2%, respectively, reflecting the complex and diverse connections between images and texts.

Table 2: Logical semantic relationships in English advertisements

Logic-semantic relationship			Quantity	Percent
Extend		State	11	11%
	Expatiate	Example	Text over image	22	22%
		Image greater than text	4	4%
	Extend		48	48%
	Enhance	Time	2	2%
		Space	4	4%
		Cause and effect	7	7%
Cast	Discourse (phrasing)		0	0%
	Thought (meaning)		2	2%
Total	/		100	100%

4.2 Error comparison results

At the same time, the experiment used 100 English advertisements as a test set to compare with SVM and random forest methods, and the results of emotion classification were shown in Figure 2. From the perspective of systemic functional linguistics, the accuracy of convolutional neural network used in this paper is over 90%, the accuracy of SVM method is over 70%, and the accuracy of random forest is over 80%. Under the same test set, the error of this method is smaller, and it has better performance in the analysis of graphic relations in English advertisements.
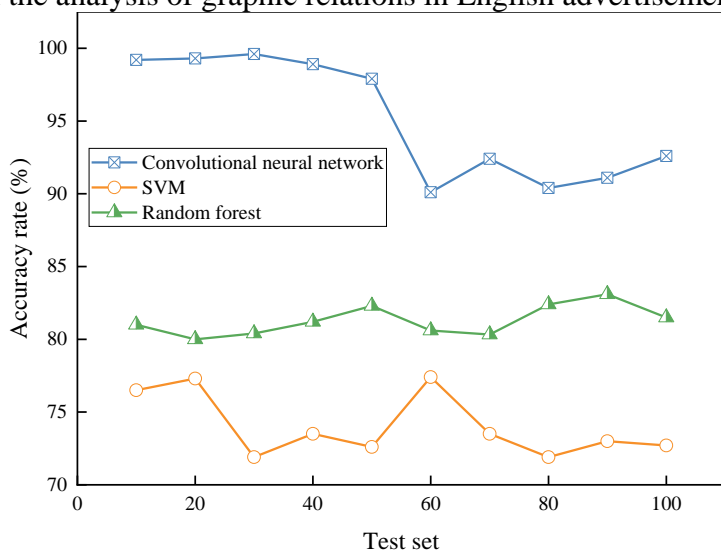

Figure 2: Accuracy of the three methods

5. Conclusion

Based on the theoretical framework constructed by Martin &Salway, this study takes 100 English advertisements as the object of empirical research, and deeply analyzes the relationship between images and texts. The selection of samples takes into account the different positions of image and text in advertising, such as independence, complementarity and attachment. Through detailed data statistics and in-depth case analysis, the study found that in English advertisements, text usually occupies a dominant position and is the cornerstone of transmitting core information. However, the role of images in advertising cannot be ignored, and they form an equal and complementary relationship with text in most situations. This trend reflects that the value of images

and text in advertising is becoming more and more balanced, and the two complement each other in constructing meaning and providing new information together. This finding further highlights the importance of images and text providing new information to each other in advertising, which not only helps to enrich the content of advertising, but also significantly increases its appeal. This study provides valuable insights into the field of advertising design and communication and provides theoretical guidance for practitioners.

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