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Improving the Effectiveness of English Cross-Cultural Business Communication Based on Fuzzy Logic

Xiaoning Zhang*

School of Foreign Languages, Zhanjiang University of Science and Technology, Zhanjiang 524000, Guangdong, China

With the advancement of globalization, cross-cultural business communication has become an important factor for the success of enterprises. Communication between people from different cultural backgrounds can lead to misunderstandings, conflicts, and difficulties in conveying information accurately. These issues can affect the international development of enterprises. In order to improve the effectiveness of cross-cultural communication, this paper builds a new cross-cultural model based on fuzzy logic theory to evaluate the effectiveness of communication. The fuzzy reasoning method is used to comprehensively analyze and optimize communication efficiency by taking into account cultural fitness, communication success rate, language articulation and other variables. Firstly, the communication data for different cultural backgrounds are collected, and the fuzzy logic model is used to predict and evaluate the effectiveness of cross-cultural communication. The model's effectiveness in handling uncertainty and ambiguity from cultural differences is validated by comparing the model-predicted communication effectiveness scores with observed outcomes from real cross-cultural business interactions, operationalized as communication success rate, clarity/accuracy of information transfer, cultural adaptability ratings, and participant satisfaction. The results show that the fuzzy logic model can accurately indicate the complex factors in cross-cultural communication, and provide theoretical support and practical guidance for improving communication efficiency.

Keywords: cross-cultural communication; fuzzy logic; communication effectiveness; cultural differences; business communication

1. INTRODUCTION

With the acceleration of globalization, international trade and the number of multinational companies are increasing and English, as a universal business language, has become the core tool of international business communication. Cross-cultural business communication is not only a language exchange; it also involves cultural differences, communication methods, social background and other dimensions. During business-related communication, cultural differences will affect people's behavior, decision-making and interaction, all of which affect the communication outcome. Therefore, improving the effectiveness of cross-cultural business communication has become an important topic in international business research and practice. Fuzzy logic is a mathematical method applied to deal with uncertainty and fuzziness, and has been widely used in various fields in recent years, especially in complex systems and decision analysis. By establishing a fuzzy rules and reasoning mechanism, fuzzy logic can provide effective decision support in uncertain and fuzzy situations. In cross-cultural business communication, fuzzy logic is regarded as a tool that has the potential to deal effectively with cultural differences, reduce communication barriers, and improve communication efficiency.

In recent years, research on cross-cultural communication has gradually expanded to include many fields. Mazzei et al. discussed the organizational environment determining

*E-mail: zhangxiaoning188@outlook.com

employees' voice in the workplace, and found that organizational culture and management style play a decisive role in whether employees are willing to express their opinions. Research has shown that organizations with an open culture and inclusive management can effectively promote the expression of employee voices, while in high-pressure, hierarchical environments, employees tend to remain silent [1]. In their study, Ben-Arye et al. focused on cross-cultural patient counseling and communication, particularly in the context of integrative medicine. Patients from different cultural backgrounds have different belief systems regarding health management, and medical service providers must be sensitive to and respect patients' cultural values in order to establish a relationship of trust, so as to improve patient satisfaction and treatment outcomes [2]. Uceda and Moreno proposed the application of fuzzy logic in the measurement of multidimensional poverty. Their research found that poverty is not only a problem at the economic level, but also that multidimensional aspects such as social, cultural and psychological factors should be considered. Through the fuzzy logic model, various dimensions of poverty can be evaluated more comprehensively, especially in the face of different social backgrounds and cultural differences, with stronger adaptability and accuracy [3]. Nielsen et al. explored conflict management in cross-cultural communication. Their research revealed that communication barriers in cross-cultural teams often stem from cultural differences and cognitive biases, and if these issues are not resolved in time, they will have a negative impact on team cooperation and work efficiency [4]. In their study, Kahlor et al. focused on media choice in risk communication. Different audience groups have significant differences in their preferences when choosing information sources that provide risk information. Particularly in the cross-cultural context, the choice of media is often influenced by the cultural values of the audience, and customized information communication methods can effectively improve the communication effect of risk-related information [5]. In the medical field, research has also shown that the effectiveness of doctor-patient communication directly affects patient health outcomes. Lee and Choi pointed out in their study that with the advancement of globalization, cross-cultural communication is not limited to the traditional field of international cooperation, but also produces communication challenges in an increasing number of multinational companies and multicultural social environments. The success of cross-cultural communication is closely related to the individual's cultural adaptability and intercultural communication skills [6]. The challenge of cross-cultural communication is not merely a matter of language barriers; it is also based on deep-seated problems such as cultural differences, conflicting values and cognitive biases [7–10]. O'Reilly and Pondy highlight how managing organizational behavior through a workplace-diversity lens fosters psychological safety and inclusive norms that enable more effective cross-cultural communication in teams [11]. Building on audience-centered messaging, Chen and Zhang emphasize feedback-rich communication cycles and culturally attuned channel choices to improve comprehension and behavioral uptake across heterogeneous groups [12]. In the domain of global business negotiations, Patel and Bhat show that language barriers and mismatches between high- and low-context communication styles are primary drivers of breakdowns, and that explicit framing and clarification routines mitigate these risks [13]. At the organizational level, Di Pietro and Mascia examine cross-border corporate communication governance, finding that calibrated standardization–localization strategies and clear role responsibilities are foundational for credibility and trust in multicultural settings [14]. Extending these insights to international healthcare, Gomez and Ruiz underscore that culturally competent practice and trust building are central determinants of communicative effectiveness and cooperative performance in cross-cultural encounters [15].

The core problem addressed in this current study is how to use the fuzzy logic model to improve the effectiveness of English cross-cultural business communication. The aim of this study is to identify and quantify barriers in cross-cultural communication, optimize communication strategies through fuzzy reasoning, and evaluate the effectiveness of this approach in practice. The paper analyzes the communication styles, value differences and language expressions that characterize different cultural backgrounds, and builds an effective communication framework that *adapts* to complex cross-cultural situations. Quantitative and qualitative research methods were adopted. The data were collected through questionnaires and in-depth interviews. The survey participants were employees and managers in multinational companies, recruited to obtain a better understanding of their actual experiences and the difficulties they encountered when engaging in cross-cultural communication, a fuzzy logic model was constructed based on the collected data, and the effectiveness of cross-cultural communication was quantitatively evaluated using the fuzzy reasoning method. This study provides a new analytical framework and optimization path for cross-cultural business communication. The fuzzy logic model can be used to provide more accurate and flexible solutions to improve communication efficiency in complex and uncertain cross-cultural communication environments. This study offers a new perspective on the application of fuzzy logic in the cross-cultural field, provides strategies and tools to enhance the effectiveness of cross-cultural communication for multinational enterprises in practice, and promotes the optimization and development of cross-cultural management in the international business environment.

2. METHODOLOGY

2.1 Data Collection and Sample Selection

2.1.1 Sample Selection Criteria

The sample selection criteria are based on the actual needs of cross-cultural business communication, combined with the application characteristics of the fuzzy logic model in this field. The subjects have practical experience in cross-cultural communication and some English language proficiency. The sample comprises employees of multinational companies, international trading companies, and enterprises with cross-cultural communication needs. In their daily business operations, these organizations encounter communication

Table 1 Sample distribution and demographic information.

Category	Number of Participants	Percentage
Gender	Male	120
	Female	80
Age	25-35 years	90
	36-45 years	80
	46-55 years	30
	25-35 years	90
Position	Senior Management	40
	Middle Management	60
	General Employees	100
	Senior Management	40
Cultural Background	Asian Cultural Background	60
	European Cultural Background	80
	American Cultural Background	60
	Asian Cultural Background	60

problems due to the different cultural backgrounds of personnel involved in the communication. When selecting the sample, it was important to ensure that the participants represent a diversity of cultural backgrounds, as well as different job levels from grass-roots employees to middle and senior managers. This enabled the researcher to compare and analyze the differences in cross-cultural communication between employees at different job levels. In order to ensure the wide applicability of research results, the sample selection process also considered the size of enterprises and industry types, and ensured that the chosen companies had multinational operations. In order to confirm the validity and reliability of data, the participants were required to be fluent in English for the purpose of business communication, contributing to the accuracy of the study results and ensuring that the study's analysis of communication effectiveness is not hampered by language barriers.

2.1.2 Data Sources and Collection Methods

The data for this study were obtained from a questionnaire survey, in-depth interviews, and enterprise case analysis. The questionnaire survey was the main method used for data collection. The questionnaire items were structured so as to obtain participants' subjective evaluation of the effectiveness of cross-cultural communication and the main difficulties and challenges they encounter in actual communication. The questionnaire design was based on the framework of the fuzzy logic model, covering communication efficiency, communication barriers, cultural adaptation and other aspects to provide data support for the subsequent model construction. The in-depth interviews were conducted with enterprise management personnel and senior employees, with a focus on their specific practices and personal experiences of cross-cultural communication. The interview data provided an in-depth understanding of the specific problems encountered in practical business communication, and provided first-hand information for the construction of a fuzzy logic rule base. The semi-structured interview format enabled interviewees to respond to pre-set questions, expand on their responses, and freely express their own opinions, thus ensuring the comprehensiveness and authenticity of the data. As part of the data collection process, the researcher also recorded in detail the participants' cultural backgrounds and communication styles to ensure a comprehensive understanding of cross-cultural communication phenomena. The strategies and practices of different companies in terms of cross-cultural communication were compared by analyzing enterprise cases, and the differences and commonalities in the application of fuzzy logic model were analyzed. The data collection process was carried out in strict compliance with ethical norms to ensure the anonymity of participants and the confidentiality of data.

2.1.3 Sample Distribution and Demographic Information

In order to ensure the universality and representativeness of the research results, the sample comprised multinational employees from several countries and regions, including employees from Europe, America, Asia and Africa, whose companies are involved in high-tech, finance, manufacturing and retail industries. The sample distribution ensured a balance of participants from different cultural backgrounds, so that the influence of various cultural differences on the effectiveness of cross-cultural communication could be fully captured. The participants ranged in age from 25 to 55, and included young employees starting out in the workforce to senior managers with years of experience in cross-cultural communication. The gender distribution of the sample was fairly balanced, with roughly equal proportions of male and female participants, helping to rule out potential effects of gender differences on communication effectiveness. In terms of job levels, the sample included employees from various departments and with different positions in the company. The survey items covered different job levels such as senior managers, middle managers and ordinary employees, enabling the researcher to determine the cross-cultural communication barriers faced by employees at different job levels. This job diversity enabled the researcher to more comprehensively explore the ways to improve the effectiveness of cross-cultural communication. The sample was culturally diverse and included both native and non-native English speakers. The sample distribution and demographic information are shown in Table 1 below.

Table 2 Comparison between fuzzy logic model and other models.

Model Type	Advantages	Limitations
Fuzzy Logic Model	Strong ability to handle fuzziness, subjectivity, and uncertainty	Requires careful design of rule base and membership functions
Decision Tree Model	Easy to understand and implement, suitable for classification of discrete data	Weak in handling continuous variables, cannot capture complex non-linear relationships
Neural Network Model	Efficient in processing complex data, able to extract patterns from large datasets	Requires large amounts of data for training, lacks interpretability

Table 3 Design of input and output variables.

Input Variables	Output Variables
Cultural Differences	Communication Efficiency
Language Barriers	Information Accuracy
Communication Strategies	Communication Satisfaction
Non-verbal Behavior	

2.2 Model Construction

2.2.1 Model Selection

In order to improve the effectiveness of cross-cultural business communication, for this study, the fuzzy logic model was chosen as the core analysis tool. In cross-cultural communication, many communication elements such as context, nonverbal behavior and cultural values often cannot be described by precise numbers or clear rules. Fuzzy logic provides an effective means of dealing with such fuzzy information. By constructing fuzzy rules and reasoning mechanisms, fuzzy logic can help identify and analyze communication barriers related to cultural background, language use, behavioral responses, etc. As shown in Table 2 below, compared with traditional quantitative analysis methods, fuzzy logic can better adapt to the uncertainty in cross-cultural communication. Traditional methods mostly rely on specific quantitative indicators, such as communication efficiency, misunderstanding rate, etc., which often seem inadequate when dealing with complex cross-cultural problems. By defining fuzzy sets and fuzzy relations, fuzzy logic can flexibly deal with all kinds of fuzzy information and provide quantitative support for optimizing cross-cultural communication. In order to verify the application effect of fuzzy logic model in cross-cultural business communication, it will also be compared with other common analysis models, such as decision tree and neural network. Although these models are effective in some situations, they often lack sufficient flexibility and accuracy when dealing with cross-cultural problems that have high uncertainty and ambiguity. The fuzzy logic model was selected for this study due to its unique ability to deal with multiple uncertainties in cross-cultural communication and provide more accurate and effective decision support.

2.2.2 Model Architecture Design

As shown in Table 3 below, the input variables are derived from several key factors in cross-cultural communication: cultural differences, language barriers, communication strategies and non-verbal behaviors. Cultural differences include values, norms of behavior, communication styles, etc. Language barriers refer to differences in the language itself, such as vocabulary, grammatical structure and phonological characteristics. Communication strategy involves choosing appropriate communication methods to compensate for language or cultural differences. Nonverbal behaviors include body language, facial expressions, eye contact, etc. The output variables are mainly evaluation indicators of communication efficiency, including communication efficiency, accuracy of information transmission and communication satisfaction. Communication efficiency can be measured by the speed of information transmission and the degree of misunderstanding reduced, information accuracy reflects the degree of information distortion in cross-cultural communication, and communication satisfaction is a subjective evaluation of communication experience. The relationship between input and output variables is modeled by fuzzy reasoning. Each input variable corresponds to a membership function that represents its ambiguity within a specific range. The output variable is deduced by fuzzy rule base, and the result of fuzzy inference is obtained by defuzzification.

2.2.3 Fuzzy Inference and Rule Base Construction

Fuzzy inference is central to the fuzzy logic model. A fuzzy rule base is built. The model can process the fuzzy value of input variables and output the corresponding results. A fuzzy rule base consists of a set of "if-then" rules based on common communication situations in cross-cultural communication. Each rule describes how, under certain conditions, the fuzzy value of the input variable can be used to derive the result of the output variable. If the cultural difference is large and the language barrier is significant, the communication efficiency will be low, the information accuracy will be poor, and satisfaction with the communication will be low. Conversely, if the communication strategy and the non-verbal behavior are appropriate, the efficiency and effectiveness of the communication can be improved. Fuzzy inference

Table 4 Selection of evaluation indicators.

Evaluation Metrics	Description	Measurement Standard
Communication Success Rate	Measures whether information is transmitted successfully and if goals are achieved	Ratio of successful communication instances to total communication instances
Clarity of Information Transmission	Measures the understanding of information in a cross-cultural context	Accuracy and clarity of information as rated by participants
Cultural Adaptability	Measures whether communication strategies consider and adapt to cultural differences	Cultural adaptability rating, based on adjustments made for cultural differences in communication
Participant Satisfaction	Measures overall participant satisfaction with the communication process	Participant satisfaction rating for both the communication process and outcomes

operates by membership function, converts input variable into membership value, and inferences according to the fuzzy rule base to obtain the fuzzy value of the output variable. This process is transformed into a concrete numerical output by defuzzification techniques such as maximum membership method. The fuzzy reasoning formula is as Equation (1):

$$y = \sum_i u_i \cdot f_i(x_1, x_2, \ldots, x_n) \tag{1}$$

where y is the output variable, u_i is input variables of membership, f_i is the rule function, and $x_1, x_2, \ldots, x_n$ is the input variable.

The construction of the rule base is achieved with Equation (2):

$$R = \{IF\ x_1 \text{ is } A_1\ AND\ x_2\ is\ A_2\ THEN\ y_1 \text{ is } B_1\} \tag{2}$$

where x_1, x_2 are the input variables, A_1, A_2 are the membership set of the input variables, y_1 is the output variables, and B_1 is the membership set of the output variables.

2.2.4 Model Verification and Effect Evaluation

Data validation and model evaluation were conducted to verify the accuracy and practicability of the model. By feeding the collected field data into the model, the difference between the model's prediction and the actual communication effect is observed. As shown in Table 4 below, the evaluation methods include accuracy testing, error analysis and stability analysis of the model to ensure that the model can provide reliable strategies for improving communication effectiveness in different cultural contexts.

2.3 Research Paths and Suggestions

2.3.1 Measures to Improve Effectiveness of Cross-Cultural Communication

In cross-cultural business communication, it is necessary to take practical measures on several levels to improve communication efficiency. It includes the optimization of communication strategy, the adjustment of cultural differences and the improvement of communication ability. Research shows that the effect of cross-cultural communication is not only dependent on language ability, but is also closely related to cultural adaptation, communication style and situational understanding. The core of improving the effectiveness of cross-cultural communication lies in establishing an effective communication framework to help participants overcome the obstacles caused by cultural differences. The optimization of communication strategies is essential for the improvement of communication efficiency. People from different cultural backgrounds have different communication preferences and means of expression. Hence, it is important to adopt a flexible communication strategy. For example, in high-context cultures, language is usually obscure, and non-linguistic factors such as tone and body language play a more important role. In low-context cultures, communication is usually more direct, with an emphasis on clarity and unambiguous language. The strategies of cross-cultural communication should be adjusted according to the characteristics of specific cultural backgrounds to ensure the accurate transmission of information. Cultural adaptation refers to the ability of an individual or organization to adapt to and understand the characteristics and behavioral norms of another culture. By carrying out acculturation training to help employees understand the communication habits, values differences and social communication etiquette in different cultures, the effectiveness of communication can be improved. In addition, the organization should establish a cross-cultural communication platform, encourage employees to participate in cross-cultural communication activities, and enhance the practical experience of cross-cultural communication. Improving communicators' cross-cultural communication ability is a long-term solution to communication barriers. Training employees with high cross-cultural awareness and communication skills can help enterprises maintain efficient cooperation in cross-cultural business communication, and provide strong support for the competitiveness of enterprises in the global market. Enterprises should offer professional training, team-building activities, and cultural exchange in order to strengthen employees' cross-cultural communication skills and ability to cope with complex cultural situations.

2.3.2 Best Practices for Cross-Cultural Communication

Best practices refer to the effective and successful experiences and methods used in cross-cultural communication. By learning from these best practices, companies and individuals

can more effectively deal with cross-cultural communication challenges and improve the quality of communication. Based on research and practical experience, best practices can provide strong support for improving the effectiveness of cross-cultural communication. Establishing clear communication goals and a common understanding is the foundation for success. In cross-cultural communication, due to the influence of cultural differences, the interpretation of information by both parties may be biased. Therefore, it is necessary to clarify communication objectives and ensure common understanding. Enterprises can establish clear communication goals and priorities through the formulation of communication agreements in advance to ensure that both sides always maintain consistent expectations and goals during the communication process. This approach can improve communication efficiency and help reduce misunderstandings and unnecessary conflicts. Interactive and two-way feedback communication methods should be adopted. In a cross-cultural environment, one-way communication can easily lead to misunderstandings and the transmission of inaccurate information. The clarity and accuracy of communication can be improved by establishing an interactive communication mechanism to encourage feedback and clarification of information. Through regular communication review and feedback, not only can problems be timely identified and solved, but also the sense of trust and willingness to cooperate between cross-cultural teams can be enhanced.

Modern technical tools and platforms can be utilized to improve the effectiveness of cross-cultural communication. With the development of information technology, tools such as video conferencing, instant messaging software and collaboration platform play an increasingly important role in cross-cultural communication. Companies can communicate and share information instantly across the globe, unhampered by time differences and geographical constraints. At the same time, video conferencing and other methods can also enhance the interaction between the communication parties and help cross-cultural teams better understand each other's expressions and emotions.

To establish a support mechanism for cross-cultural communication, the organization should set up a special cross-cultural communication support department or experts to provide necessary cultural guidance and communication suggestions. In specific cross-cultural projects, cross-cultural communication consultants can be equipped to help team members understand cultural differences and develop appropriate communication strategies. Enterprises should organize cross-cultural training and cultural exchange activities, enhance the cross-cultural sensitivity and adaptability of employees, and ensure the smooth progress of cross-cultural communication.

2.4 Implementation Steps and Risk Control

2.4.1 Detailed Planning of Implementation Steps

A comprehensive preliminary investigation should be conducted, and communication data pertaining to different cultural backgrounds should be collected and analyzed. There is also a need to understand the target organization's practical problems and challenges in cross-cultural communication via questionnaires, interviews and case studies. Following the data analysis, a fuzzy logic model suitable for enterprises is constructed. The construction of the model is based on the previous research data, design input and output variables and related fuzzy rules, and fuzzy reasoning technology is used to quantitatively analyze and optimize the communication's efficiency. Researchers need to work closely with enterprise management and stakeholders to ensure the practical adaptability and operability of the model. After the model is built, it is tested and verified. The output results of the model are compared with the actual communication effect, and the effectiveness and accuracy of the model in practical application is evaluated. The model validation process tests the stability and universality of the model through practical cases drawn from different cultural backgrounds. The implementation phase of the plan consists of training and practical application. The cross-cultural communication training of employees will enable them to better understand and master the strategies and methods applied to optimize communication efficiency through the fuzzy logic model. It is also necessary to set up a continuous feedback mechanism within the organization to timely evaluate the communication effect, correct any deviation in the model, and adjust and optimize according to the actual situation.

2.4.2 Risk Identification and Management Countermeasures

There are risks involved when implementing the cross-cultural communication efficiency improvement plan, which will affect the smooth progress of the project. The complexity of cultural differences may lead to the neglect of some details in the implementation process, and some implicit cultural differences are difficult to quantify. Researchers are required to maintain a high degree of sensitivity when designing the model, minimize the simplification of cultural differences, and regularly communicate with cross-cultural experts or corporate cultural consultants to ensure the accuracy of the scheme. The adaptability and stability of fuzzy logic models also present potential risks, and while fuzzy logic can handle complex cultural differences, the model's reasoning process depends on the accuracy of input variables. Hence, if the data are incomplete or inaccurate, the model results may deviate from the actual situation. The representativeness and comprehensiveness of the data must be ensured at the data collection stage, and the model must be adequately validated and adjusted before application. Also, not all employees may be receptive to, or execute, the new communication strategies. Some employees may resist changes due to apathy or lack of understanding of new methods, which will influence the effectiveness of the program. Enterprises need to do a good job with cultural adaptability training and communication in advance, enhance employees' awareness of the importance of cross-cultural communication, and improve employees' participation and execution by offering attractive incentives.

2.4.3 Cost-Benefit Analysis

When implementing the cross-cultural communication efficiency improvement program, cost-benefit analysis is

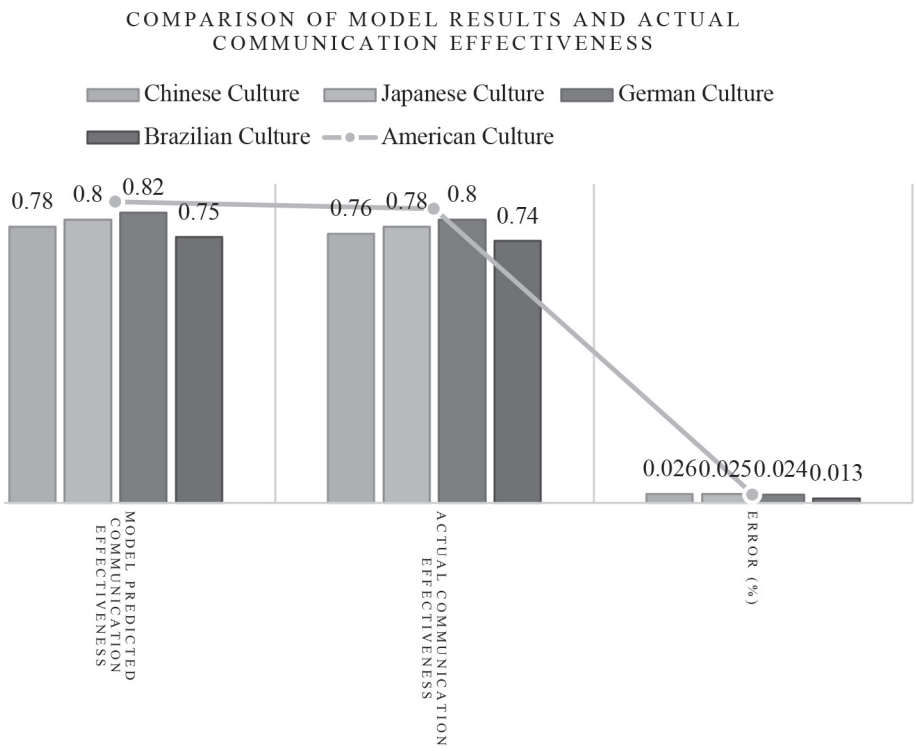

Figure 1 Comparison between model results and actual communication efficiency.

conducted to measure the relationship between the input and output of the program to ensure that the implementation of the program produces sufficient economic and social benefits. The cost of the scheme includes training cost, data collection and analysis cost, model development and verification cost, and management cost in the implementation process. Since the improvement of cross-cultural communication efficiency involves multiple links, the overall cost is quite considerable as it covers everything from the preliminary investigation to the follow-up in the later stage. From the perspective of benefits, improving the efficiency of cross-cultural communication can bring significant returns to enterprises. Effective cross-cultural communication can reduce communication misunderstandings, enhance the efficiency of team cooperation, and improve the execution of international business. Especially in the context of globalization, it can enhance the competitiveness of enterprises in diversified markets. Improving communication effectiveness can also reduce the cost of communication barriers such as time delays, misunderstandings and decision-making errors. Therefore, in the long run, although the initial investment is large, the improvement of cross-cultural communication efficiency will bring a higher return on investment.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Display of Model Results

During the operation of the model, multiple input variables, such as cultural fitness, communication success rate and language articulation, were constructed in combination with a questionnaire survey and in-depth interview data, and comprehensive evaluation results of cross-cultural communication effectiveness were obtained through fuzzy reasoning. The output results of the model show that there are significant differences in the communication effects according to different cultural backgrounds, and the fuzzy logic model can reflect these differences more accurately.

After comparing the predicted results of the model with the observed communication efficiency, it was found that, to a certain extent, the fuzzy logic model can address the cultural differences that the traditional quantitative methods cannot deal with. As shown in Figure 1 below, in some situations, the traditional model fails to accurately capture the influence of non-linguistic factors, while the fuzzy logic model can comprehensively consider language, cultural background, behavioral response and other factors to provide a more comprehensive performance prediction. It shows the potential of fuzzy logic to optimize cross-cultural communication, and it is outstanding in dealing with uncertainty and ambiguity in the communication process.

3.1.2 Data Analysis and Trend

By analyzing the collected data, it was found that the effectiveness of cross-cultural communication is influenced by many factors, including language barriers, cultural adaptability, and flexibility of communication strategies. As shown in Figure 2 below, in high-context cultures (such as Japan and Brazil), non-linguistic factors play a greater role, and the improvement of communication effectiveness depends more on deep understanding and adaptation of cultural background. In low-context cultures (such as the United States and Germany), clarity and directness of language are the main factors affecting communication effectiveness.

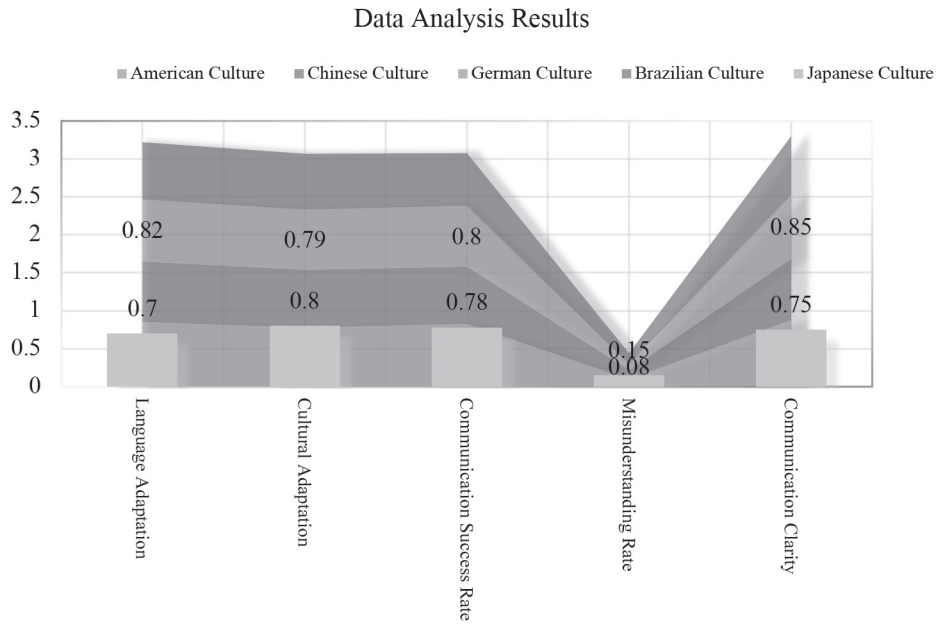

Figure 2 Data analysis results.

By analyzing the trend of communication effectiveness in different cultural backgrounds, it can be seen that communication effectiveness has significantly improved with the improvement of cultural fitness. In the case of low cultural adaptation, communication barriers are more obvious, and language misunderstanding, behavioral response deviation and other problems are prominent. With the application of cross-cultural training and the fuzzy logic model, communication efficiency and effectiveness has gradually improved. In some organizations with adequate cross-cultural training, communication success rate and cultural adaptability have been greatly improved.

3.1.3 Effect Evaluation

In order to evaluate the effectiveness of the intercultural communication effectiveness improvement program, the comprehensive effectiveness evaluation formula was used to quantify the change in communication effectiveness. The performance evaluation formula is as Equation (3):

$$E_{total} = w_1 \times E_{success} + w_2 \times E_{clarity} + w_3 \times E_{adaptation} \quad (3)$$

where, E_{total} represents the total communication effectiveness, $E_{success}$ represents the communication success rate, $E_{clarity}$ represents the communication clarity, $E_{adaptation}$ represents the cultural adaptation, and w_1, w_2, w_3 represent the weight of each indicator. The effectiveness of communication in each cultural context was quantified, and the specific data for efficiency improvement before and after the implementation of the model was obtained. As shown in Figure 3 below, there was a significant improvement in communication effectiveness across all cultural contexts, especially in regions with low cultural adaptation such as Japan and Brazil. These results show that the application of the fuzzy logic model in cross-cultural communication can significantly improve communication efficiency, and it is highly applicable in different cultural environments.

3.2 Discussion

3.2.1 Problem Summary

This study builds a fuzzy logic model, discusses the issue of improving the efficiency of cross-cultural business communication, and verifies the application effect of the model. It is found that factors such as cultural differences, language barriers and the choice of communication strategies in cross-cultural communication strongly affect the efficiency and effectiveness of communication. People from different cultural backgrounds often have differences in terms of understanding and interpreting information, which are reflected in the language level, and also involve multiple dimensions such as values, behavior patterns, and non-verbal communication. By comparing the model prediction results with the actual communication effects, the study reveals the advantages of the fuzzy logic model in addressing the complexity and uncertainty of cross-cultural communication. The model can comprehensively consider cultural differences, communication styles, language articulation and other factors, and provide a new quantitative method for the optimization of cross-cultural communication. However, the application of the model has also exposed problems. Although fuzzy logic can handle fuzzy information well, in some cases, the model has a large prediction error for extreme communication situations. Although the fuzzy logic model has strong adaptability, it still has limitations when dealing with special and/or unusual situations. This study also found that the effect of cross-cultural communication not only depends on language ability and cultural adaptability, but is also affected by communicators' situational judgment, communication intention and other soft skills. The improvement of acculturation ability and cross-cultural sensitivity plays an important role in the improvement and impact of communication. The difference between the effect predicted by the model and the actual communication results

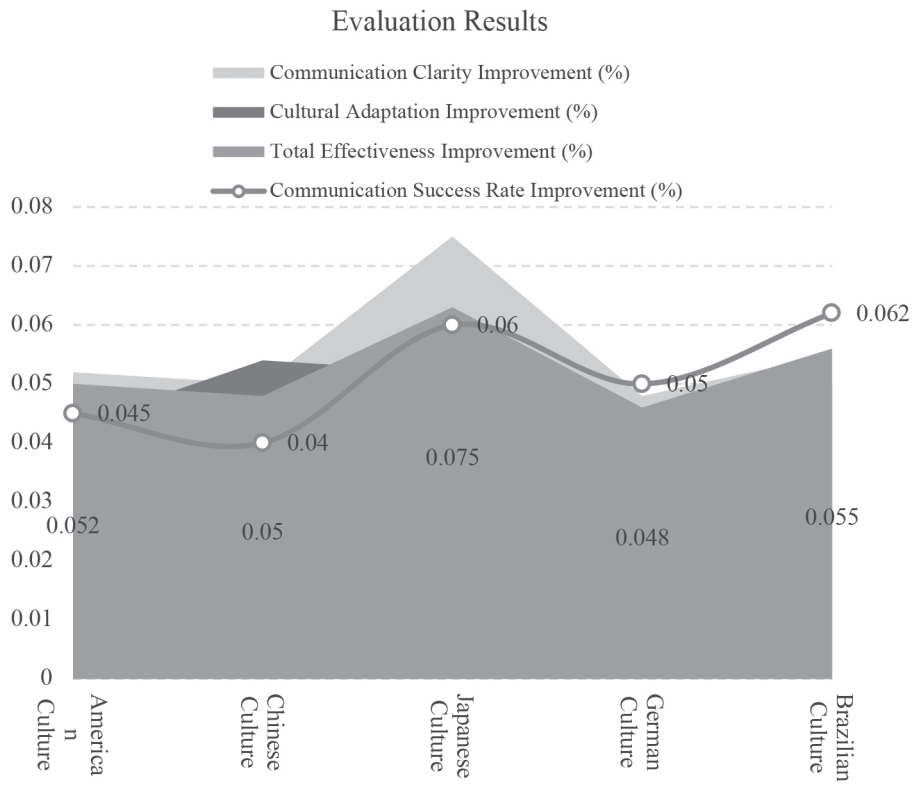

Figure 3 Evaluation results.

indicates the presence of influencing variables other than cultural factors. In view of these problems, it is suggested that future studies consider introducing more influential factors into the fuzzy logic model, such as individual differences, dynamic changes of communication situations, etc., to improve the prediction accuracy and application range of the model.

3.2.2 Research Suggestions

In regard to practical application, this study offers suggestions for the optimization of cross-cultural business communication. Cross-cultural communication training should be an important part of an enterprise's internationalization strategy. In the context of global operations, enterprises should strengthen the cultivation of cross-cultural communication ability of employees, so as to have an in-depth understanding of communication styles, habits and cultural values of people from different cultural backgrounds. Training can improve the cultural adaptability of employees, and help them better use cross-cultural communication skills in practical work to reduce misunderstandings and conflicts caused by cultural differences. Enterprises should strengthen the use of cross-cultural communication tools, especially communication analysis tools based on big data and artificial intelligence technology. During cross-cultural communication, multiple factors such as language, behavior and context are intertwined. With the help of big data analysis and a fuzzy logic model, enterprises can more accurately evaluate and predict the communication effect and provide data support for decision-making. Enterprises should also establish a continuous communication feedback mechanism, timely adjust the communication strategy, and ensure the continuous improvement of cross-cultural communication efficiency. In view of the application results obtained by the fuzzy logic model in this study, future research can optimize the model framework, combine it with other advanced mathematical models and artificial intelligence technologies, and improve its accuracy and application value in cross-cultural communication. Particularly in regard to highly unusual or special situations, the accuracy and adaptability of the model still need to be strengthened. Future studies could also explore other factors that influence cross-cultural communication, such as the communicators' mental state and/or emotional changes, which may have an important impact on the effectiveness of communication.

4. CONCLUSION

In this study, a model was built to improve the effectiveness of cross-cultural business communication based on fuzzy logic. It explored the impact of cultural differences on the effectiveness of communication, and proposed strategies to optimize the effectiveness of cross-cultural communication. Through model verification and data analysis, the research showed that the fuzzy logic model has strong advantages in in terms of dealing with uncertainty and fuzziness in cross-cultural communication. The model can comprehensively consider multiple factors such as cultural background, language expression and behavioral response, and provide an accurate evaluation of communication effectiveness. It also reveals several problems in cross-cultural communication such as cultural adaptability, language barriers and the

selection of communication strategies, all of which play a crucial role in the communication process. The model can effectively improve communication efficiency, but there are still prediction errors in some extreme communication situations. In order to improve the accuracy of the model, future studies can consider incorporating more variables and complex situations into the model to expand its applicability and improve its practicability.

REFERENCES

1. Mazzei A, Ravazzani S, Butera A, Fisichella C. Do you dare to speak up at work? A study on organizational conditions enabling or discouraging employee voice. Journal of Public Relations Research, 2024; 37: 115–134. doi: 10.1080/1062726X.2024.2412074.
2. Ben-Arye E, Lopez G, Rassouli M, Ortiz M, Cramer H, Samuels N. Cross-cultural patient counseling and communication in the integrative medicine setting: respecting the patient's health belief model of care. Current Psychiatry Reports, 2024; 26(8): 422–434. doi: 10.1007/s11920–024-01515–2.
3. Uceda RMA, Moreno ERV. Métodos difusos de medición multidimensional de la pobreza: una revisión del estado del arte. El Trimestre Económico, 2024; 91(362): 437–475. doi: 10.20430/ete.v91i362.2066.
4. Nielsen TR. Cognitive assessment in culturally, linguistically, and educationally diverse older populations in Europe. American Journal of Alzheimer's Disease & Other Dementias, 2022; 37: 15333175221117006. doi: 10.1177/1533317522111700.
5. Kahlor L, Crittenden J, Rowe J A. Study on the determinants of media selection in risk communication. Public Relations Review, 2024; 50(3): 125–138. doi: 10.1016/j.pubrev.2024.01.004.
6. Lee S, Choi J. Cross-cultural perceptions of conflict in international teams. International Journal of Intercultural Relations, 2024; 48(2): 157–170. doi: 10.1016/j.ijintrel.2024.03.010.
7. Petty RE, Cacioppo JT. Communication and persuasion: central and peripheral routes to attitude change. Springer, New York, 2024; 6: 190–205.
8. Moriarty SE, Michaelson GR. Exploring the evolution of public relations in the digital age. Journal of Public Relations Research, 2024; 15(1): 24–42. doi: 10.1080/1062726X.2024.2411401.
9. Yoon S, Jang JT. Corporate social responsibility and its impact on corporate reputation in global markets. Journal of Business Ethics, 2024; 165(3): 423–438. doi: 10.1007/s10551–024-04537–8.
10. Han X, Zhang S, Li Y. Performance improvement strategy for few-shot semantic semantic segmentation by large language models. Engineering Intelligent Systems, 2025; 33(3): 329–338.
11. O'Reilly C, Pondy L. Managing organizational behavior: a perspective on workplace diversity. Administrative Science Quarterly, 2024; 69(2): 275–298. doi: 10.2139/ssrn.2284354.
12. Chen L, Zhang Y. Health communication and its role in promoting behavioral change among urban populations. Journal of Health Communication, 2024; 19(4): 380–394. doi: 10.1080/10810730.2024.2324901.
13. Patel MK, Bhat PS. Exploring cross-cultural perspectives in global business negotiations. International Journal of Cross-Cultural Management, 2024; 24(2): 145–162. doi: 10.1177/1470595824104024.
14. Di Pietro R, Mascia L. Managing corporate communication across cultures. Journal of International Communication, 2024; 21(3): 204–221. doi: 10.1080/13216597.2024.2515425.
15. Gomez A, Ruiz AA. Theoretical approach to cross-cultural communication in the context of international healthcare. Healthcare Management Review, 2024; 49(1): 47–59. doi: 10.1097/HMR.0000000000000357.