Optimize the Teaching of Chinese Pronunciation as a Foreign Language from the Perspective of Data Science

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Jinping Zhang[1] and Xiaohui Zou[2 3 4 [0000-0002-5577-8245]]

[1] Faculty of Language and Translation,Macau Polytechnic University, Macau, China
[2] SINO-US Searle Research Center,Room 501,Building 1, No. 100 Renshan Road, Hengqin, Guangdong 519000, China
[3] Interdisciplinary knowledge modeling research group, Peking University, No.5 Summer Palace Road, Haidian District, Beijing 100871,China
[4] Institute of Intelligent Engineering and Math., Liaoning Technology University, Fuxin, Liaoning 123000,China
949309225@qq.com

Abstract. This paper aims to optimize the phonetic teaching of Chinese as a foreign language from the perspective of data science and explore the teaching strategies for tone misreading from Portuguese-speaking countries as Chinese learners. Its method is to adopt three groups of comparative studies, namely, man-machine mutual assistance and interpersonal mutual assistance, including personal self-help by using AI tools. The result is that, the advantages and disadvantages of the three aspects were found. Its significance lies in: firstly, it highlights the characteristics of the era of man-machine mutual assistance, and then clarifies the necessity and importance of optimizing the phonetic teaching of Chinese as a foreign language from the perspective of data science. Finally, it makes the academic and the teaching Chinese as a foreign language, understand that the era of big data and AI will inevitably significantly change all aspects of Chinese teaching and even the whole education.

Keywords: Phonetic teaching of Chinese as a foreign language, the perspective of data science, the teaching strategies for tone misreading, from Portuguese-speaking countries as Chinese learners,the human-machine mutual assistance.

1   Introduction

This paper aims to optimize the teaching of pronunciation of Chinese as a foreign language from the perspective of data science, in particular, to explore the teaching strategies of tonal misreading for Chinese learners from Portuguese-speaking countries.The results show that in the era of big data and artificial intelligence, not only teaching Chinese as a foreign language, but also all aspects of the whole education and teaching strategy need to be re-explored.This study adopts three groups of control studies closely related but harmonious and different. Among them, it includes not only the traditional rule-based expert knowledge system, but also big data processing based on statistics, machine learning and deep learning,such as a new

generation of artificial intelligence and even primary general artificial intelligence, such as GPT+ and LLM+.

2 Method

Its method is to adopt three groups of comparative studies, namely, man-machine mutual assistance and interpersonal mutual assistance, including personal self-help by using AI tools.

2.1 The first group of human-computer dialogue results

Please note that Xiaohui Zou and ChatGPT4 by Time-saving technology.

Question: Discussion on optimizing phonetic teaching of Chinese as a foreign language from the perspective of data science-teaching strategies for tone misreading of Chinese learners from zero starting point in Portuguese-speaking countries

Answer (artificial intelligence system gives generalized experience):

This paper aims at solving the problem that learners of Chinese from scratch in Portuguese-speaking countries are prone to misreading when learning Chinese tones through the methods and techniques of data science, and puts forward corresponding teaching strategies. By collecting learners' phonetic data, feature extraction and model construction, we can deeply analyze learners' tone problems and provide personalized and effective teaching methods and tools. This paper will introduce the application of data science in teaching Chinese tones as a foreign language, including data collection, feature extraction, model construction and teaching strategies, aiming at improving the accuracy of Chinese tones in Portuguese-speaking countries. *Key words*: data science, teaching Chinese as a foreign language, pronunciation teaching, tone misreading, data collection, feature extraction, model construction, teaching strategy. *2.1.0.Introduction:* Teaching Chinese tones as a foreign language is an important challenge for learners in Portuguese-speaking countries. Learners are often prone to misreading when learning Chinese tones, which may be caused by the differences between Portuguese, the mother tongue, and Chinese tone systems. However, by applying the methods and techniques of data science, we can collect learners' phonetic data, analyze learners' tone problems by using the techniques of machine learning and deep learning, and provide corresponding personalized teaching strategies. *2.1.1. Collection the phonetic data* of learners in Portuguese-speaking countries. Comparative Study of Tone Systems between Portuguese and Chinese. *2.1.2.Extraction Tone Feature* Method Based on Speech Signal and Text Alignment. *2.1.3. Application of Construction Machine Learning Model* in Tone Misreading. *2.1.4.Teaching Strategies Design* for Tone Misreading. Development and Application of Personalized Teaching Tools. *2.1.5.Conclusion*: Through the methods and techniques of data science,the Portuguese-speaking learners can be analyzed deeply.

2.2 The second group of man-machine conversation results

Please note that Xiaohui Zou and Chatbot by JKTChat.

Question: Discussion on "Phonetic Teaching" of Chinese as a Foreign Language-Teaching Strategies for Tone Misreading of Chinese Learners from Zero Starting Point in Portuguese-speaking Countries

Answer (artificial intelligence system gives generalized experience): *2.2.1.* Use appropriate teaching materials: In the process of teaching, it is very important to choose suitable textbooks and teaching materials for successful teaching. Tone is a difficult aspect for Portuguese-speaking countries to learn Chinese from scratch, some textbooks or teaching materials with tones and provide some exercises and tests to help learners master tone can be chosen. *2.2.2.* Pay attention to the correctness of pronunciation: In tone teaching, it is very important to pay attention to the correctness of pronunciation. For those who learn Chinese from scratch in Portuguese-speaking countries, they may have the problem of inaccurate pronunciation, so they need to pay attention to the correctness of pronunciation. Teachers can help learners pronounce correctly through pronunciation tests and repeated exercises. *2.2.3.* Provide a variety of practice methods: In order to help students master tones, teachers can provide a variety of practice methods. For example, pronunciation tests and simulated dialogues can be used to help learners practice correct pronunciation and intonation. In addition, different teaching materials, such as pictures, audio and video, can be used to help learners practice different pronunciations and tones. *2.2.4.* Emphasize language and culture: In tone teaching, teachers also need to emphasize language and culture. The culture and language of Portuguese-speaking countries are different from Chinese, so students need to understand and respect different cultures. Teachers can help students better understand Chinese and its culture through cultural introduction and language and cultural exchange, help them better master Chinese pronunciation and intonation. The teaching strategies for tone misreading in Portuguese-speaking learners need to pay attention to the correctness of pronunciation, provide various practice methods, emphasize language and culture and adopt appropriate teaching materials. Through these strategies, teachers can help learners better master the pronunciation and intonation of Chinese and improve their language ability.

2.3 The third group is the self-questioning and self-answering of people

Please note that Jinping Zhang and Xiaohui Zou with the same **Question a**s before.

Answer:*2.3.0.Abstract*: Portuguese is a non-tonal language. The Portuguese students who begin to learn Chinese tend to be negatively transferred by their native language when it comes to pronunciation, and even form a conceptual phenomenon in tonal mispronouncing, which will affect the acquisition and development in Chinese in the future. Tone teaching is the key to the formation of voice. How Portuguese students learn Chinese from the beginning can avoid the interference caused by their mother tongue, cultivate the correct tonal concept of Mandarin pronunciation, and lay a solid foundation in acquiring Mandarin, so as to master the pronunciation of initials and finals in the right tonal track, achieving communication with a good language competence, which is the main content this essay discusses.

2.3.1.Introduction:How to learn Chinese well and speak Mandarin well more scientifically and effectively has become a hot topic. According to the characteristics

of foreigners learning Chinese, some corresponding monographs have sprung up. Many scholars put forward that phonetic teaching is the basis of teaching Chinese as a foreign language. For foreign students who are just getting started, phonetic teaching has its specific objectives and principles[1], and summarizes three views held by the field of Chinese as a foreign language: phoneme teaching, language flow teaching and the combination of phoneme and language flow teaching. On this basis, the theory of "syllable teaching method" is emphasized. Zheng Gu and Zhongwei Wu's paper "A Study on Phonetic Teaching for Foreign Students at the Entry Stage" [2] is a paper that is more in line with the characteristics of Chinese phonetic learning and is a new masterpiece worth learning from. The shortcomings are that there is no transposition research based on the identity and mother tongue characteristics of second language learners, and there is no local monograph on the three elements of pronunciation teaching: tone, initial consonant and vowel, which can not be directly used in teaching.

"A Study on Phonetics and Phonetics Teaching of Chinese as a Foreign Language" published by Mr. Jinming Zhao, an expert at Beijing language and culture university in China that book is a monograph for foreign students to learn Chinese phonetics, in which the second section talks about the teaching of Chinese tones[3]. However, the book only focuses on Chinese as a second language learners in other countries, and does not deal with Chinese learners in Portuguese-speaking countries.

"Exploration on Teaching Chinese Phonetics to Brazilian Portuguese-speaking Students as a Foreign Language" [4], mentioned that "although there has been some progress in the field of phonetic contrast research in China at this stage, the research on teaching methods and skills of Chinese phonetics as a Foreign Language has gradually increased and achieved certain results. However, at this stage, there is a lack of Chinese phonetic comparison and teaching research results for students whose mother tongue is small languages such as Portuguese. " On the basis of previous phonetic research results, this paper combines its own teaching practice in Brazil, and under the guidance of contrastive theory, makes a comparative analysis between Chinese and Brazilian Portuguese in phonetics, syllable structure and intonation, and makes an investigation, analysis and summary of students' phonetic errors in the teaching process, and puts forward some phonetic teaching skills and strategies suitable for students in Portuguese-speaking countries. This is also a rare and targeted academic paper on Chinese phonetics teaching in Portuguese-speaking countries in recent years. Tone training in the initial stage of teaching Chinese as a foreign language can be said to be very important. Unfortunately, this paper ignores its importance and the research on the primary factor "tone" in the formation of Chinese pronunciation is slightly insufficient.

Rong proposed doctoral thesis "The Listening Pattern of Mandarin Tones" that "Putonghua tones were taken as the research object, and the parameters such as the location of the recognition boundary, the width of the boundary, the maximum recognition rate, the perceptual category, the peak value of discrimination and the reaction time were analyzed through the recognition experiment and the discrimination experiment. The experiments involved in this paper include the listening experiment of different durations between the four tones of Putonghua and real words. On the results of the tone experiment, this paper summarizes and analyzes the

listening category of the four tones. It also makes a preliminary analysis of the listening categories of various tones in Mandarin Chinese, thus summarizing the listening pattern of tones in Mandarin Chinese. " [5] However, although this paper makes a very detailed professional analysis of tones, it is partial to theoretical research and has a certain distance from operation. There is no targeted correction and strategy for the problems that actually occur in students' study.

There is an obvious shortage of research monographs on pronunciation teaching in Portuguese-speaking countries, especially the research on mastering the key elements of Chinese pronunciation is quite weak. Based on the above representative papers, this paper discusses how to make Chinese learners in Portuguese-speaking countries master and use the pronunciation-tone of spoken Chinese better and faster.*2.3.2.Tone teaching for beginners of Chinese.*Tone teaching is the focus of beginners' oral Chinese, and it is also the key to the formation of Chinese learners' oral appearance [6]. A Chinese character is a syllable, and each syllable is composed of three parts: tone, initial and final, which are also the three elements of phonetic teaching. However, tone teaching is the basis for the formation of phonetic features. For students in Portuguese-speaking countries who are learning Chinese from scratch, the most worrying thing is that their tone is inaccurate. Chinese is a melodic tonal language. The tones of spoken Mandarin Chinese are "level tone, rising tone, curved upper tone and falling tone", and the four tones plus a "light tone" must be taken into account. Only by mastering the tone level and length of each Chinese character accurately can we correct the phonetic image when speaking. For students from Portuguese-speaking countries who are not in tonal language, it is really not easy to master Chinese tones that have a strong sense of melody when reading. The initials and finals of Chinese are relatively easy for students in Portuguese-speaking countries who use pinyin. How to make students in Portuguese-speaking countries master the tones of Mandarin as soon as possible and lay a solid foundation for learning spoken Chinese, Based on the tone teaching of the first-year Chinese phonetics course in Leiria Institute of Technology, Portugal, this paper analyzes and summarizes the actual teaching, taking it as a case for teaching Chinese as a foreign language in the future.*2.3.2.1. Overcome the interference of mother tongue and establish a correct tone image of Putonghua.* At first, one of the problems in the teaching of Chinese phonetics in the first year of Leiria Institute of Technology in Portugal is how to make students master the tones of Mandarin as soon as possible without interference from their mother tongue. Tone is the melody of speech, just like Dorimi Fasolasi in music. If the tone is not accurate at first, the pronunciation will not be correct in the future. Moreover, once students form a solidified misreading pattern, it is difficult to correct the foreign accent. Therefore, for students in Portuguese-speaking countries who are new to Chinese, tone is the facade of their pronunciation, so they must lay a solid foundation so that their future speech will not be out of tune. Because Portuguese only has the difference in tone and intonation due to different emotions or attitudes, as well as the difference in the strength of sentences and the speed of speech, unlike Chinese, which has obvious changes in tone, people whose mother tongue is Chinese listen to Portuguese speakers speak their mother tongue, and feel that the language flow seems to be only the level of Mandarin, and the phonetic image sounds a bit like boiling

water, which seems to be a pattern of rapid and slow repeated scrolling. Cui Gang, a linguist, once said in the book neurolinguistics: When people whose native language is tonal language hear rapidly changing tones that match the tones of their mother tongue, the metabolic activity of the frontal insula of their left hemisphere will be much larger than that of the temporal lobe, which used to be responsible for phoneme processing. However, when they hear a rapidly changing tone that doesn't match the tone of their mother tongue, their left frontal lobe insula will not show an increase in metabolic activity. [7]

Portuguese does not have a completely rising level corresponding to Mandarin; Suppress first and then raise to relieve the curved upper voice. The phonemes of Chinese and Portuguese are not equal, so students in Portuguese-speaking countries will be confused by their mother tongue when they first learn Chinese, such as rising tone, curved rising tone and falling tone. However, words with rising tone and falling tone can be correctly pronounced naturally. This phenomenon often occurs when the students in the first-year class.

When learning tones at first, students will have misreading in two different stages. In the first stage, it is easy to unify the words that read rising tone, curved rising tone and falling tone into the level tone.

Table 1. The first stage of misreading as 1 from 2,3,4,tone phenomenon.

1(Misread as)	2 (Correct tone)	3 (Correct tone)	4 (Correct tone)
"汪"(wāng)[55]	"王"(wáng)[35]		
"窝"(wō)[55]		"我"(wǒ)[214]	
"商"(shāng)[55]			"上"(shàng)[51]

 For example, see table1. This phenomenon of regular pronunciation shift is mainly because their mother tongue does not have a tone completely corresponding to Chinese, so they will naturally be drawn to phonemes similar to their mother tongue. The misreading phenomenon in the second stage is that when the pitches of the four tones of a monosyllable are basically different, there will be irregular tone dislocation when reading words and connecting sentences.

Table 5. The second stage of misreading as 1,2,3,4 from 3,1,4,tone phenomenon.

1[55]	2 [35]	3 [214]	4 [51]
1(Misread as)	2 (Misread as)	3 (**Correct tone**)	
"捞"(lāo)[55]	"劳"(láo)[35]	"老"(lǎo)[214]	
1(**Correct tone**)		3(Misread as)	4(Misread as)
"师"（shī）[55]		"使"（shǐ）[214]	"是"（shì）[51]
1 (Misread as)	2 (Misread as)		4 (**Correct tone**)
"憨"(hān)[55]	"韓"(hán)[35]		"漢"(hàn）[51]
	2 (Misread as)	3(**Correct tone**)	4 (Misread as)
	"魚"(yú)[35]	"語"(yǔ)[214]	"玉"(yù)[51]

For example see table 2. The main reasons for these tone misreading in the flow of words or sentences are as follows: First, students have not formed a stable concept of tone pitch in their minds. Second, the practice of words with the same or different tones is not in place, resulting in dislocation and misreading. [8] For foreigners who are just beginning to learn Chinese, tone learning is the initial stage of pronunciation, which must be expanded step by step, from easy to difficult, firmly and steadily, and lay a solid foundation, and must not be impatient and quick. When practicing tones, we can mobilize the "motor language center" [9] to inspire students to use body language, especially gestures to indicate the direction of pitch and read tones at the same time (see Figure 1 "Putonghua Tone Map"), which is the most effective way to correct and stabilize tones. If the students make mistakes, they will correct them with reading and gestures. For beginners of Mandarin Chinese, intonation reading is a tool for every student to learn to use and master intonation, and it is the best helper to master accurate intonation. For learners who start from scratch, teachers should lead students to read tones with sign language together every day until students form a solid pitch pattern and can skillfully and accurately use tones by themselves. For individual words that are often habitually mispronounced, we must read four tones with sign language repeatedly, and find out the correct tone of the corresponding word in the process of reading, so that we can master the tone of that word naturally by repeating it several times. Follow the rules of linguistics [10] and repeat it for more than 30 times, so that it is possible to stabilize the memory. When practicing intonation, in addition to the practice of using four different tones of "Ma, Ma, Ma and Ma" to distinguish the pitch and different meanings, we can further strengthen intonation practice with several groups of words with different tones that are more vivid and sensible.

Table 3. Strengthening Tone Memory with Words with Sensible Images.

1Tone[55]	2Tone[35]	3Tone[214]	4Tone[51]
花(huā)=flowers	魚(yú) =fish	水(shuǐ)=water	跳(tiào) =jump
山 (shān)=mountain	雲(yún) =cloud	雨(yǔ)=rain	樹(shù)=tree
雞(jī)=chicken	羊(yáng) =sheep	狗(gǒu) =dog	叫(jiào)=barking
聽(tīng)=listening	讀(dú)=reading	寫(xiě)=writing	問(wèn)=asking

For example see table 3. When reading "flowers" above, use your hands to indicate that the flat and wide land is full of flowers. When reading "fish", use your hand to signal the fish to jump out of the water. When reading "water", signal the fish to jump into the water and jump out of the water. When reading "jump", do the athlete's diving. "Mountain, cloud, rain, tree" and "chicken, sheep, dog and barking" can also be used as the same vivid metaphors. There are also the words "listen, read, write and ask" that students will encounter every day. When reading the tune, sign language can be used to signal students to listen, read, write and ask. You can also practice by inserting words in disorder, so as to master the tone skillfully. These things that are easy to evoke association [11] will make students subtly deepen their memory of tone

images, and at the same time produce relevant associations to remember tones. Students can also practice intonation with their own and classmates' Chinese names to deepen their impression of intonation. Doing so can easily arouse students' initiative to practice intonation, because they don't like to mispronounce their Chinese names. In the process of memorizing, you can strengthen your memory with body language, so that the pitch contrast of tones can be gradually stabilized in your mind. After mastering the intonation of monosyllabic words, we will make a transition from disyllabic words to phrases and then to sentence and paragraphs, so as to ensure continuous expansion and steady progress on the basis of accuracy. In addition, combined with listening discrimination and calibration, synchronous practice is also a more effective means of strengthening.Figure 1 Schematic Diagram of Tone Reading in Putonghua.
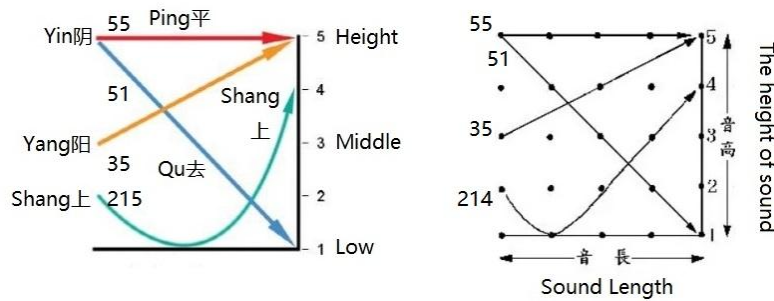

Fig. 1. (a) first picture is colored; (b) second picture is black and white.Four tones with [55,35,214,51].

2.3.2.2.On the sound word and its tone sandhi teaching [12].These tone sandhi patterns are basically regular. There are two main ways to pronounce the upper tone: the complete upper tone and the semi-upper tone.After the basic pronunciation of the upper tone is correct, let's talk about the tone sandhi of the upper tone.Tone sandhi on tone sandhi is as follows: (1) The first syllable of the two syllables becomes flat:(33 reading 23). (2) When the three syllables are read together, if the meaning of the first two syllables is closely combined, then both syllables will become flat: (333 reading 223). (3) When three syllables are read together, if the meaning and meaning of the next two syllables are closely combined, the second syllables will become flat: (333 reading 323).When that upper sound word is read continuously,if the meaning of the word is close, it will be pronounced as rising tone.For example see table 4.

Table 4. Three groups of examples for 3[214]

(1) 3[214] as 33 reading 23	(2) 3[214] as 333 reading 223	(3) 3[214] as 333 reading 323
管理(guǎnlǐ)	洗脸水(xǐliǎn shuǐ)	打雨伞(dǎ yǔsǎn)
=management	=face washing water	=with an umbrella
雨伞(yǔsǎn)	管理好(guǎnlǐ hǎo)	好管理 (hǎo guǎnlǐ)
=umbrella	=management good	=good management

If you encounter a sentence that is all consonants, segment it according to the relationship and compactness of the combination of words and meanings.Then tone sandhi in turn according to the above formula that use numbers to identify four tones.

2.3.2.3. The intonation of "one" and "no" and the teaching of tone sandhi. When beginners learn Chinese, they will encounter this problem when they read the tones of "one" and "no", and students don't know when and what tone to read. In addition to explaining that the original tone of "one" is level tone, the original tone of "no" is voiced. It should also be emphasized that the tone sandhi of "one" and "no" depends on the tone of the words following "one" and "no".The pronunciation and tone of them are as follows: (1) The pronunciation and tone sandhi of "one".(2) The pronunciation and tone sandhi of "no or bu". (3) Three fonts, the "one" and "no" sandwiched in the middle are generally read softly.For example see table 5.

Table 5. The tone sandhi of "one" and "no" depends on the tone of the words following.

(1) "一" = one or yi；（2）"不" = no or bu；（3）"一" and "不"
一样 (yíyang)=the same, 一定 (yíding)=certain, 一问 (yíwèn)=one question
一般 (yì ban)=general, 一同 (yìtóng)=together, 一碗 (yì wan)=a bowl
不用 (bú yê ng)=don't use, 不去 (bú qê)=don't go, 不问(búwèn)=don't ask
听一听(ting yi ting)=listen,读一读(dúyi dú)=read
说不说(shuo bu shuo)=say or not,来不来(lái bu lái)=come or not

3   Result and Conclusion

The result is that, the advantages and disadvantages of the three aspects were found,and is that, it is found that the new ideas and new methods of Smart System Studied combined with interpersonal interaction and man-machine mutual assistance are also suitable for the teaching strategies of tonal misreading for zero-start Chinese learners in Portuguese-speaking countries. In particular, it can form a reasonable division of labor and complementary advantages between teachers and students, students and man-machine, and even highly assist and optimize interaction.

This paper is based on the author's effective teaching correction strategies in the classroom teaching of Chinese phonetics as a foreign language, aiming at the misreading phenomenon of students in Portuguese-speaking countries when learning the tones of spoken Chinese Putonghua. The author thinks that the tone teaching of Putonghua in teaching Chinese as a foreign language is the basis and focus of the formation of spoken Chinese, and it is also the key to whether the learners of Chinese will have a correct oral appearance in the future. Therefore, it is necessary for teachers to understand the phonetic characteristics of students' mother tongue in teaching, and make a comparative analysis with Chinese pronunciation to find out their similarities and differences, so as to teach more pertinently.

This quaternary relation covers four groups of monosyllabic Chinese characters with different tones. Therefore, for the time being, the functional relationship between

the two sets of arithmetic numbers (decimal or binary) and prime numbers (P-base) called Chinese characters can be found in the monograph of the correspondent.

$$w（55a）+x（35b）+y（214c）+z（51d）= 0 \qquad (1)$$

This paper holds that it is an effective method to guide students to read intonation correctly by using "intonation method", and it is also the best means to prevent students from being influenced by their mother tongue and correcting intonation misreading. In view of this, the focus of this paper is how to make students in Portuguese-speaking countries learn tones effectively and lay a good foundation for learning Mandarin, so as to master spoken Chinese comprehensively in the future and realize the purpose of communicating with standard Mandarin. This paper is just a review and summary of tone teaching in Chinese phonetics course for students from Portuguese-speaking countries who have just started learning Chinese from scratch. In the future, it is necessary to further explore the higher-level Chinese learners in Portuguese-speaking countries and make a more in-depth study of their pronunciation teaching in order to have a more comprehensive view of Chinese teaching for students in Portuguese-speaking countries.

Its significance lies in: firstly, it highlights the characteristics of the times of man-machine mutual assistance, and then clarifies the necessity and importance of optimizing the phonetic teaching of Chinese as a foreign language from the perspective of data science. Finally, it makes the academic and industry, especially the teaching of Chinese as a foreign language, understand the truth that the era of big data and artificial intelligence will inevitably significantly change all aspects of teaching Chinese as a foreign language and even the whole education and teaching.

Its core is: higher requirements are put forward for human teachers, specifically, teaching practice, teaching research and scientific research must be balanced, and at the same time, data science should be mastered as much as possible to keep pace with the development of big data and AI (man-machine mutual assistance), so as to optimize the phonetic teaching of Chinese as a foreign language and even the whole process of education (not just specific discrete strategies of teaching). It is particularly noteworthy that the big data processing technology based on machine learning and deep learning, the new generation of AI and even the general artificial intelligence, such as GPT+ and LLM+, and the application of data science principles behind them have a great impact on natural language understanding, especially on the acquisition, expression and reuse of expert knowledge, and on AI-assisted teaching.[13-16]This paper mainly raises a series of questions.

Acknowledgements

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Appendix:

Learning Chinese tones is a challenging task for students in Portuguese-speaking countries. However, through effective learning methods and practice, they can overcome these difficulties and establish a correct concept of Mandarin tones. The following are some suggestions that can help students in Portuguese-speaking countries avoid the influence of their mother tongue and improve their tone accuracy:

1. Learning listening: Listening training is the key to establishing a correct concept of tone. Students should try to listen to the Chinese pronunciation of native speakers and imitate their tone contours and tone changes. Listen more and imitate more, and gradually get familiar with the tone characteristics of Chinese.

2. Comparative learning: Compare the pronunciation of Chinese tones with that of Portuguese, and find the differences between the two languages. This can help students realize the influence of their mother tongue on tone, so as to better adjust their pronunciation.

3. Mouth exercises: By imitating correct Chinese mouth gestures and mouth movements, students can better produce correct tones. This includes training in opening your mouth, the position and strength of your tongue.

4. Deliberate practice: Conduct deliberate tone practice on a regular basis, practice for different tones, and observe and compare the differences between your own pronunciation and standard pronunciation. This kind of repeated practice and feedback can help students gradually improve the accuracy of tone.

5. Cooperative learning: Learn spoken Chinese with other students or native speakers, and make mutual correction and feedback. This kind of cooperative learning can provide more different listening and pronunciation models and help students understand and master Chinese tones more comprehensively.

To sum up, through listening, imitation, comparison, oral training and cooperative learning, students in Portuguese-speaking countries can effectively overcome the interference of their mother tongue, establish a correct concept of Mandarin tones, and improve their oral Chinese ability.