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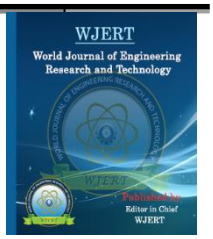

VISUAL RECOGNITION OF ORACLE BONE SCRIPT AND SIMPLIFIED CHARACTERS: ASSESSING THE IMPACT OF CHINESE READING AND WRITING SKILLS AMONG THE ETHNIC CHINESE STUDENTS IN MALAYSIA

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ABSTRACT

Facing the varied proficiency levels in Simplified Character reading and writing among Ethnic Chinese student in Malaysia, as well as the potential of Oracle Bone Script in aiding Simplified Character learning, this study draws upon Visual Recognition Theory and Peirce Semiotic Theory to conduct a quantitative analysis of the Chinese reading and writing abilities of 391 students across four private universities in Malaysia, and their relationship with the ability to visually recognize Oracle Bone Script. The objective is to determine whether their reading and writing abilities are associated with the capacity to visually recognize Oracle Bone Script. Through discussing the reading and writing abilities of Ethnic Chinese students, significant disparities between reading and writing abilities in Simplified Character were highlighted. Given Malaysia's robust Chinese education system and the frequent use of Chinese language in daily life, the majority of students demonstrated strong reading capabilities, yet far fewer exhibited a high level of writing proficiency. This discrepancy underscores the challenges in writing Chinese, as learners show insensitivity to the structural composition of characters. Furthermore, the study revealed a general difficulty among students in intuitively recognizing the similarities between Oracle Bone Script and Simplified Character, suggesting a divergence in character structure over time, as well as the abstract nature of Simplified Character. However, the research found a correlation between Simplified

Character reading and writing abilities and visual recognition capabilities, indicating that enhancing visual recognition skills could aid in learning Simplified Character. Future research might further explore the application of Oracle Bone Script imagery in Simplified character training.

KEYWORDS: *Chinese reading and writing ability, visual recognition, oracle bone script, Chinese education.*

INTRODUCTION

Simplified Characters (hereafter referred to as SC) are considered one of the most challenging scripts to learn worldwide (Qiang et al., 2020; Chai, 2022). Their visual complexity makes it difficult for learners to recognize (Tian, 2021; Li et al., 2019), and their complexity in form, strokes, and structure complicates reading and writing (Chang et al., 2022). In a study by Nkrumah & Asamoah (2022), over 80% of participants reported difficulty in recognizing SC, with reading and writing being considered more challenging than speaking and understanding the language. This is especially pronounced in regions where Chinese is not the first language, such as Malaysia (Chang et al., 2022), where SC are not only the standard written form but also represent the status of Chinese as a lingua franca in Chinese communities (Ong, 2020). However, some learners still struggle with reading and writing SC despite years of learning the language (Chuen & Yusof, 2021). In research by Chua et al. (2022), 76% of students stated they required more time and effort to learn SC. Among learners, 73% strongly agreed that differentiating between SC shapes is challenging. The root cause of this phenomenon lies in the difference between SC, comprised of many pictorial units containing more visual information, and phonetically dominated English words (Yang & Qiao, 2021). Wu (2022) posits that SC have a complex internal spatial structure involving multiple structural levels, combinations, and radical functions. This complexity may necessitate more visual cognitive resources for processing, requiring a more complex visual recognition mechanism in the user's mind.

Thus, learning to read and write SC heavily relies on the learner's visual recognition abilities, as SC represent a myriad of visual patterns. Studies continue to suggest that incorporating oracle bone script (hereafter referred to as OBS) imagery, being pictographic, into SC learning could bridge this gap (Zhang, 2023; Wang, 2023; Fu, 2022). Gao et al. (2022) noted that SC evolved from OBS, sharing a degree of visual resemblance. Okoye et al. (2022) suggested that using pictographic images to supplement learners' imagination of SC meanings

is beneficial. Xu et al. (2021) argued that constructing visual models could enhance learners' SC writing skills. OBS, as a pictographic script, acts as a bridge between abstract SC and their meanings (Yin, 2022). Rai & Li (2021) posited that regardless of their complexity, SC are always a form of painting. The ability for visual decoding plays a more significant role in Chinese reading, with OBS providing the quickest visual association with the characters (Liu et al., 2022). Despite the visual complexity of OBS increasing over time, and its correspondence with SC not always being visually apparent (Chen, 2022), Egorova & Еропов (2021) found that the complexity of recognizing individual OBS symbols may decrease as the writing system becomes more intricate. Lin (2020) observed that changes in the shape of OBS symbols have made them more challenging to recognize visually in relation to SC. Although the visual recognition correspondence between OBS and SC is complex, there is still reason to advocate for OBS as a tool for learning SC, both theoretically and practically. Theoretically, previous studies have primarily focused on analyzing the differences between OBS and SC. However, since the primary users of OBS are SC learners, it is essential to carefully examine how learners at different levels differ in their visual recognition of OBS and SC. Practically, OBS has become a popular tool in SC learning, with its derivatives achieving success in educational practices.

Therefore, this study aims to measure the extent of visual recognition between OBS and SC among Chinese students in Malaysia and explore the relationship between reading and writing abilities and visual recognition.

Chinese Proficiency and Influencing Factors Among the Ethnic Chinese in Malaysia

Previous studies have explored the current state of Chinese language proficiency among the Ethnic Chinese in Malaysia, focusing on the relationship between the four aspects of listening, speaking, reading, and writing, and the factors influencing these abilities. While some research has outlined the status of Chinese proficiency among students (Lam & Kuan, 2019; Fang, 2022), there remains a lack of sufficient data specifically addressing reading and writing abilities. On the other hand, various studies have identified factors influencing Chinese proficiency, although these factors are important for enhancing learners' Chinese skills, this evidence primarily focuses on external influencing factors from the learners' environment, not the object of study, namely the characteristics of Simplified Chinese characters. Hoon et al. (2022) investigated the relationship between vocabulary, reading, and writing abilities of students and their learning strategies, finding that higher-ability learners

employed more thinking strategies, while lower-ability learners tended towards memorization. Chuah et al. (2022) assessed the learning capabilities of students learning Chinese as a second language and found a significant relationship between the Motivational Self System and listening skills performance. Ling et al. (2019) examined the role of learning tools in Chinese language acquisition, noting that e-learning was most beneficial for improving speaking skills (M=4.38), followed by reading (M=4.20), writing (M=3.95), and listening comprehension (M=3.75). Yang et al. (2023) studied the impact of language cognitive skills on Chinese reading, indicating that inference and comprehension monitoring directly aid in reading comprehension, while language skills and working memory indirectly contribute through higher cognitive skills.

The researcher believes that, in terms of SC, their complex and abstract graphical features impact learners' recognition and memorization, with reading and writing abilities reflecting the learners' cognitive understanding and processing of these graphical elements (Landerl et al. 2021). Recent research suggests that reading involves not only perceiving and interpreting text but also processing all visual stimuli perceived by the brain, with this visual information aiding in processing the logic within the text (Batur et al. 2019). Additionally, in the writing process of SC, the writer's control over the spatial positioning of visual or graphical information within the characters requires stronger visual cognitive abilities. Visual processing in the writing and reading systems of SC is equally important (Tso, 2021). Therefore, analyzing the relationship between learners' reading and writing abilities and their visual recognition skills is crucial.

Research of Visual Recognition Theory and Peirce's Theory in Oracle Bone Script and Simplified Characters

In recent years, the application of Visual Recognition Theory and Peirce's Theory has garnered widespread attention in academia. Visual Recognition Theory focuses on how visual information is processed and interpreted, suggesting that people can recognize thousands of object categories in an incredibly short time, discerning images based on similarity without needing to resort to abstract semantic interpretation (Mehrpour et al., 2021). Existing studies have mainly concentrated on understanding how human's express things and phenomena visually by comparing and analyzing OBS and SC (Wang et al., 2022; Han, et al., 2022; Zhuo & Zhang, 2024). Research indicates that, like SC, spatial arrangements in OBS imagery play a crucial role in conveying meaning (Jiao, et al., 2021), suggesting that a more systematic and

efficient application of OBS in learning SC could address barriers faced by learners. Peirce's theory, on the other hand, offers a triadic framework for understanding visual symbols: the "representamen - object - interpretant" system (Barham & Everett, 2021). This framework easily explains how visual symbols function, as Peirce's interpretation of sign relations is fundamentally visual (Senivongse & Bennet, 2022). In the context of OBS and SC, the representamen refers to the form of OBS, the object represents the SC referred to by OBS, and the interpretant is the ideological meaning created by literate readers (Lisha, 2023; Jin, 2021; Yin, 2021). This offers a robust theoretical framework for understanding the complex relationship between OBS and SC, facilitating a better comprehension of the relationship between the form and meaning of OBS. Peirce further divides the representamen into "icon", "index", and "symbol" (Stjernfelt, 2019; Zhao, 2022), with the iconicity, indexicality, and conventionality in OBS imagery corresponding to these categories (Fang, 2014; Hu & Kluensuwan, 2023).

Current research mainly focuses on the individual application of these two theories. Visual Recognition Theory has been employed to analyze the visual processing of OBS and SC, primarily in the areas of image recognition and image processing technology (Fu et al., 2022; Rai & Li, 2021; Chen et al., 2022; Yue et al., 2022). Previous literature reveals that while technological advancements have efficiently facilitated the interpretation of OBS through digital means, data on visual recognition of OBS and SC by the human eye in education remains lacking. On the other hand, Peirce's theory has been used to explain the semiotic nature of OBS, with different properties being explored in SC education and graphic design (Liu & Wang, 2023; Meng, 2023; Yin, 2021; Weng et al., 2021). Researchers have found that graphic design and educational methods combined are being used in SC learning, particularly in utilizing the pictographic nature of OBS to stimulate children’s sensory experiences and enhance learning effectiveness. However, there is a lack of actual data analysis on the acceptance level of learners with different abilities.

These studies provide important insights into the connection between the form and meaning of OBS, as well as the cultural and historical background of SC. However, despite the valuable information provided by existing research, they often fail to combine Visual Recognition Theory and Peirce's Theory, lacking a comprehensive consideration of their interaction and complementary nature in studies on human visual recognition and understanding.

Oracle Bone Script and Simplified Characters in Malaysia Education

Current research predominantly focuses on integrating OBS into the teaching and practice of SC. Studies begin by analyzing the typographic differences between OBS and SC, aiming to enhance SC learning through design (Zou & Fang, 2023). Zhao et al. (2020) designed a Virtual Teaching Machine System for OBS, using dynamic descriptions of SC structures. This interactive teaching software, by dynamically deconstructing and displaying complex OBS structures, has heightened learner engagement. Wang (2021) conducted a qualitative study with 30 children, finding that OBS teaching shifted learners' perspectives and thinking about SC, cultivating their abilities to observe, generalize, and compare, thereby fostering cognitive development in SC. Despite the assistance provided by OBS imagery in learning SC, its practical application faces several challenges.

Firstly, the visual structural and symbolic differences between OBS and SC present recognition challenges for learners. Jia (2022) found that differences in the writing direction of the OBS for "手" led to changes in meaning, potentially causing misunderstandings. Although some studies indicate that OBS can enhance students' understanding of the cultural background of SC, this method might increase cognitive load in practice (Chen, 2021; Wang et al., 2023; Yang & Cao, 2023). Secondly, the primary users of OBS in education are SC learners, and current research often lacks consideration of the applicability of OBS teaching methods across different learners. Studies by Xu (2020) and Guo (2019) provided suggestions for the application of OBS in school education but did not address strategies for students with varying learning abilities. Wang (2016) stratified learners by age and categorized OBS for teaching different age groups. While this addressed a research gap, her categorization was not based on learners' abilities or levels of acceptance. Whether this effective categorization method is also applicable to learners from different language backgrounds remains to be researched. Therefore, researchers believe it is essential to carefully study how learners at different levels differ in their visual recognition of OBS and SC. Lastly, previous studies on OBS and SC often remain theoretical. Guo (2021) studied the structure of demonstrative characters in OBS based on Chinese character etymology, while Chen (2023) explored the narrative creation of OBS in SC teaching, supported by context theory. These studies lack empirical support and fail to analyze from a visual theory perspective. Most importantly, research on the application of OBS in SC teaching has mainly focused on studies and practices in Mainland China, leaving a gap in understanding its effectiveness for the Chinese community in Malaysia.

Based on the discussions, this study aims to address three primary questions:

1. What is the level of visual recognition between OBS and SC among the ethnic Chinese students in Malaysia?
2. What is the level of reading and writing abilities on SC among the ethnic Chinese students in Malaysia?
3. What is the relationship between SC reading and writing abilities and OBS visual recognition?

The objectives of this study are as follows:

1) To examine the level of visual recognition between OBS and SC among the ethnic Chinese students in Malaysia.
2) To examine the level of reading and writing abilities on SC among the ethnic Chinese students in Malaysia.
3) To determine the relationship between SC reading and writing abilities and OBS visual recognition?

The Current Study

The present research tested three variables and their interrelationships: "Chinese reading ability" as Independent Variable 1, "Chinese writing ability" as Independent Variable 2, and "the level of visual recognition between OBS and SC" as the Dependent Variable. In the testing phase, the types and number of SC included in this study were selected from the "Standards for Language and Script Regulation and International Chinese Education Chinese Proficiency Grading Standards (GF0025-2021)" issued by the Center for Language Education and Cooperation of the People's Republic of China on March 24, 2021. These Standards, emanating from a Chinese government background, possess considerable authority and inclusivity, focusing on effective alignment with internationally recognized language standards (Liu, 2021).

In the survey, excluding one SC used as an example, the remaining 35 SC were distributed across the three aspects of the survey: 10 for Chinese reading ability, 10 for Chinese writing ability, and 15 for visual recognition. Notably, for the test samples of OBS and SC, 15 SC were randomly selected from the SC database to correspond with OBS. Two images as a set were used to form the test samples for "Original OBS to SC," evaluating the level of recognition between OBS and SC. All SC forms used regular script as the standard font, as it is the standard font for writing in China and has been in use for approximately 1800 years

(Feng, 2021). This methodological approach provides a comprehensive assessment of the participants' abilities in reading and writing SC, as well as their proficiency in visually recognizing the relationship between OBS and SC. By using a well-established standard in Chinese language education, the study ensures that the findings are relevant and applicable to current educational practices and standards.

For Independent Variable 1, the "Chinese Reading Ability" section utilized a selective pairing format, matching SC and Pinyin. The ten SC and their Pinyin equivalents were provided, and the tester was asked to match them. The results of the pairings were recorded. These SC are shown in the table below.

Table 1: Chinese Reading Ability (SC-Simplified Character; PY-PinYin).

No.	1	2	3	4	5	6	7	8	9	10
SC	网	行	日	月	雨	用	也	要	气	朋
PY	wǎng	xíng	rì	yuè	yǔ	yòng	yě	yào	qì	péng

For Independent Variable 2, the "Chinese Writing Ability" section employed handwritten SC to fill in the blanks for the phrases provided. The test taker was presented with a set of fragmented SC words, the fragmented parts of which were annotated in Pinyin, and was asked to enter the corresponding SC by hand according to the prompts. As one Pinyin character corresponds to more than one SC, the prompts in the questions were only used as a reference to determine the range and did not induce any results in the test. In this section, ten simplified characters were tested. These SC are shown in the table below.

Table 2: Chinese writing ability (SC-Simplified Character; P-Phrase).

No.	1	2	3	4	5	6	7	8	9	10
SC	坐	子	衣	页	小	文	身	山	肉	人
P	坐下	桌子	衣服	页码	小孩	文化	身体	山川	牛肉	人民

For Dependent Variable, the " the level of visual recognition between OBS and SC " section addressed a test by visual way. For the test samples of OBS and SC, during this section, 15 SC were selected by random sampling from the SC database to correspond with OBS. Two pictures were used as a group to form a test sample of "the Original OBS-SC " which tested the level of recognition between them. All SC forms used the regular script as a standard font because the regular script is the standard font for Chinese writing, and this standard has been

used in China for about 1800 years (Feng, 2021). These samples are shown in the table below.

Table 3: The Level of Recognition in Simplified Character and Oracle bone Scripts (SC- Simplified Character; OBS- Oracle bone Scripts).

No.	SC	OBS
1	能	
2	面	
3	米	
4	京	
5	介	
6	候	
7	高	
8	干	
9	方	
10	弟	
11	出	
12	车	
13	午	
14	不	
15	八	

It is important to note that, all the samples of OBS in this section were taken from the "XiaoXue Oracle Database" platform. The OBS collection in this platform is based on the facsimile characters included in the book "Oracle dictionary," published by the Chung Hwa Book Publish in 1965 and compiled by The Institute of Archaeology CASS. They scanned, traced, and computerized to create the characters. It consolidates 40 types of publications monographs about oracle bone script images, which is a very comprehensive and authoritative model. A total of 24,701 oracle bone scripts are currently included (as of

October 2022) on this platform. A detailed search is available for the volume in which the OBS are located, the part of OBS, collection numbers, old records, and class groups (Institute of History and Philology, Academia Sinica, 2023).

METHODS

Sample

This study involved a group of participants among ethnic Chinese students from private universities in Klang Valley, Malaysia, such as Taylor's University, UCSI University, Management & Science University, and Sunway University. According to the statistics, the number of students in PHELs in Malaysia reached 537434 in 2020 (Nazurah, 2021). This research will collect as convenience sampling form top 4 private universities in Kiang Velly, Malaysia. This is because in the samples tested, everyone was in the same situation. Even though it is not possible for every single person to be the same, but the differences that are present do not affect the results of the test.

In this survey questionnaire, the student population in private universities in Klang Valley exceeded half a million. The researcher established a 5% confidence interval, meaning that 95% of respondents were considered effective. A total of 384 participants were included based on sample size calculations (Sample Size Calculator, 2023). However, the study invited 391 participants, considering that 9-10% of the responses might be deemed ineffective, such as incomplete responses. As a reference, the effective response rate was adjusted to 96%.

The selected population of ethnic Chinese students from private universities in Klang Valley provided a suitable sample for this study. By analyzing their understanding of OBS, the research aimed to generate insights that could contribute to the development of relevant strategies and decision-making processes. The use of an online questionnaire as the primary data collection method allowed for the efficient gathering of information, enabling the researcher to draw meaningful conclusions and make informed recommendations.

Variables

X1: The Chinese Reading Ability

For efficient statistical analysis of the variables, the researchers designed 10 questions in this section, employing a matching format. Participants were tasked with matching ten SC with their corresponding Pinyin. Each SC was paired with one specific Pinyin.

This format of the questionnaire allows for a straightforward and objective assessment of reading ability. Each correctly matched pair of SC and Pinyin was assigned a score of 1 point. Thus, the more points a participant scored, the stronger their reading ability was indicated to be. This scoring system provides a quantifiable measure of the participants' proficiency in reading SC, a crucial aspect of Chinese literacy.

The use of Pinyin as a matching element helps in evaluating the participants' ability to connect the phonetic and visual aspects of the Chinese language, an essential skill in reading Chinese effectively. This approach also ensures that the assessment is accessible and understandable to a broad range of learners, including those who may be more proficient in spoken Chinese than in written form.

In terms of the classification of Chinese reading ability. The researcher grouped the data after the questionnaire was summed according to a certain proportion, where the criterion used to differentiate between high and low groups was the 25% pre-post ratio. The 25% scale was chosen because, on the one hand, it is normally distributed and, on the other hand, a lower scale makes it easier to see differences (Yan & Zheng, 2022). The researcher first determined the number of high and low subgroups. In this study, a total of 391 participants completed the Chinese reading ability test, and using the 25% criterion, it was calculated that 391*25% = 97.75, which should be rounded up to 98. This means that the number of high and low subgroups was 98.

The researcher then ranked the cases in terms of total score and determined a threshold of 10 for the high group and 8 for the low group, which was collated to produce the table below.

Table 4: The Level of Chinese Reading Ability.

Interval	Level
0-8	Low ability
9	Normal ability
10	High ability

Based on the scoring criteria outlined in Table 4 for assessing Chinese reading ability, participants' proficiency is categorized into three distinct levels:

Low Ability: This category is for participants who score between 0 to 8 points. Scores in this range indicate a basic to moderate level of proficiency in reading simplified Chinese

characters. Participants in this category may have difficulty recognizing some characters or associating them correctly with their Pinyin.

Normal Ability: A score of 9 points places participants in this category. This suggests a competent level of proficiency, where the participant can correctly identify and match most of the simplified characters with their Pinyin. However, there may still be room for improvement in recognizing more complex characters or less commonly used ones.

High Ability: Participants scoring the maximum of 10 points are categorized as having high ability. This indicates a strong proficiency in reading simplified Chinese characters, with the ability to accurately recognize and match all the characters presented in the test with their corresponding Pinyin.

To analyze the participants' Chinese reading abilities, the distribution of scores across these categories can be examined.

Table 5: Data of The Level of Chinese Reading Ability.

Score	Scale	N	Frequency	Percent (%)
0	Low Ability	104	0	0
1			15	3.8
2			10	2.6
3			12	3.1
4			9	2.3
5			6	1.5
6			9	2.3
7			4	1
8			39	10
9	Normal Ability	8	8	2
10	High Ability	279	279	71.4
Total	391	391	391	100

The analysis of the dataset reveals insightful information about the Chinese reading abilities of the participants:

Firstly, a significant majority of the participants (71.4%, or 279 individuals) were classified in the "High ability" category, indicating they answered all questions correctly. This high percentage suggests a strong proficiency in reading Chinese among a large portion of the study's participants. Secondly, the "Low ability" category comprised 27.6% of the participants, amounting to 104 individuals. Within this group, scores varied from 0% to 10%, but it is notable that 10% of the participants (39 individuals) scored an 8-point. Interestingly,

no participant scored 0-point, indicating at least some basic level of Chinese reading ability across all participants. Finally, the "Normal ability" category had the fewest participants, with only 2% (or 8 individuals) falling into this group.

X2: The Chinese Writing Ability

As part of "Chinese writing ability", The participant was presented with 10 sets of mutilated Chinese phrases in which the tested SC was missing and prompted by Pinyin in place of the missing part. The participant could guess the missing SC based on the Pinyin and the phrases from their mastery of Chinese language skills, and then record their answers in handwritten input. Each correctly guessed character was awarded 1 point. A higher total score implies a stronger writing ability, enabling a quantitative assessment of each participant's proficiency in writing SC.

On the other hand, the procedure and criteria for classifying Chinese writing ability are the same as those for Chinese reading ability. The researcher grouped the data after summing the questionnaires according to certain proportions, and the criterion used to differentiate between high and low groups was the proportion of 25% before and after. The 25% scale was chosen because, on the one hand, it is consistent with a normal distribution and, on the other hand, a lower scale makes it easier to see differences (Yan & Zheng, 2022). The researcher first determined the number of high and low subgroups. In this study, a total of 391 participants completed the Chinese writing ability test, and using the 25% criterion, it was calculated that 391*25% = 97.75, which should be rounded up to 98, i.e. the number of high and low subgroups was 98.

The researcher then ranked the cases in terms of total score and determined a threshold of 10 for the high group and 7 for the low group, which was collated to produce the table below.

Table 6: The Level of Chinese Writing Ability.

Interval	Level
0-7	Low
8-9	Normal
10	High

Based on the scoring criteria outlined in the table for assessing Chinese writing ability, participants' proficiency is categorized into three levels:

Low Ability: This category includes participants who score between 0 to 7 points. Scores in this range suggest a basic to moderate level of proficiency in writing SC. Participants in this

category may struggle with forming characters correctly or may have difficulty recalling and writing more complex characters.

Normal Ability: Participants scoring 8 to 9 points fall into this category. This level indicates a competent proficiency in writing SC, where participants can accurately write most characters but might still face challenges with some of the more complex or less frequently used characters.

High Ability: Participants scoring the maximum of 10 points are classified as having high writing ability. This demonstrates a strong proficiency in writing SC, indicating that they can accurately and confidently write all the characters presented in the test.

Analyzing the distribution of scores across these categories can provide insights into the overall writing proficiency levels of the participants. This analysis will highlight areas where additional focus or support might be needed, especially for those in the lower proficiency categories. It's also important to consider the diversity in the participants' backgrounds, as factors such as education, frequency of writing in SC, and exposure to the language could significantly impact their writing skills. Understanding these dynamics is crucial for designing effective language learning strategies and educational interventions.

Table 7: Data of The Level of Chinese Writing Ability.

Score	Scale	N	Frequency	Percent (%)
0	Low Ability	110	30	7.7
1			3	0.8
2			7	1.8
3			6	1.5
4			2	0.5
5			10	2.6
6			25	6.4
7			27	6.9
8	Normal Ability	169	47	12
9			122	31.2
10	High Ability	112	112	28.6
Total	391	391	391	100

The analysis of the overall percentages for Chinese writing ability among the participants reveals the following distribution across the three proficiency levels:

Firstly, the majority of the participants, 43.2% (169 individuals) were categorized as having normal writing ability. This suggests that while these participants have a sufficient

understanding of Chinese writing, they may not have fully mastered it. Their proficiency level indicates a need for further practice and refinement to reach a higher proficiency level. Secondly, a significant proportion of participants, 28.6% (112 individuals) demonstrated high ability in Chinese writing. These participants answered all questions correctly, indicating a high level of proficiency and mastery in writing SC. Finally, a nearly equal proportion (28.2%) of participants as the high ability group, but in the low ability category, indicates that a significant portion of the study's participants face challenges in writing SC. The distribution of scores within this group varied, with 7.7% of the participants (30 individuals) scoring 0 points, suggesting they were unable to write SC at all.

Y: Visual recognition

As part of "the level of visual recognition between OBS and SC", the participant took a quiz on how well they can recognize OBS and SCs. In this part, there were 15 Single-choice questions in total. On the one hand, each Single- choice question consisted of one picture as an OBS and one picture as a SC, accompanied by a textual explanation as "Look at the images below, and choose only one option". On the other hand, three different options for each question were contained: A. The two images look the same to me: B. The two images don’t look alike, but they convey the same meaning: C. The two images look completely different from each other. The participant could only choose one of these as their answer. It is worth noting that the same template was used for all the options in the 15 questions.

Based on the difficulty on visual recognition of the similarity relationship represented by the above options, the researcher further generalized the difficulty of visual recognition on the OBS. It was described in three levels as follows: firstly, "High difficulty" represented those OBS selected as option 3, as participants felt that the visual relationship between OBS and SC was No Similarity according to the description of the options; "Moderate difficulty" represented those OBS selected as option 2, as The participants perceived that there was Uncertainty in the visual relationship between OBS and SC. These uncertainties may be influenced by several potential factors; "Low difficulty" represents those selected as option 1 because the participants believed that the OBS and the SC appeared visually Similarity.

Table 8: The Level of Oracle Bone Script.

Definition	Option	Category	Recognition ability
Low Difficulty	1 (The two images look the same to me)	Similarity	High
Moderate Difficulty	2 (The two images don't look alike, but	Uncertainty	Normal

	they convey the same meaning)		
High Difficulty	3 (The two images look completely different from each other)	No similarity	Low

Table 9: The Participant Ability.

Recognition ability	Scores	N	Percent (%)
Low	15-25	251	64%
Normal	26-35	55	14%
High	36-45	85	22%

This can be seen by examining the overall percentages. Firstly, the highest number of participants were in the "High ability" (71.4%) category with 279 participants who answered all questions correctly, showing a high level of Chinese reading ability. This was followed by participants in the "Low ability" (27.6%) category, with 104 participants. Within this group, participants' scores were generally homogeneous, with a range from 0% to 10%. However, it is worth noting that 10% of the participants (39) were able to score an 8-point, and no one scored a 0-point. The least number of participants was "Normal ability" (2%), with 8-point participants.

Overall, the dataset suggests that the Chinese reading ability of the participants is generally high, with most individuals exhibiting strong performance in the high reading ability. However, there is still a big proportion of participants with low reading ability, highlighting the need for continued support and education to improve literacy skills among these individuals.

Data analysis

Descriptive analyses

To find out the highest value, lowest value, mean and standard deviation, the following data is descriptive statistics result:

Table 10: Descriptive Statistics Result.

N=391	Min.	Max.	Sum.	Mean	Std. Dev.	Variance	Skewness		Kurtosis	
							Statistic	Std.Error	Statistic	Std.Error
Reading Ability	1	10	3393	8.68	2.571	6.609	-1.933	.123	2.416	.246
Writing Ability	0	10	3026	7.74	2.892	8.363	-1.673	.123	1.775	.246
Visual Recognition	15	44	13334	34.10	9.860	97.220	-.949	.123	-.618	.246

Tests of Normality

The normality test is conducted to determine whether the research variables are normally distributed or not. There are three variables in this study, namely perceptions towards the reading ability (X1); writing ability (X2); and visual recognition (Y). The standard in the normality test is if the skewness is within the range of ± 2 when the data are normally distributed (Georege & Mallery, 2021; Pallant, 2020).

Based on the Table 1 the normality test results for reading ability (X1) have a skewness value of -2<-1.933 < 2, the data is normally distributed; writing ability (X2) has a skewness value of -2<-1.673 < 2, the data is normally distributed; and visual recognition (Y) with a skewness value of -2<-.949 < 2, the data is normally distributed.

Correlational Analysis

Table 11: Results of Pearson Product-Moment Correlation Between Reading Ability and Visual Recognition.

Factors	r	p
Reading ability	.870	.000

Table 12: Results of Pearson Product-Moment Correlation Between Writing Ability and Visual Recognition.

Factors	r	p
Writing ability	.836	.000

Table 13: Guildford's Rule of Thumb

r	Strength of Relationship
<.2	Negligible
.2−.4	Low
.4−.7	Moderate
.7−.9	High
>.9	Very High

According to the results of the correlation analysis between the variables X1 and Y obtained a significance value of 0.000 and a Pearson Correlation value of 0.870. Then the value is smaller than 0.05 or (0.000 < 0.05) so from these results H0 is rejected and H1 is accepted, so it can be concluded that there is a relationship between reading ability and visual recognition because the value of the Pearson Correlation is positive, meanwhile base on the table 13, the two variables have a positive and high relationship.

The results of the second correlation analysis between X2 and Y obtained a significance value of 0.000 and a Pearson Correlation value of 0.836. Then the value is smaller than 0.05 or (0.000 < 0.05) so from these results H0 is rejected and H1 is accepted, so it can be concluded that there is a relationship between writing ability and visual recognition because the value of the Pearson Correlation is positive, meanwhile base on the table 9, the two variables have a positive and high relationship.

Table 14: The Status of Chinese Reading and Writing Abilities in Different Visual Recognition Difficulty.

		visual recognition difficulty		
		Low difficulty	**Moderate difficulty**	**High difficulty**
Chinese reading ability	**Low ability**	33.3%	77.4%	80.9%
	Normal ability	34.7%	12.7%	9.0%
	High ability	33%	9.9%	10.1%
Chinese Writing ability	**Low ability**	45.1%	79.1%	68.6%
	Normal ability	27%	13.1%	21.4%
	High ability	27.9%	7.7%	10.0%

The table provides a statistical breakdown of how students' reading and writing abilities correlate with the perceived difficulty of visually recognizing the relationship between OBS and SC.

For Chinese reading ability: on the one hand, 80.9% of participants categorized as Low Ability face difficulty in recognizing the visual similarities between OBS and SC, with an additional 77.4% exhibiting uncertainty in visual recognition. Only 33.3% of participants perceive a similarity between the two scripts. This scenario shifts among participants with Normal and High Abilities. There is a noticeable decrease in the number of participants who find OBS challenging to recognize (Normal=9%; High=10%), suggesting that those with higher reading abilities have better visual recognition ability. On the other hand, as participants' Chinese reading abilities improve, the proportion who find OBS high difficult to

recognize decreases (from 80.9% among those with Low ability to 10.1% among those with High ability), and uncertainty in recognition also diminishes (from 77.4% among those with Low Ability to 7.91% among those with High ability). This indicates that as participants' reading abilities enhance, their visual recognition levels also improve.

For Chinese writing ability: Similar results emerged regarding Chinese reading ability. On one hand, a large proportion of participants with low writing ability find OBS challenging to recognize (68.9%) and exhibit uncertainty (79.1%) in visual recognition. Although this is also the case for those with Normal and High Abilities, the change is not as pronounced. On the other hand, as participants' Chinese writing abilities improve, the proportion who find OBS highly difficult to recognize decreases (from 68.6% among those with Low ability to 10.0% among those with High ability), and uncertainty in recognition also diminishes (from 79.1% among those with Low ability to 7.7% among those with High ability). This indicates that, similar to Chinese reading ability, participants' Chinese writing abilities also influence their visual recognition capabilities.

In summary, there is a clear trend that students with higher reading and writing abilities tend to perceive lower difficulty in visually recognizing the relationship between OBS and SC. Conversely, those with lower literacy skills are more likely to struggle with visual recognition. This could suggest that literacy proficiency is a strong predictor of the ability to process and understand the visual aspects of the Chinese language, which is crucial for the development of effective language education strategies.

Multiple Linear Regression Analysis

Table 15: R-Squared Model Summary.

Model	R	R-Squared	Adjusted R Square	Std. Error of the Estimate
1	.870[a]	.756	.756	4.872
2	.836[b]	.699	.698	5.421
3	.956[c]	.915	.914	2.888

a. Predictors: (Constant), reading ability

b. Predictors: (Constant), writing ability

c. Predictors: (Constant), writing ability, reading ability

Using stepwise regression technique, the model 1 with reading ability as the predictor show R^2=.756 indicates that 75.6% of the variance in the visual recognition is explained by reading ability. The model 2 with writing ability as the predictor show R^2=.699 indicates that 66.9% of the variance in the visual recognition is explained by writing ability. The model 3 with both reading ability and writing ability as predictor show R^2=.915 indicates that 91.5% of the variance in visual recognition explained two variables.

Table 16: Guildford's Rule of Thumb.

r	Strength of Relationship
<.2	Negligible
.2−.4	Low
.4−.7	Moderate
.7−.9	High
>.9	Very High

Meanwhile, according to the table 16 the model 1 with reading ability as the predictor show *R*=.870 indicates that there is a positive and high correlation between the reading ability and visual recognition. The model 2 with writing ability as the predictor show *R*=.836 indicates that there is a positive and high correlation between the reading ability and visual recognition. The model 3 with both reading ability and writing ability as the predictors show *R*=.956 indicates that there is a positive and very high correlation between the predictors and visual recognition.

Table 17: Regression Equation Significance Test Result.

ANOVA[a]					
	Sum of Squares	**df**	**Mean square**	**F**	**Sig.**
Regression	34680.673	2	17340.336	2079.617	0.000[b]
Residual	3235.235	388	8.338		
Total	37915.908	390			

a. Dependent Variable: visual recognition

b. Predictors: (Constant), reading ability, writing ability

Referring to the Table 17 of ANOVA test, the regression model is statistically significant for reading ability and writing ability to visual recognition [F (2,388) =2079.617] sig.=<.0005. It means that visual recognition (Y) is related to reading ability (X_1) and writing ability (X_2).

In the Table 18 below, the coefficient regression for model, reading ability to visual recognition is B=6.438, p=<.05 or statistically significant. Writing ability to visual recognition is B=6.454, p=<.05 or statistically significant. The equation for the regression line is the level of visual recognition = b0 + b1* reading ability + b2* writing ability.

$$\hat{Y} = 5.404 + 6.438X_1 + 6.454X_2$$

Table 18: Results of a Multiple Linear Regression Between Reading Ability, Writing Ability and Visual Recognition.

Factors	B	Std.Error	Beta	t	p
Constant	5.404	.468		11.539	.000
Reading ability	6.438	.205	.577	31.349	.000
Writing ability	6.454	.241	.494	26.823	.000

It means that for every 1 unit increase in reading ability (X_1), visual recognition (Y) will increase by 6.438 units while for every 1 unit increase in writing ability (X_2), visual recognition (Y) will increase by 6.454 units.

DISCUSSION

Reading and writing ability

In our study, we expanded the database in the literature by assessing the ability of the ethnic Chinese students in Malaysia to read and write SC. Consistent with earlier research, a high proportion of students (71.4%) demonstrated a strong ability in reading SC, implying their capability to recognize SC and understand its pronunciation. This proficiency can be attributed to Malaysia's well-established Chinese education system (Yan, 2022; Wan et al., 2020) and the high frequency of Chinese in the daily spoken language among the Chinese community (Ong & Troyer, 2022). In contrast, a smaller proportion exhibited high writing ability (28.6%), with some students (7.7%) unable to write SC at all, confirming findings by Chuen et al. (2021) that Malaysian Chinese are weaker in writing than reading Chinese. The study also found that participants with low writing ability (28.2%) outnumbered those with low reading ability (10%). This indicates greater challenges faced by students in writing SC. SC are composed of various graphical elements (Park et al., 2022), and the low writing ability

is due to learners' insensitivity to the structural composition of characters (Nkrumah & Asamoah, 2022). Future research could further investigate the influence of the number of structural components in SC on reading and writing abilities.

Visual recognition ability

Moreover, the data clearly shows that most participants (64%) exhibited low recognition ability, indicating difficulty in visually identifying similarities between OBS and SC. This supports Wang et al.'s (2022) assertion that, after years of evolution, the font structures of OBS and SC have diverged significantly, with the abstract nature of SC obscuring the visual connection. However, some participants (Normal=14%, High=22%) were able to recognize similarities, indicating that certain OBS and SC still share similar structural features (Gao et al., 2022), potentially aiding learners in establishing visual connections and facilitating the acquisition of SC. Additionally, the ability to recognize these connections might be influenced by individual capabilities, suggesting that greater familiarity with SC can facilitate recognition of graphical relationships. Xue (2021) argued that writing SC requires proficient graphical recognition and processing skills, with reading involving reconfirmation of graphical forms and writing being a recall of previously accumulated graphical memory. Further research could explore the easily recognizable visual features in oracle bone script categorized as Low Difficulty and Moderate Difficulty, and the factors influencing learners' recognition.

Relationship between reading and writing ability and visual recognition

Finally, the data indicates a positive correlation between Chinese reading ability and visual recognition, as well as between Chinese writing ability and visual recognition. This corroborates previous studies which suggest that Chinese reading and writing abilities are part of the visual behavior in Chinese learning (Zhai & Fischer, 2019; Ou et al., 2023). Yang & Qiao (2021) discussed the association of reading ability and visual skills in Chinese language acquisition with linguistic working memory and visual-spatial working memory. They highlighted the significance of visual skills and language working memory in early character recognition in SC. This is due to the high linguistic memory requirements when learning characters and the need to visually distinguish radicals in different characters. This suggests that visual training using OBS may improve learners' Chinese reading and writing abilities. Additionally, participants with low reading abilities showed lower visual recognition capabilities, while those with high reading abilities demonstrated higher visual recognition

skills. This phenomenon is similarly observed in the relationship between writing ability and visual recognition. This implies that Chinese reading and writing abilities influence visual recognition. Multiple linear regression further elucidates this phenomenon, indicating that as participants' Chinese reading and writing abilities improve, so does their visual recognition ability. This suggests that Chinese reading and writing skills are influencing factors for participants' visual recognition abilities, aiding in better identification of relationships between SC. Zhuang et al. (2019) argued that enhancing proficiency in SC helps improve visual recognition and visual skills. Tso et al. (2021) also mentioned the strong visual-spatial foundation in the character recognition process and its strong correlation with writing ability in their study.

In addressing the teaching of SC to the ethnic Chinese students, educators firstly need to select OBS imagery suitable for learners, as closely visually linked imagery is more readily accepted. Secondly, graphic designers can redesign OBS to enhance connections between OBS, SC, and their meanings, making the learning process more engaging and interesting. Lastly, it is essential to conduct OBS training for students. Future research could focus on using OBS for visual training and comparative teaching to further explore its assistance in Chinese reading and writing. Additionally, redesigning OBS is a breakthrough method to overcome its recognition challenges; increasing its recognizability through design will assist learners' education.

CONCLUSIONS

Our study offers significant insights into the dynamics of Chinese reading and writing proficiencies among ethnic Chinese students in Malaysia, examining the intricate relationship between these linguistic skills and the capacity for visual recognition of Oracle Bone Script (OBS). Through comprehensive analysis, we have uncovered a spectrum of proficiency levels in Chinese literacy within this demographic, alongside a notable positive correlation between their abilities in visual recognition and their linguistic competencies in reading and writing. This correlation underscores the importance of visual acuity in the acquisition and mastery of the Chinese language, pointing to a fundamental interplay between visual cognition and linguistic skill development.

Furthermore, our findings prompt a call for future research to intensively investigate the underlying factors that influence visual recognition abilities, particularly among learners exhibiting lower levels of reading and writing proficiency. Delving into these factors is

crucial for the development of targeted teaching strategies and the creation of educational materials tailored to the diverse learning needs of students. By pinpointing the specific challenges and barriers faced by learners, educators can devise more effective methods to enhance Chinese language education, fostering a deeper understanding and greater mastery of the language.

It is essential to acknowledge that our research is at an exploratory stage, laying the groundwork for further studies in this field. The complexity and variability of language acquisition processes necessitate ongoing investigation to fully understand the multifaceted relationship between visual recognition and language proficiency. As we continue to explore these dynamics, our ultimate goal is to contribute to the refinement of Chinese language pedagogy, making it more responsive to the nuances of learner diversity and more conducive to achieving educational excellence.

In conclusion, this study not only highlights the critical role of visual recognition in learning Chinese but also opens new avenues for research into language education strategies. By addressing the gaps identified in our exploratory research, future studies can build on our findings to enhance the efficacy of language teaching and learning, ensuring that educational practices evolve in line with our growing understanding of the cognitive processes involved in language acquisition. This endeavor is not just academic; it has practical implications for improving the educational outcomes of ethnic Chinese students in Malaysia and potentially for Chinese language learners globally.

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