Evaluating the Impact of Rote Memorization and Visual Mnemonics on Chinese Character Acquisition

02.218TS Introduction to Psychology

Research Report

Group 4

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1 Abstract

While Rote Memorization (RM) has been used in Chinese culture as a traditional learning method to recognize Chinese characters in the short-term, our research shows that Dual Coding Theory (DCT) proves Visual Mnemonics (VM) further aids learners in retention and recalling. As a result, this study seeks to compare the effectiveness of the VM method against solely using traditional RM for the recognition and understanding of Chinese characters among adult CFL learners. A quasi-experimental design was employed for this research, utilizing a web-based multiple-choice questionnaire flashcard system, assessing both immediate recall and long-term retention of 20 widely used Chinese characters, which was accompanied by a pre- and post-test survey to facilitate the assessment of both quantitative outcomes (precision rate in meaning) and qualitative outcomes (learner interest and delight). Since most participants found Visual Mnemonics (VM) more engaging, this study aims to advocate for the integration of VM in CFL education, leading to increased confidence and ultimately better learning outcomes.

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3 Introduction

Learning Chinese characters presents a significant challenge, especially for adult beginners. Unlike alphabetic languages, Chinese employs a logographic writing system in which each character is a unique visual symbol representing a word or a meaningful unit. With over 40,000 characters—3,500 of which are required for functional literacy (Taylor & Taylor, 1995)—the vast amount to memorize seems to be a daunting task which scares away many potential interested learners.

Beyond the sheer volume of characters, their structural complexity compounds the difficulty. Each character is often composed of smaller components called radicals, which provide semantic or phonetic cues. For instance, the character for "mother" (妈) incorporates the "woman" radical (女), indicating its category. Furthermore, Chinese characters are categorized into different types based on their structural composition. Of the 3,500 characters that are frequently used in Standard Chinese, pure semantographs are estimated to be the rarest, accounting for about 5% of the lexicon, followed by pure signs with 18%, and semantic–form and phonetic–form compounds together accounting for 19%. The remaining 58% are phono-semantic compounds (Wikipedia, 2024). Our study will focus on common pure semantographs, also known as pictograms, as they serve as radicals for many words.

Research on native Chinese speakers highlights the primacy of visual recognition over phonological awareness when processing Chinese characters (Tan et al., 2005; McBride, 2016). These findings suggest that effective strategies for teaching Chinese as a Foreign Language (CFL) should prioritize methods that enhance visual and semantic understanding. However, traditional approaches such as Rote Memorization (RM)—commonly used in Chinese education—have

shown limited effectiveness for long-term retention and learner engagement, particularly among adult CFL learners.

This study investigates how the integration of Visual Mnemonics (VM) with Rote Memorization (RM) can improve the acquisition of Chinese characters. Drawing on the Dual Coding Theory (DCT) and the Affective Filter Hypothesis, we explore how combining these methods impacts learners' ability to recognize, recall, and connect form with meaning. This approach not only addresses the cognitive challenges of learning Chinese characters but also seeks to enhance motivation and enjoyment, for a more positive and effective learning experience.

To frame this research, first, we examine the structural features of Chinese characters and their implications for learning strategies. Next, we evaluate existing methods in CFL education, to ground our study with theoretical and empirical contexts. Building on existing findings, this study aims to provide measurable quantitative and qualitative insights into teaching approaches that leverage visual associations compared to rote memorization, for improved language acquisition, to show the importance of visual associations for CFL education.

4 Literature Review

4.1 Breakdown of Chinese Character Composition and Form-Meaning Connections

Before examining teaching methods, it is essential to understand the unique structure of Chinese characters, as this directly impacts learning strategies. As mentioned in the introduction, Chinese is a logographic language where each character represents a word or a meaningful unit, often composed of smaller components called *radicals*. Radicals provide semantic or phonetic clues, aiding in the interpretation and memorization of characters. Characters can be simple (a single radical) or complex (a combination of radicals), making learning both visual and semantic.

Understanding this composition is crucial for CFL learners, as it affects how characters are memorized and recalled. Existing literature (e.g., Shen, 2010; Taft & Chung, 1999) suggests that radical knowledge facilitates character learning. Xu, Chang, and Perfetti (2014) further explore this by investigating how radical-based grouping impacts the form and meaning representations of characters. Their study, "The Effect of Radical-Based Grouping in Character Learning in Chinese as a Foreign Language," found that presenting characters that share the same radicals together in a learning session can significantly enhance learners' ability to recall character forms and meanings compared to when the radicals are spread across different learning sessions. This suggests that visual mnemonics—associating characters with images or meanings—can support memory by leveraging natural semantic or pictorial cues.

4.2 Methods for Teaching Chinese Characters in CFL Institutions

The previous studies we referenced for this paper include works by Shen (2010), Taft and Chung (1999), Chang et al. (2022), Leminen and Bai (2023), and Campos et al. (2003). From these studies,

we identified that teaching methods for CFL students can be broadly categorized into two main types: (1) Non-Semantic and (2) Semantic-Encoding.

4.3 Non-Semantic

The primary method within the non-semantic category is Rote Memorization (RM), which aims to develop students' ability to recognize and memorize as many characters as possible by repeatedly copying the characters without delving deep into their meanings.

4.4 Semantic-Encoding

Many other methods fall under the Semantic-Encoding category, and these methods make use of mnemonic devices to associate meaning to the Chinese characters. The commonly used Semantic-Encoding methods are listed below:

1. **Historical Origins of the Character**: Focuses on memorizing characters by exploring their ancient historical origins.
2. **Contextual-Based Methods**: Emphasize learning character meanings within meaningful contexts such as literature and stories (Lam, 2011).
3. **Wild Association**: Encouraging students to create their own explanations for characters.
4. **Visual Mnemonics**: Leverages Dual Coding Theory by associating visual images with verbal information. This will be elaborated further in the section later entitled 'Deeper Dive into Visual Mnemonics for Chinese Character Learning'.
5. **Hanyu Pinyin (or Phonetics) Method**: Romanization of Chinese Characters to master their pronunciation first.

4.5 Deeper Dive into Rote Memorization Method for Chinese Character Learning

Rote Memorization is a technique that has deep roots in Chinese culture and is also a common way in which native speakers learn Chinese (Yang & Dai, 2011). Its prevalence suggests an inherent

cultural and linguistic alignment, making it relevant to study its effectiveness in the context of CFL students. Previous studies have found that Rote Memorization strategies are effective mainly for short-term memorization (Dehn, 2008) but may improve the effectiveness of learning outcomes as more focus is given to Rote Memorization (Dehn, 2008; Greenberg, 2000).

Taking a deeper look at existing studies involving Rote Memorization specifically for learning Chinese characters for CFL students, it was found that Rote Memorization was less effective than delayed character introduction (DCI), character color-coding (CCC) or a control group involving a mixed reading, writing, listening, and speaking that mimicked a typical classroom environment (Osborne, 2020) in terms of listening tasks, but proved more effective than the other methods when it comes to recognition based tasks, scoring the highest in the simultaneous supply of correct translations and Pinyin of characters, as well as the highest scores for supplying correct translations but wrong Pinyin of characters. Additionally, Osborne's study found that Rote Memorization excelled in usage of individual characters while underperformed when it came to using either phrases only or both phrases and words, compared to the other learning methods, suggesting that while Rote Memorization may support isolated recognition tasks, it may not foster the integrated linguistic skills necessary for higher level language proficiency.

The cognitive load, aka how many working resources are required to complete a task, is another facet to Rote Memorization that studies have considered. Cognitive load theory suggests that overwhelming working memory reduces efficiency in learning and retention (Sweller, 1988). In the case of Rote Memorization, it was found that it induced a high cognitive load due to its repetitive, shallow processing, where learners must repeatedly focus on both the visual and phonetic details of the individual characters without context, failing to engage deeper cognitive structures that help in long-term retention (Shen, 2004), further bolstering the findings mentioned on the advantages for isolated recognition but limitations on integrated linguistic tasks.

Although cognitive load is a key factor to the effectiveness of Rote Memorization, a learner's age and culture are also key factors to investigate, as age will impact the learner's capacity for language acquisition. The critical period hypothesis proposed by Lenneberg (1967) suggested a specific time window during human development when language acquisition occurs most easily and effectively, which is from the age of 2 till puberty. This critical period is aligned with key neurological changes in the brain, since the brain exhibits high plasticity during early childhood, which allows for easier formation of neural connections related to language acquisition. As the target participants in this study will have passed this critical period, Rote Memorization may not be as effective when used with children.

On the other hand, a learner's culture also has influence over the effectiveness of Rote Memorization strategies, as it was found that adult learners from East-Asian backgrounds could learn beyond 'rote' and achieve deeper understanding despite being under the category of adult learners (Tan, 2011). Although these studies do not directly concern CFL learners, they provide insight into potential strategies that could apply effectively for specific ages and cultures.

4.6 Deeper Dive into Visual Mnemonics for Chinese Character Learning

Visual mnemonics leverage the Dual Coding Theory (Paivio, 1986) by associating visual images with verbal information, creating more robust memory traces. According to Chen (2021), integrating visual mnemonics with Rote Memorization can enhance recall and understanding by utilizing both visual and verbal channels of memory. Xu et al. (2014) demonstrated that radical-based grouping, a form of visual mnemonics, significantly improves learners' ability to recall character forms and meanings by creating consistent form-meaning associations across grouped characters. This method aligns with the Affective Filter Hypothesis (Krashen, 1982), as it fosters a positive and engaging learning environment, potentially increasing motivation and emotional engagement (Sukma, 2024).

4.7 Choice of Method to Conduct our Study

One pertinent study by Chang et al. (2022) examined the effectiveness of combining Key-Images with Pithy Formula (similar to wild association) in learning Chinese characters. This study involved 66 CFL students in Taiwan and compared three methods:

1. **Stroke Sequence**: Detailing every individual stroke to write the character.
2. **Key-Images**: Associating illustrations with semantic and phonetic radicals.
3. **Key-Images + Pithy Formula**: Combining illustrations with brief sentences that decompose radicals into meaningful phrases.

Results indicated that the **Key-Images + Pithy Formula** strategy yielded better results for character writing than the other two methods. However, there was no significant improvement in Chinese character to English translations across any methods, suggesting a need for more effective strategies in this area.

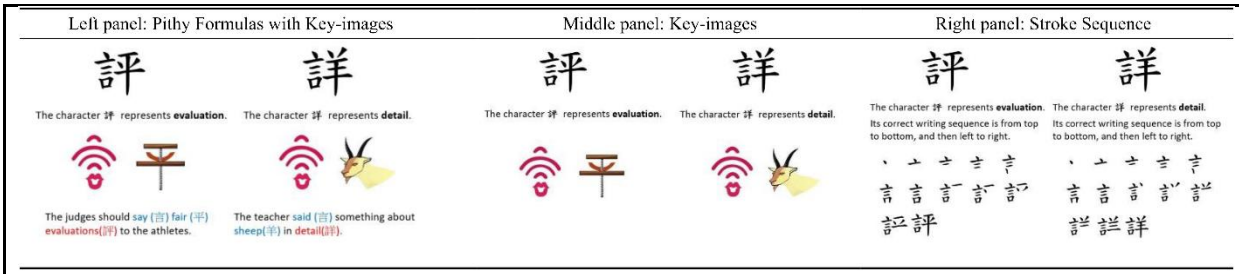

Figure 1: Illustrations showing the three different methods, starting with Key-Images + Pithy Formula, Key-Images and then Stroke Sequence (Chang et. al, 2022)

Another study utilizes a different experiment design involving the use of a crossover trial to discern the efficacy and user satisfaction between two methods of learning Chinese characters (Leminen & Bai, 2023). The study recruited 30 participants and separated into two groups, 17 in experimental and 13 in control. For the first part, the experimental group would recognise Chinese characters using visual mnemonics with Hierarchical order and Writing (Similar to Stroke Sequence of previous study done by Chang et al. (2022)), whilst the control group would only use Hierarchical

order and Writing. Thereafter, the participants will have a 1-week cool down period before continuing onto the second part, where the experiment and control group switch learning methods. As a result, the participants who utilized visual mnemonics in their learning demonstrated better correct strokes order and correct Chinese character identification regardless of their group, meaning that the crossover trial did not influence the participants retention or learning.

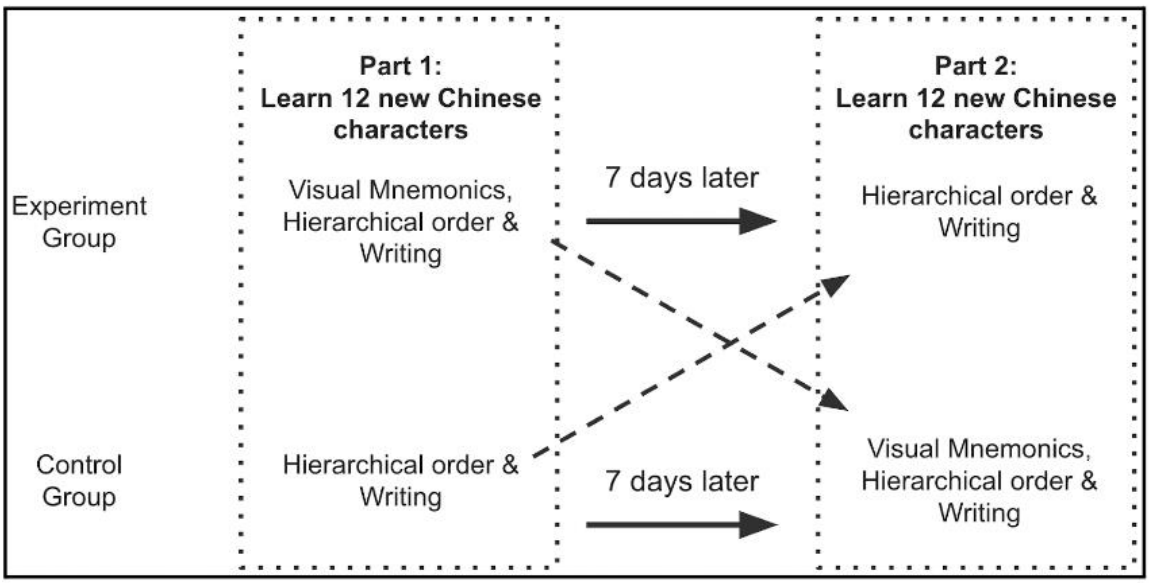

Figure 2: Crossover trial experiment design ((Leminen & Bai, 2023))

Despite these benefits, Campos et al. (2003) highlighted potential disadvantages of visual mnemonics, such as increased cognitive load and the possibility that learners might prefer direct association and repetition in constrained time frames (e.g., less than 5 seconds per character).

Given these insights, our study aims to explore how combining Rote Memorization with visual mnemonics specifically enhances form-meaning connections in Chinese character learning, addressing gaps identified in previous research, particularly in improving Chinese character to English translations.

4.8 Theoretical Framework

The theoretical underpinning of this study is grounded in Dual Coding Theory (Paivio, 1986), which posits that both verbal and visual information are processed and stored in separate but interconnected systems. According to this theory, integrating visual mnemonics with verbal Rote Memorization can create more robust memory traces, enhancing recall and understanding (Chen, 2021).

Additionally, the Affective Filter Hypothesis (Krashen, 1982) suggests that positive emotions can lower the affective filter, making learners more receptive to new information. By fostering a positive and enjoyable learning environment through visual mnemonics, the RM + VM method aligns with this hypothesis, potentially leading to better language acquisition outcomes (Sukma, 2024).

Furthermore, Xu et al. (2014) provided empirical support for the importance of form-meaning connections in character learning. Their research demonstrates that radical-based grouping enhances learners' ability to form strong form-meaning associations, which are crucial for effective character retention and recall.

Our research aims to add to these existing studies on Chinese character learning. This leads to our research topic, which is to explore how different learning and teaching techniques influence the retention, recall, and confidence of adult learners in reading Chinese characters.

5 Methods

5.1 Participants

This study employs a quasi-experimental design to evaluate the effectiveness of an augmented learning method— Visual Mnemonics (VM) —in comparison to traditional Rote Memorization (RM). The primary focus is on enhancing Chinese character recognition and understanding among CFL learners. By incorporating a post-test questionnaire, the design facilitates the assessment of both quantitative outcomes (precision rate in meaning) and qualitative outcomes (learner interest and delight). This study targets non-Chinese speakers aged 18-30 with no or limited Chinese language experience. Demographic data collected includes age, education, ethnicity and known languages.

5.2 Materials and Procedures

First, 20 Chinese characters were selected based on the following criteria:

1. **Frequency of Use:** Chosen from the top 100 most used radicals to ensure relevance and practical utility (Dong Chinese, n.d.).
2. **Simplicity:** Characters with 2-6 strokes to facilitate ease of learning for absolute beginners.
3. **Pictorial Origins:** Characters with clear pictorial meanings that have remained consistent in both traditional and simplified forms.
4. **Common Usage:** Ensures that learners encounter characters frequently in real-world contexts.

From the above criteria, the list of the 20 chosen characters are as follows:

口, 水, 手, 木, 人, 心, 土, 肉, 火, 女, 日, 刀, 目, 衣, 山, 米, 大, 门, 子, 雨

The study was then conducted in the form of web-based MCQ flashcards, reason being that it was deemed as suitable for both immediate and retention testing to evaluate character recognition and

understanding. It consisted of two phases: the Learning Phase and the Testing Phase. For the Learning Phase, the 20 chosen characters were split into four groups (i.e. there are five characters per group). The learning of the 20 characters were alternated between RM and VM methods, or in other words the characters in Groups 1 and 3 were learnt by the participants using the RM method while characters in Groups 2 and 4 were learnt using the VM method. For the RM method, each participant was shown each of the five characters for 10 seconds, alongside the character's meaning and audio pronunciation. The same thing was done for the other characters in that group. Then, to increase their retention after memorization, each character was presented again via a 5-options MCQ flashcards 3 times, each for 5 seconds, but in randomized order. Two sample flashcards, one of which is the 10-second flashcard while the other is the 5-second one (with 5-options MCQ), are shown in Figures 3 and 4 respectively. In short, there were 3 MCQ flashcards for each of the 5 characters in an RM group, which corresponds to a total of 15 MCQ flashcards per group. Since the participants were exposed to each character for 5 seconds for each flashcard, plus the initial 10 seconds to stare at the flashcard, the total exposure per character in an RM group is:

(3 x 5 seconds) + 10 seconds = 25 seconds of exposure per character in an RM group

Figure 3: Initial RM Flashcard shown for 10 seconds during the Learning Phase

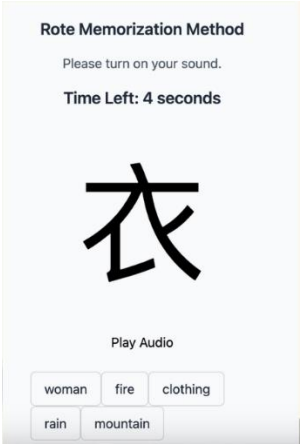

Figure 4: Subsequent RM Flashcard shown for 5 seconds also during the Learning Phase

For the learning via VM method, the characters in a VM group were also shown as flashcards. Each flashcard of the character will be shown for 20 seconds, accompanied by the corresponding audio pronunciation, meaning and visual mnemonics. There visual mnemonics comprised two images, which were the (1) real-world representation and (2) historical representation of that character itself to aid memory retention, as shown in Figure 5 below.

Figure 5: VM Flashcard during the Learning Phase.

5.3 Testing Phase

During the Testing Phase, the participants were given a MCQ-based test that assesses their recall of the 20 learned characters. We tested all 20 words in a random order using flashcards, and the participant answers with the meaning.

The test flashcards (shown in Figure 6 below) include:

- Each character with the corresponding audio pronunciation
- 4 other options with an "*I don't know*" option
    - Allow participants to answer "*I don't know*" instead of guessing

We recorded time taken to answer each question, which will be used to measure quickness of recall in our data analysis.

Figure 6: Test Flashcard during the Testing Phase.

5.4 Surveys

Finally, 3 different surveys were carried out during the study as follows (see Appendix Survey Section

1. **Pre-Learning Survey:** Assesses participants' initial feelings and interest in learning Chinese characters.
2. **Post-Learning Survey:** Measures changes in emotions and interest levels after the learning session.
3. **Feedback Survey:** Collects qualitative feedback on learning experiences and thought processes.

6 Results

6.1 Participant Demographics

Of 36 initial respondents, 26 participants produced valid, complete data. The sample skewed toward young adults (mean age: 20.92, range: 17–26) with relatively high educational backgrounds. The gender distribution included slightly more males than females and while unbalanced, was not extremely skewed. Most participants were ethnically Indian, with smaller numbers identifying as British, Malay, or other ethnicities. All participants spoke English, and many also understood at least one Asian language. Hence, the sample is relatively homogeneous, consisting of young adults with a high level of education, leading to limited generalizability to other populations. So what we can see from the demographic statistics is that our sample is actually quite WEIRD, with our population consisting mostly of young and highly educated people, which might limited the applicability of our results to the general population. With that in mind, let's check out the main statistics that we have been waiting for.

Total Participants	36
Valid Responses	26
Male Participants	16
Female Participants	10
Age Range	17 – 26 years
Average Age	20.92 years

Table 1 Experiment details and participant demographics

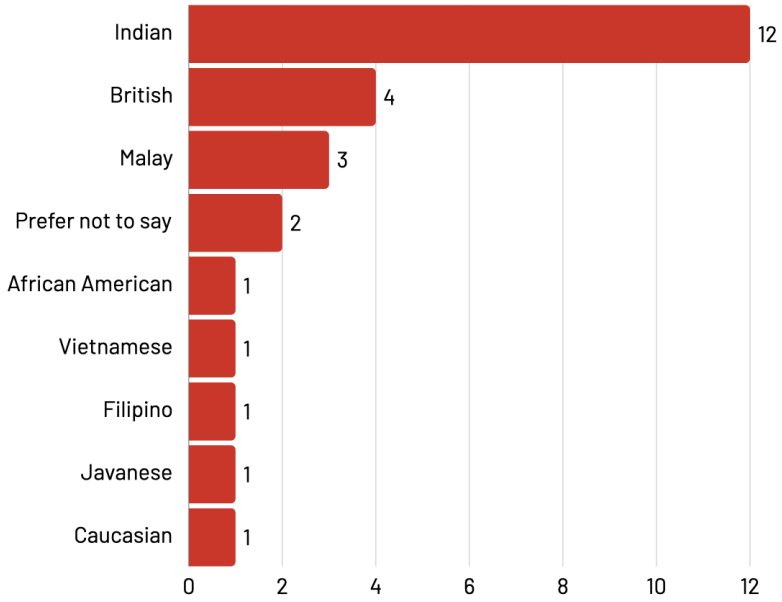

Figure 1 Distribution of participant ethnicities

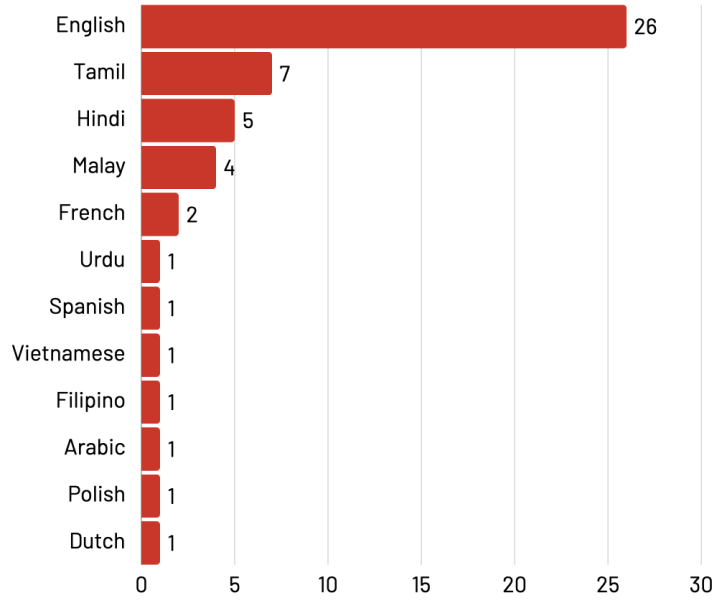

Figure 2 Distribution of languages known by participants

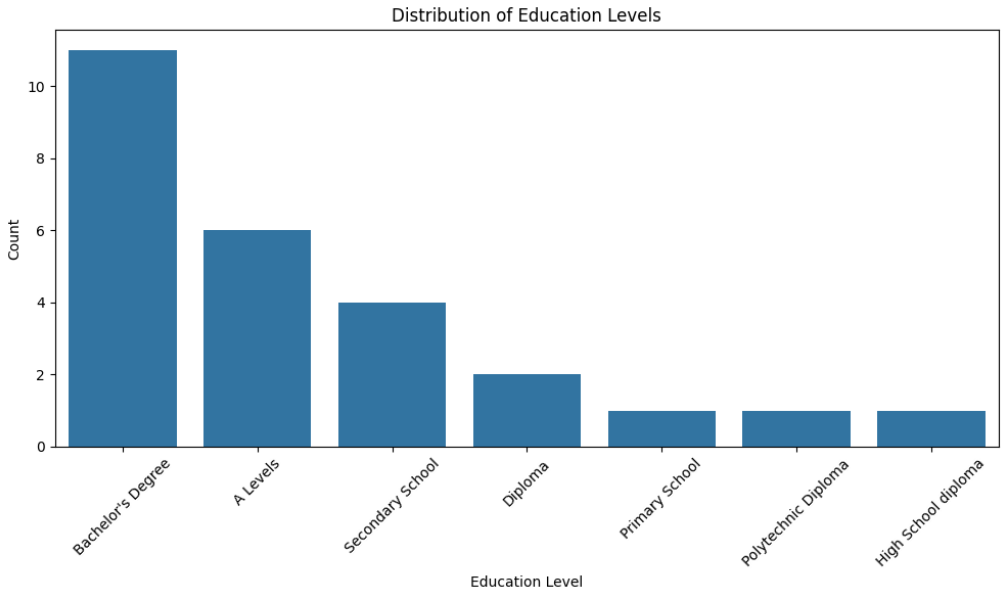

Figure 8 Distribution of education levels of the participants

6.2 Pre-Learning Perceptions

Prior to the experiment, most participants reported feeling “not confident” or “neutral” in their ability to learn Chinese characters. Interest levels were moderate, with most selecting “neither interested nor uninterested” or “somewhat interested.” Only one participant reported being “very interested.”

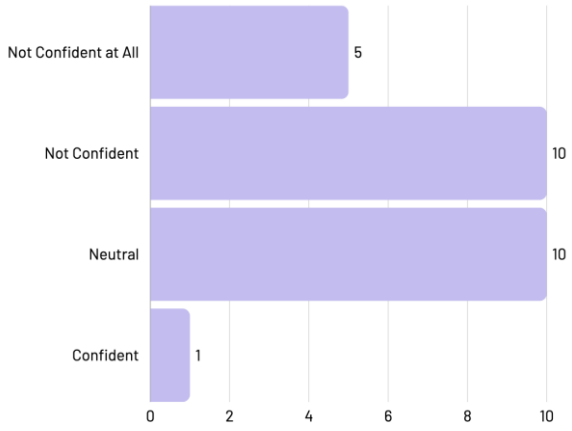

Figure 3 Participant confidence levels before experiment

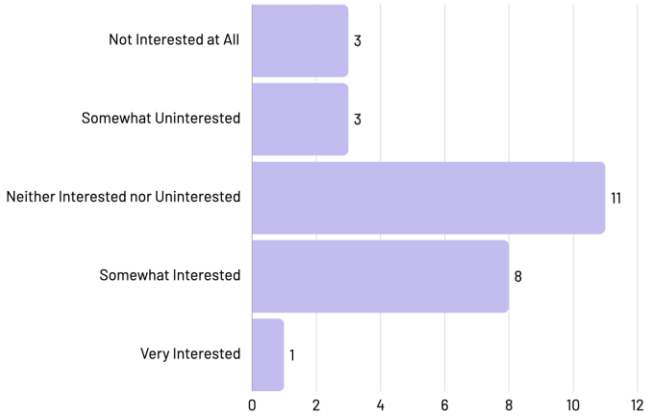

Figure 40 Participant interest levels before experiment

6.3 Quantitative Outcomes

6.3.1 Response Times

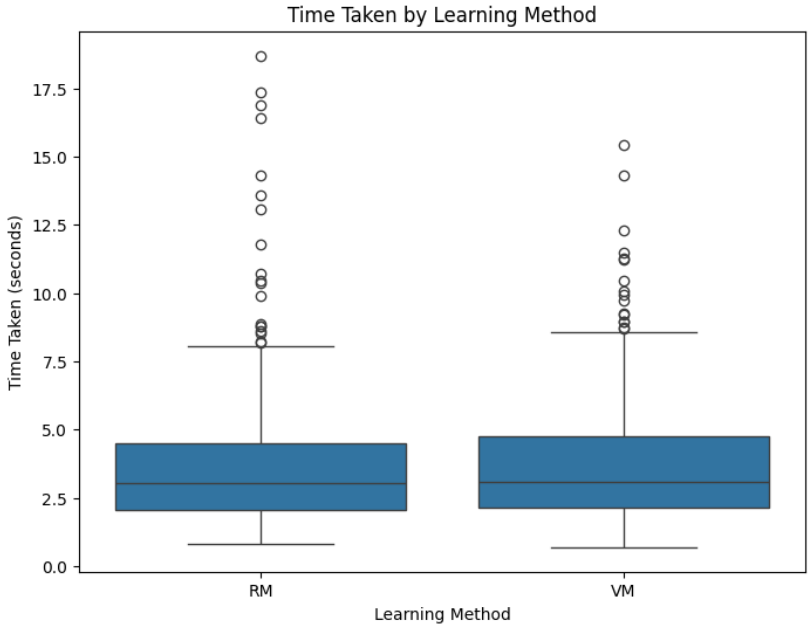

Figure 51 Response times by learning method

It was found that for both learning methods, RM and VM, that there was not much difference in response times, being in the 3.8-3.9s range, with mean response time across all participants and conditions being 3.87 seconds. The Shapiro-Wilk test indicated non-normal distribution of

response times; thus, the Mann-Whitney U test was applied. This test revealed no statistically significant difference in response times between RM and VM (U = 32691.5, p = 0.518).

Mean	3.87s
Standard Deviation	2.63
Mean Time (RM)	3.896462s
Mean Time (VM)	3.843692s
Shapiro-Wilk Test	RM: statistic=0.753, pvalue=1.87e-19 VM: statistic=0.836, pvalue=7.02
Mann-Whitney U Test	U-Statistic: 32691.5 p-value: 0.518

Table 2 Summary of response time results

6.3.2 Answer Accuracy

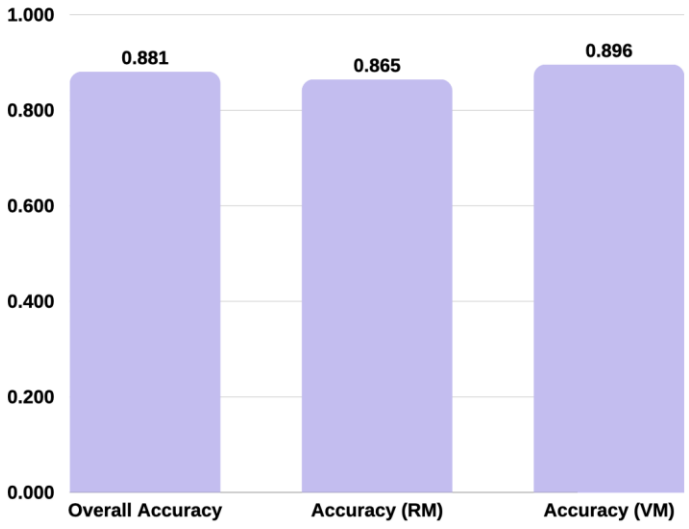

Figure 62 Overall, RM, and VM answer accuracy

Regarding answer accuracy, which is the proportion of correct answers to the total number of questions, there's no difference in answer accuracy between RM and VM. It was found that for both RM and VM, answer accuracy was around 0.8, with VM accuracy being marginally higher.

A chi-square test comparing accuracy distributions found no statistically significant difference between RM and VM conditions ($\chi^2 = 0.897$, $p = 0.344$). Thus, both methods led to similar short-term recognition performance. The table below summarizes the details of the answer accuracy results.

Overall Accuracy	0.881
Accuracy (RM)	0.865
Accuracy (VM)	0.896
Chi-Square Test	p = 0.344 Chi2 = 0.897

Table 3 Summary of answer accuracy results

6.4 Qualitative Feedback and Perceptions

Despite the lack of statistical differences in answer accuracy performance, qualitative feedback was markedly more favourable toward the VM condition. While only 11.5% of participants perceived RM as more effective, 46.2% considered VM more effective. Enjoyment ratings were also higher for VM: 73.1% (19 out of 26) of participants found the VM method enjoyable (agree or strongly agree). Additionally, several participants reported spontaneously creating their own mental visual mnemonics even when presented with RM stimuli, suggesting a natural inclination toward imagery-based strategies.

Representative comments included:

- “Even during the Rote Memorization I was making my own visual mnemonics so I think it’s only natural to learn that way”
- "For me I was using the VM for all the symbols (by trying to create a link between the word and symbol) as this is how I memorize stuff like this."

- "Visual with images is fun"
- "I think having the short tests helped a lot but the visual stuff was more engaging"

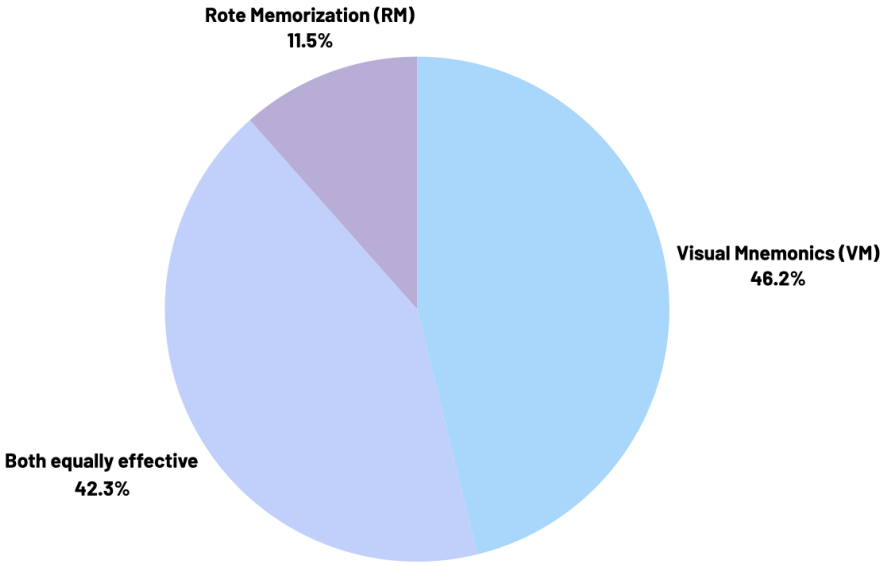

Figure 17 Perception of learning method effectiveness

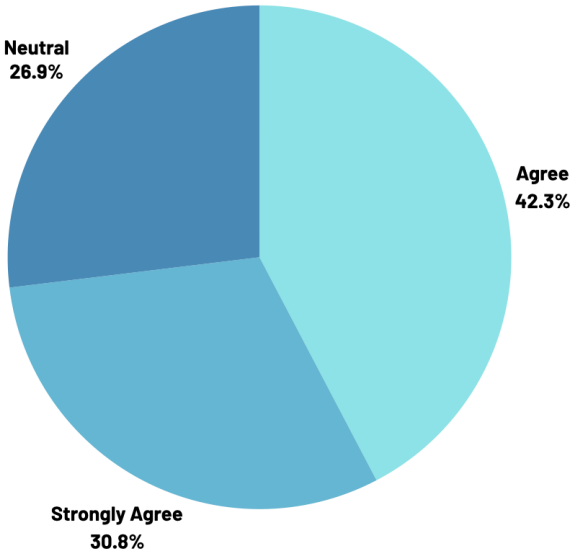

Figure 84 Enjoyment level of visual mnemonics learning method

6.5 Key Findings

1. **Performance of Learning Methods:** No significant differences in objective performance (response time, accuracy) emerged between RM and VM conditions.
2. **Affective Factors:** Participants subjectively favoured VM, perceiving it as more effective and enjoyable.
3. **Usage of Visualization in RM:** Some participants used mental imagery even during the RM learning phase, indicating a natural preference or ease of forming visual associations for some.
4. **Demographics**: The findings are limited to a narrow demographic of young, highly educated learners.

7 Discussion

This project managed to capture a homogeneous sample consisting of young adults ages 17-26 years old with a high level of education, hence, a limited generalizability in other populations out of a total of 26 valid results from participants who were not of Chinese ethnicity and with no prior knowledge of the 20 Chinese tested characters.

Response times showed minimal variation, with an average of 3.87 seconds across all participants with RM taking 3.896s and VM slightly lower at 3.843s (RM: 3.90s, VM: 3.84s; Mann-Whitney U Test: $U = 32691.5$, $p = 0.518$). Accuracy rates also demonstrated slight differences (RM: 86.5%, VM: 89.6%), with a chi-square test yielding no significant difference ($\chi 2 = 0.897$, $p = 0.344$). These objective results indicate that, although both methods were effective in the short run, neither showed a clear advantage under the conditions of the study. Unfortunately, this goes against the intuition of the expectations of this project, since studies conducted by Chang et al. (2022) and Leminen & Bai (2023) have emphasized the effectiveness of similar learning methods to VM with similar participant numbers.

First, the immediate testing phase of our study may have reduced any potential advantage of VM, as participants never had a chance to rely on their memory to recall the Chinese characters they learned. The immediate testing after the learning phase captured short-term memory but did not account for long-term retention and thus likely favored RM due to its emphasis on repetition. Moreover, Leminen and Bai (2023), postulate that the benefits of mnemonic techniques are more evident in delayed recall conditions for as long as one week, therefore supporting the hypothesis that the short time frame was a limiting factor in observing differences. In future studies, testing phases could be used on a delay such as one day to learn and the following day to test to better demonstrate the efficiency of VM over RM.

Familiarity with the tested characters might have biased the results because participants could have seen frequently used characters such as 水 (water) or 火 (fire) outside of the learning environment, even without any prior formal exposure to Chinese. In particular, within the ethnically Chinese-dominated society of Singapore, it would not be difficult for a participant to come across such common characters in their day-to-day life. To mitigate this, future research should use less familiar but equally simple characters like 友 (friend) or 网 (net).

Instead of a checklist to determine which characters are known by the participants, an extended pre-test to assess each participant's Chinese language background knowledge would have been more appropriate. The checklist is simple enough to assess participants on their background knowledge of Chinese characters, but a pre-test would better assess which characters to use during the learning and testing phase and provide a much better result regardless of the participant's Chinese language background. However, this would still require a much larger pool of Chinese characters to use from, so future experiments will need to address that first and foremost.

These items were presented in a single character format, and possibly the MCQ format itself made it easier for test candidates to eliminate the wrong choices rather than rely on the memory of the correct meaning assigned to each character. By adopting open-ended answers or incorporating a larger character pool at the expense of MCQs, the testing period may be more challenging, such that future results for both RM and VM would further be differentiated.

In the case of subjective findings for a participant's preference of the learning methods, there was a clear distinction between the two VM and RM. The post-test survey response showed 73.1% agreed or strongly agreed to enjoy doing VM, 46.2% rated it as more effective than RM; thus, showing strong preferences for RM amongst participants. Although the objective results of our study did not make VM clearly superior, subjective data indicated that this approach may be more congenial to a positive learning experience.

While quantitative measures yielded no significant differences concerning either retention or recall, the qualitative feedback expressed a strong preference for VM as more enjoyable and engaging. These findings suggest that even though the immediate cognitive advantages of VM are not apparent when learning Chinese characters, VM would be more effective. The Affective Filter Hypothesis (Krashen, 1982) further supports these findings since it claims that methods increasing enjoyment led to better learning. Several limitations of the study include prior character familiarity, immediate testing, and a reliance on multiple-choice formats that likely biased the results. Overcoming these limitations in further research may yield more conclusive findings on the relative merits or disadvantages of either method.

8 Conclusion

This study investigated the comparative effectiveness of traditional Rote Memorization (RM) and Visual Mnemonics (VM) methods in teaching Chinese characters to adult CFL learners. Quantitative results revealed no significant differences in immediate recall accuracy or response times between the two methods, indicating that both approaches are similarly effective for short-term character recognition. However, qualitative feedback overwhelmingly favoured the VM method, with participants reporting higher levels of enjoyment and engagement. These positive affective responses suggest that integrating visual mnemonics into CFL education can enhance the learning experience, potentially fostering greater motivation and sustained interest in language acquisition. Despite the promising qualitative outcomes, the study's limitations—such as a homogeneous participant sample and the focus on short-term retention—highlight the need for further research, which our web application can serve as an easily replicable test to serve a much wider population. Future studies should explore long-term retention effects and include more diverse populations to fully understand the benefits of combining RM with visual strategies.

Ultimately, incorporating visual mnemonics alongside traditional memorization techniques is key in improving both the effectiveness and enjoyment of learning Chinese characters, serving as a fun and effective introductory stepping stone to the world of Chinese.

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10 Raw Data

Link to raw data (.json format) of all completed users, sensitive data removed:

https://drive.google.com/file/d/1X-0gkGC4eipM-V3mPfcrYMUrUkE-C3Nh/view?usp=sharing

11 Budget Report

Each team member was given $16 to find at least five participants for the project. The money could be used however each member thinks works best for their recruitment.

12 Member Contribution

Jarell Lim En Yu

Literature Review, Further Discussion and Improvements, Ideation, Recruitment

Jordan Lee Wei

Research Proposal, Methodology, Experiment Planning and Creation, Recruitment, Data Preprocessing and initial analysis,

Nuryn Insyirah Bte Mohd Adib

Introduction, Literature Review, Final Report, Recruitment

Abram Tan Jia Han

Literature Review, Results, Experiment Creation, Recruitment, Data Processing, and in-depth data analysis

Wong Hei Ching Netty

Abstract, Introduction, Literature Review, Recruitment

13 Appendices

13.1 GitHub Repository

https://github.com/abramtan/chinese-learning-methods

13.2 Experimental Platform (web app)

http://chineselearningmethods.vercel.app

13.3 Plots

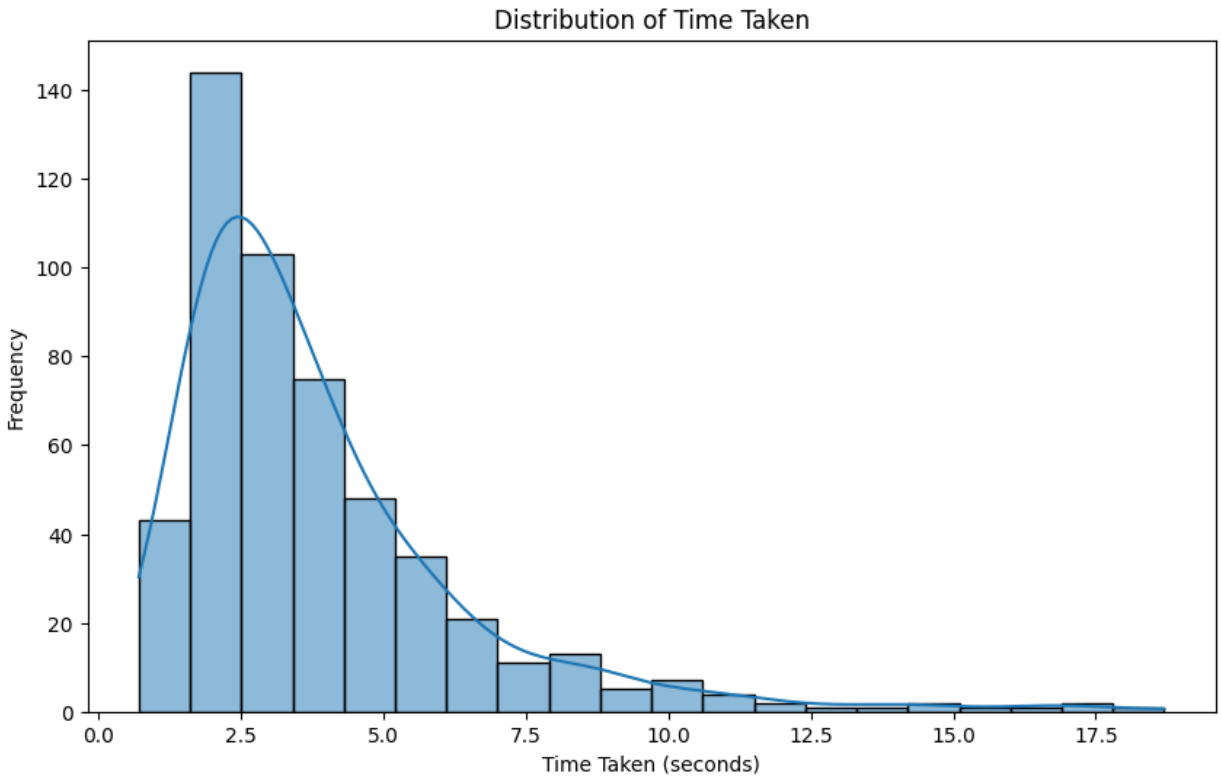

Figure 9 Distribution of response times

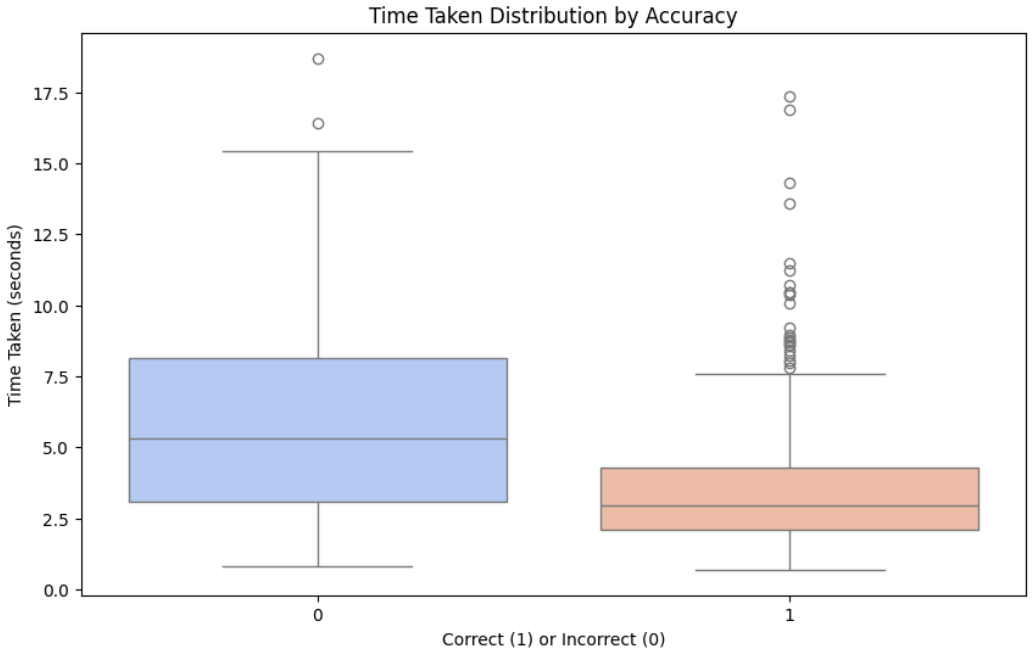

Figure 106 Response times by answer correctness

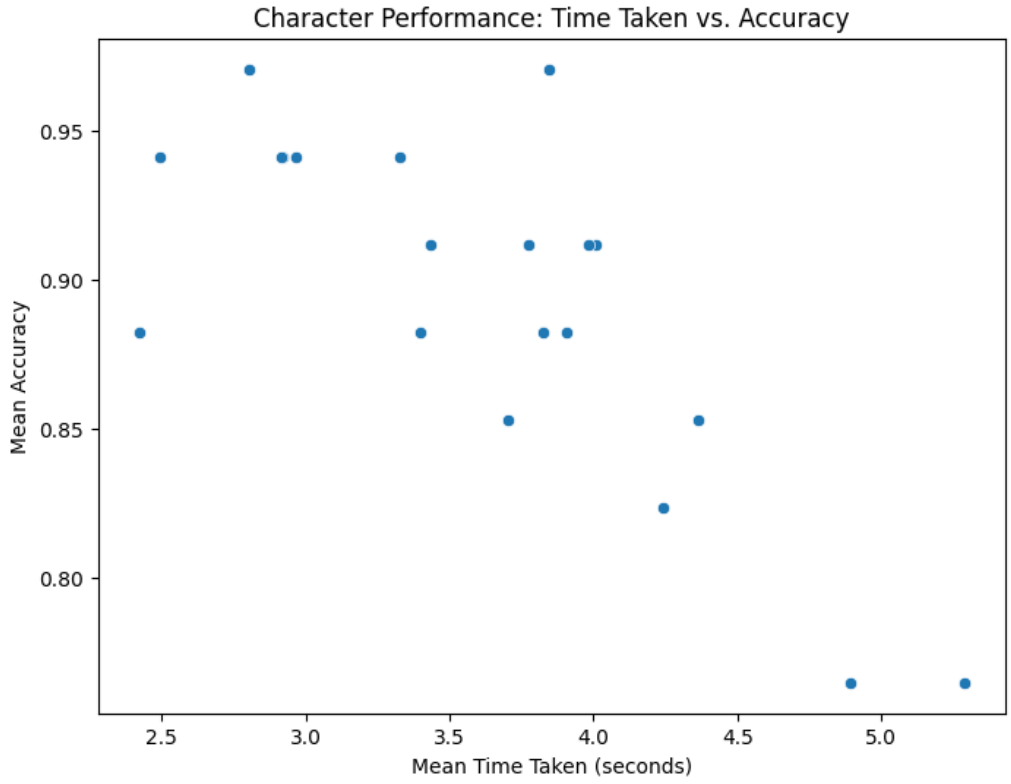

Figure 17 Mean accuracy vs mean response time by characters

13.4 Surveys

13.4.1.1 Appendix A: Demographics Survey

Purpose: To gather demographic information about the participants, including age, gender, education level, ethnicity, language proficiency, and recognition of specific Chinese characters.

Questions:

1. **Age**
    a. *Type:* Numeric Input
    b. *Description:* Enter your age.
2. **Gender**
    a. *Type:* Single Select Dropdown
    b. Options:
        i. Male
        ii. Female
        iii. Non-Binary
        iv. Prefer not to say
3. **Highest Level of Education**
        i. Primary School
        ii. Secondary School
        iii. Polytechnic Diploma
        iv. Diploma
        v. Bachelor's Degree
        vi. Master's Degree

vii. Doctorate

viii. Other

b. *Conditional Input:* If "Other" is selected, please specify your highest level of education.

4. Ethnicity

i. Chinese

ii. Malay

iii. Indian

iv. Eurasian

v. Other

vi. Prefer not to say

b. *Conditional Input:* If "Other" is selected, please specify your ethnicity.

5. Languages Known

i. English

ii. Mandarin

iii. Malay

iv. Tamil

v. Japanese

vi. Korean

vii. French

viii. Italian

ix. Spanish

x. Other

b. *Conditional Input:* If "Other" is selected, please specify the additional language(s) (separate multiple languages with commas).

6. **Can you recognize any of the following Chinese characters?**
    a. *Type:* Multiple Select Checkboxes
    b. Options:
        i. 口, 水, 手, 木, 人, 心, 土, 肉, 火, 女, 日, 刀, 目, 衣, 山, 米, 大, 门, 子, 雨, 羊, 耳, 田, 气, 月

13.4.1.2 Appendix B: Pre-Learning Survey

Purpose: To assess participants' initial attitudes, confidence levels, motivations, and expectations before commencing the learning process of Chinese characters.

Questions:

1. **How interested are you in learning Chinese characters?**
    a. *Type:* Single Select Radio Buttons
    b. Options:
        i. Very Interested
        ii. Somewhat Interested
        iii. Neither Interested nor Uninterested
        iv. Somewhat Uninterested
        v. Not Interested at All
2. **How confident are you in your ability to learn new languages?**
    a. *Type:* Single Select Radio Buttons
    b. Options:

i. Very Confident
ii. Confident
iii. Neutral
iv. Not Confident
v. Not Confident at All

3. **What is your primary motivation for learning languages?**
    a. *Description:* Please describe your main reason for wanting to learn new languages.
4. **Have you ever been fascinated by the visual aspects of written languages (e.g., characters, alphabets)?**
    i. Yes
    ii. No
    iii. Unsure
5. **On a scale of 1 to 5, how enjoyable do you anticipate the learning process to be?**
    i. 1 (Not Enjoyable)
    ii. 2
    iii. 3
    iv. 4
    v. 5 (Very Enjoyable)

13.4.1.3 Appendix C: Post-Test Survey

Purpose: To evaluate participants' experiences and perceptions after completing the learning process, focusing on the effectiveness of different learning methods and overall enjoyment.

Questions:

1. **Which learning method did you find more effective for memorizing Chinese characters?**
    i. Rote Memorization (RM)
    ii. Visual Mnemonics (VM)
    iii. Both equally effective
    iv. Neither was effective
2. **Did the use of visual mnemonics make the learning process more enjoyable compared to rote memorization?**
    i. Strongly Agree
    ii. Agree
    iii. Neutral
    iv. Disagree
    v. Strongly Disagree
3. **Did visual mnemonics help you remember the meanings of the characters more easily compared to rote memorization?**
    i. Strongly Agree
    ii. Agree
    iii. Neutral
    iv. Disagree
    v. Strongly Disagree
4. **Please provide any additional comments or insights about your learning experience, focusing on the effectiveness of each of the methods and your personal enjoyment levels.**

a. *Description:* Share your thoughts and feedback regarding the learning methods used and your overall experience.